192PY2A4CV	PROJECT WORK	SEMESTER IV

Total Credits: 8

Total Instructional Hours 192 h

GUIDELINES:

1. A Guide has been allotted to each student by the department. Student can select any topic in discussion with the supervisor. Students should maintain a work diarywere in weekly work carried out has to be written. Guide should review the workevery week and put his/her signature. The work diary along with project reportshould be submitted at the time of viva voce.

2. CA Marks Distribution: A minimum of three reviews have to be done, one at the time finalizing the project title, second at framing questionnaire/identifying the primary data and the third review at the time of commencement of report writing. They should be asked to present the work doneto the respective guide in the three reviews. The guide will give the marks for CIA asper the norms stated below:

First Review	20 Marks
Second Review	20 Marks
Third Review	20 Marks
Document, Preparation and Implementation	20 Marks
Total	**80 Marks**

3. End Semester Examination:The evaluation for the end semester examination should be as per the norms Given Below:

Record work and Presentation	80 Marks
Viva-Voce	40 Marks
Total	**120 Marks**

Note: (End Semester Examination marks jointly given by the external and internal examiner).

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Department of Physics
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Coimbatore – 641 048

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23/3/22

Text Books

1 Chen F.F, 2016, "Introduction to Plasma Physics and Controlled Fusion, 3rd Edition", Springer International Publishing, Switzerland.

2 Ghosh B, 2014, "Basic Plasma Physics", 1st Edition, Narosa Publishing House, New Delhi.

References

1 Krall N.A and Trivelpiece A.W, 1973, "Principles of Plasma Physics", 1st Edition, McGraw Hill, US.

2 Stix T.H, 1962, "The Theory of Plasma Waves", 1st Edition, Mc Graw Hill, New York.

3 Bittencourt J.A, 2004, "Fundamentals of Plasma Physics", 3rd Edition, Springer, New York.

4 Choudhuri A.R, 2015, "The Physics of Fluids and Plasmas", 5th Edition, Cambridge, India.

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192PY2A4DC	PLASMA PHYSICS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Plasma Concepts and Terminology 9 h

Plasma as state of matter - Concept of temperature - Debye shielding- Plasma parameter - Criteria for plasma - Magnetic pressure - Particle drifts - Plasma frequency - Landau damping - Collisions - Bohm diffusion - Plasma radiation.

Unit II Characteristics of Different Plasma 10 h

Production of plasma: Low pressure cold cathode discharge - Thermionic arc discharge - Plasma guns - Q machines - RF produced plasma - Current and voltage measurement in plasmas -Plasma probes: Electrostatic probe - Magnetic probe - Measurement types - Photography and atomic spectroscopy - Radiation measurements - Single particle measurements - Neutrons measurement - Light scattering measurement.

Unit III Plasma Confinement 10 h

Motion in a magnetic field - Motion in finite electric and magnetic field - Motion in inhomogeneous and curved magnetic fields - Magnetic mirrors - Motion in non-uniform electric field - Motion in time varying electric and magnetic field.

Unit IV Waves in Plasma 10 h

Wave representation - Group velocity - Phase velocity - Plasma oscillations - Electromagnetic waves in the absence of magnetic field - Electromagnetic waves perpendicular to magnetic field - Electromagnetic waves parallel to magnetic field - Electron plasma wave in cold and warm plasma - Ion acoustic wave.

Unit V Applications of Plasma 9 h

Gas Discharges- Thermonuclear fusion - Laser driven fusion - Magnetic fusion - Magnetohydrodynamic generator (MHD) – Basic theory of MHD – Principle of working – Plasma diode.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A4DC	PLASMA PHYSICS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of plasma physics.
- The theoretical aspects in the production of plasma waves and its confinement.
- The working principles behind the applications of Plasma.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Summarize the basic concepts of plasma	K2
CO2	Infer knowledge about different characteristics of plasma	K2
CO3	Utilize the confinements in plasma	K3
CO4	Classify the different waves of plasma	K2
CO5	Identify the different applications of plasma waves	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	M	M	M	S	L
CO3	S	S	S	S	M
CO4	M	M	M	S	L
CO5	M	S	S	S	M

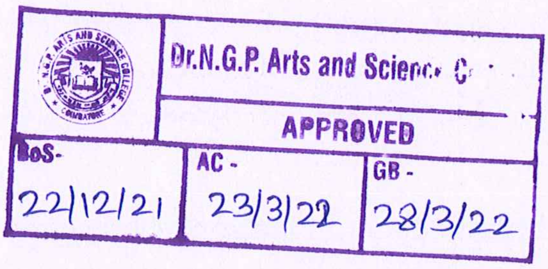
S Strong M Medium L Low

Text Books

1. Skoog, Holler and Crouch, 2014, "Principles of Instrumental Analysis", 6th Edition, Cengage Learning India Private Limited.
2. Willard M and Steve D, 1986," Instrumental Methods of Analysis", 7th Edition, CBS Publishers, New Delhi.

References

1. Skoog D.A and West M, 2004, "Fundamentals of Analytical Chemistry", 8th Edition, Saunders-College Publishing.
2. Skoog, West and Holler, 1994, "Analytical Chemistry-An Introduction", 6th Edition, Saunders College Publishing.
3. Stradling R.A, 1979, "Electron Microscopy and Microanalysis of Crystalline Materials", Applied Science Publishers, London.
4. Philips V.A, 1971, "Modern Metallographic Techniques and their Applications", Wiley Interscience.



192PY2A4DB	**INSTRUMENTAL METHODS OF ANALYSIS**	**SEMESTER IV**

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Instrumental Methods and Measurements 9 h

Classification of instrumental techniques - Basic functions of instrumentation - Sensitivity and detection limit - Hardware techniques for signal to noise enhancement - Software techniques for signal to noise enhancement - Evaluation of results - Accuracy and instrument calibration.

Unit II Thermal Analysis 9 h

Thermo gravimetric analysis: Instrumentation - Applications - Differential Thermal analysis: Instrumentation - General Principles - Applications - Differential scanning calorimetry: Instrumentation - Applications - Microthermal analysis - Thermomechanical analysis.

Unit III X-Ray Analysis 9 h

Production of X-rays and X-ray spectra - Instrumentation - X-ray absorption methods - X-ray fluorescence method - X-ray diffraction: Reciprocal lattice concept - Diffraction patterns - Automatic diffractometers - Choice of X-radiation - X-ray powder data file - Quantitative analysis - Structural applications - Crystal topography.

Unit IV Optical Methods and Electron Microscopy 11 h

U-V molecular absorption spectrometry: Measurement of transmittance and absorbance - Beer's law - Instrument components - Single beam instruments - Double beam instruments - Qualitative applications: Solvents - Detection of functional groups - X-ray photoelectron spectroscopy: Principle - Instrumentation - Applications - Atomic force microscope: Principle - Instrumentation.

Unit V Electrical Methods 10 h

Electrochemical cells - Potentiometry: General principles - Reference electrodes - Ion-selective field effect transistors - Molecular selective electrode systems - Instruments for measuring cell potentials - Coulometry: CV relationships during an electrolysis - Coulometric methods of analysis - Voltammetry: Voltametric instrumentation - Cyclic voltammetry - Applications of voltammetry.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A4DB	INSTRUMENTAL METHODS OF ANALYSIS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The principle of analytical experimental methods.
- The concepts and applications of various instrumentation methods.
- The qualitative and quantitative instrumental analysis.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Summarize the types of instrumental methods, measurements, signals and data evaluation	K2
CO2	Explain the instrumentation and analysis of TGA, DTA and DSC	K2
CO3	Develop the skills to analyze XRD and XRF spectroscopic techniques	K3
CO4	Analyze the concept of optical method and electron microscopes	K4
CO5	Examine the electrochemical techniques	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	M	M	M	S	L
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S **Strong** **M** **Medium** **L** **Low**

Text Books

1 Tayal D. C, 2018, "Nuclear Physics", Himalaya Publishing House, Mumbai (Unit I to IV).

2 Kuppuswamy Thayalan, 2017, "Basic Radiological Physics", Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi. (Unit -V).

References

1 Govinda Rajan G. N, 2018, "Radiation Safety in Radiation Oncology", CRC Press, New York.

2 Thayalan K, 2010, "Text Book of Radiological Safety", Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.

3 Glenn F. Knoll, 2010, "Radiation Detection and Measurement", 4^{th} Edition, John Wiley & Sons Inc., Hoboken, New Jersey.

4 "AERB Radiation Production Rules", 2004.

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192PY2A4DA	RADIOLOGICAL SAFETY ASPECTS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I General Properties of Atomic Nucleus 9 h

Scattering of α-particles - Nuclear size and Determination : Nuclear Force Methods, Electromagnetic Methods - Mass spectroscopy - Basic Components of Mass Spectroscopes - Double Focussing Mass spectrograph - Double Focussing Mass spectrometer - Doublet Method of mass spectroscopy - Mass Synchrometer - Theories of Nuclear Compositions

Unit II Radioactivity and Isotopes 10 h

Law of radioactive Disintegration - Displacement laws of Soddy Russell and Fajans - Law of successive Transformation - Radioactive Equilibrium - Radioactive Branching - Dosimetry - Induced Radioactivity by Nuclear Bombardment - Mixture of Activities - Radio-isotope Therapy - Measurements of Decay Constants - Isotopes (Separation and Uses).

Unit III Interactions Nuclear Radiations with Matter 10 h

Interaction of Charged Particles with Matter - Stopping Power of Heavy Charged Particles - Range and Straggling - Stopping Power and Range of Electrons - Cerenkov Radiation - Synchrotron Radiation - Absorption of Gamma Rays (Thomson, Rayleigh and Delbruck Scattering) - Photoelectric effect - Compton effect - Pair Production

Unit IV Detection and Measurement of Nuclear Radiations 10 h

Ionization chamber - Semiconductor Detectors -Diffused Junction detector - Surface Barrier detector - Lithium drifted Junction detector - Regions of multiplicative operation - Proportional Counter - Geiger Muller Counter (Quenching of Discharge) - Scintillation Counters (Photomultiplier tube, Scintillators, Pulse Formation, Resolving Power)

Unit V Principles of Radiation Production and Regulations 9 h

Sources of Radiation - Biological Effects of Radiation - Radiation Hazards, Evaluation and Control - External and Internal Hazards - Personnel Monitoring System - Regulations in India.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A4DA	RADIOLOGICAL SAFETY ASPECTS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of nuclear radiation towards biological effect and protection.
- The principles of optimization and detection of radiation.
- The safety aspects of nuclear radiation.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Interpret the structure of atomic nucleus.	K2
CO2	Make use of the principles of radioactivity into handling radio-isotopes.	K3
CO3	Identify various radiations interacting with matter.	K3
CO4	Classify various types of detector principles for nuclear radiation.	K2
CO5	Take part in implementing the safety aspects principles in radioisotope labs.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	M	L
CO2	S	S	S	S	M
CO3	S	S	S	S	M
CO4	M	M	M	M	L
CO5	S	S	S	S	S

S Strong M Medium L Low

References

1. Praod Borole, 2014, "8085 Microprocessor Architecture and Programming", ANE Books Pvt Ltd
2. Doughlas V. Hall, 1990, "Microprocessor Interfacing Programming and Hardware", 2nd Revised Edn, McGraw-Hill Inc, New Delhi.
3. Nagoor Kani, 2015, "Microprocessors and Micro Controllers", McGraw-Hill Inc, New Delhi.
4. Aditya P. Mathur, 2016, "Introduction To Microprocessors", McGraw-Hill Inc, New Delhi.

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192PY2A4CP	CORE PRACTICAL: MICROPROCESSOR	SEMESTER IV

Total Credits: 2
Total Instructions Hours: 48 h

S.No	List of Experiments
1	Write 8085 ALP for 8 bit addition and subtraction
2	Write 8085 ALP for 8 Bit multiplication and division
3	Write 8085 ALP for finding the biggest and smallest number element in the array
4	Write 8085 ALP for LED interfacing
5	Write 8085 ALP for sorting the element in an array in ascending and descending order
6	Write 8085 ALP for triangular and square wave generator using Op-amp
7	Write 8085 ALP – Masking off most significant four bits and setting bits using two different instructions
8	Write 8085 ALP for Stepper motor controller
9	Write 8085 ALP for Elevator controller
10	Write Microprocessor 8085 ALP for interface IV (Waveform generation)
11	Write Microprocessor 8086 ALP for Traffic control system
12	Write Microprocessor 8085 ALP for subroutines (display results)

Note: Any 10 Experiments

Text Books

1. Kothari. C. R, Gaurav Garg, 2019, "Research Methodology (Methods and Techniques)", 4th Edition, New Age International (P) Ltd, New Delhi.
2. Guozhong Cao, Ying Wang, 2017, "Nanostructures and Nanomaterials (Synthesis, Properties and Applications)", 2nd Edition, World Scientific Publishing Co (P) Ltd, New Delhi.
3. Mick Wilson, Kamali Kannangara, Goeff Smith, Michelle Simmons, Burkhard Raguse, 2008, "Nanotechnology (Basic Science and Emerging Technologies)", Overseas Press India (P) Ltd, New Delhi.
4. Meena Srivastava, Rajesj Singh Yadav, 2015, "Principles of Laboratory Techniques and Methods" CBS Publishers & Distributors (P) Ltd, New Delhi.
5. Gurdeep R. Chatwal, Sham K. Anand, 2014, "Instrumental Methods of Chemical Analysis", 5th Edition, Himalaya Publishing House, Mumbai.

References

1. Rajendran .V, 2010, "Processes and Characterization of Advanced Nanostructured Materials", 1st Edition, MAC Millan Publishing, New Delhi.
2. Rajendran .V, 2012, "Application of Nanomaterials (Electronics, Energy & Environmental)", 1st Edition, Blooms Bury Publishing India (P) Ltd.

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202PY2A4CC	RESEARCH METHODOLOGY	SEMESTER IV

Total Credits: 2

Total Instruction Hours: 24 h

Syllabus

Unit I Research Methodology 4 h

Meaning of research - Objectives of research - Types of research - Research approaches - Significance of research - Research methods versus methodology - Research and Scientific method.

Unit II Research Design and Data Preparation 5 h

Selecting the problems - Necessity of defining the problems - Technique involved in defining a problem - Need for research design - Data preparation process.

Unit III Interpretation and Report Writing 5 h

Techniques of interpretation - Precaution in interpretation - Significance of report writing - Types of reports- Precautions for writing research reports.

Unit IV Synthesis and Basic Laboratory Instrument 5 h

Evaporation - Sputtering - Spray Pyrolysis - Electro Spinning - Sol Gel - Colorimetry - pH meter - Autoclave - Hot air oven - Centrifugation.

Unit V Characterization & Applications 5 h

Scanning Probe Microscopy (SPM) - Raman spectroscopy - Photo luminescence - Applications: Solar Cell - Battery - Schottky Diode.

Course Code	Course Name	Category	L	T	P	Credit
202PY2A4CC	RESEARCH METHODOLOGY	CORE	2	-	-	2

PREAMBLE

This course has been designed for students to learn and understand

- The types of research available and choose a scientific problem
- The interpretation techniques and report writing strategies
- The various methods of sample preparation and advanced analytical techniques available for analysis

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the concepts of research methodologies	K2
CO2	Apply the knowledge for data Interpretation	K3
CO3	Make use of the knowledge strategies for report writing	K3
CO4	Take part in materials preparation techniques	K4
CO5	Identify the advanced analytical techniques and applications	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	S	S	S	S	M
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	M

S Strong M Medium L Low

Text Books

1 Tayal. D.C., 2017, "Nuclear Physics", Himalaya Publishing House, Mumbai.

2 Patel. S. B., 2010, "Nuclear Physics-An Introduction", 2nd Edition, New Age International, Mumbai.

References

1 Roy. R.R. and Nigam. B. P, 2008, "Nuclear Physics", 1st Edition, New Age International, Chennai.

2 Cohen. B.L, 2001, "Concepts of Nuclear Physics", 1st Edition, Tata McGraw Hill Education (India) Private Limited, Chennai.

3 Kaplan.I, 2002, "Nuclear Physics", 2nd Edition, Addison Wesley Publishing Company, New Delhi.

4 Ghoshal. S. N., 1994, "Nuclear Physics", S. Chand & Company Limited, New Delhi.

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192PY2A4CB	NUCLEAR AND ELEMENTARY PARTICLE PHYSICS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Properties of Atomic Nucleus 10 h

Nuclear size and its determination - Mass spectroscopy - Theories of nuclear composition - Binding energy – Semi empirical mass formula - Quantum numbers for individual nucleons - Independence of atomic and nuclear properties - Quantum properties of nuclear states - Nuclear magnetic dipole moment - Electric multipole moment

Unit II Radioactivity 9 h

Properties of radioactive rays - The law of radioactive decay - Radioactive growth and decay - Ideal equilibrium - Transient equilibrium and secular equilibrium - Radioactive series - Radioactive isotopes of lighter elements- Artificial radioactivity - Determination of the age of earth - Carbon dating.

Unit III Nuclear Force and Nuclear Reactions 10 h

Nuclear force: The ground state of the deuteron - Magnetic dipole and electric quadrupole moments of the deuteron - Square well solution for the deuteron - Central and non-central forces. Nuclear Reactions: Types of nuclear reactions - The balance of mass and energy in nuclear reactions - The Q equation.

Unit IV Radioactivity Decay 10 h

Range of alpha particles - Disintegration energy of spontaneous alpha decay- Alpha decay paradox - Barrier penetration - Fermi's theory of beta decay - The detection of neutrino - Parity non conservation in beta decay - Gamma ray emission - Selection rules - Internal conversion - Nuclear isomerism.

Unit V Elementary Particles 9 h

Antiparticles and antimatters - Feynman diagrams - Estimation of a pion mass - The four fundamental forces of nature - W Bosons and gluons - Conservation laws - The nucleon isospin - The Gell-Mann–Nishijima relation: Isospin of particles – The Quark model - The QCD - Colour quantum number - Colors for quarks and Gluon.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A4CB	NUCLEAR AND ELEMENTARY PARTICLE PHYSICS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The principles and concepts governing nuclear and particle physics.
- The scientific and technological applications of nuclear physics.
- The concepts of elementary particles.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Interpret the various properties of nuclei.	K2
CO2	Apply the laws of radioactivity decay for various applications.	K3
CO3	Explain the properties of nuclear forces and nuclear reaction dynamics.	K2
CO4	Identify alpha, beta and gamma decay based on its theory.	K3
CO5	Analyze the concepts of elementary particles.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	S	S	S	S	M
CO3	M	M	M	S	L
CO4	S	S	S	S	M
CO5	S	S	S	S	S

S Strong M Medium L Low

Text Books

1 Atkins.P and Depaula.J, 2009, "Physical Chemistry", Oxford University Press.

2 P. Atkins, Overton.T, Rourke. J and Weller. M, 2009, "Inorganic Chemistry", Oxford University Press.

References

1 Christopher, Cramer. J, 2004, "Essential of Computational Chemistry - Theories and Models", Oxford University Press.

2 Gerhard Herzberg, 2003, "Molecular Spectra and Molecular Structure", Krieger Pub Co.

3 Robert Eisberg and Robert Resnick, 2006, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Wiley.

4 W. Demtroder, "Molecular Physics", 2003, Springer, Berlin, Heidelberg (doi.org/10.1007/978-3-662-55523-1)

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202PY2A4CA	MOLECULAR PHYSICS	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Molecular Structure and Bonding 10 h

Chemical bonding - The VSEPR model - Valence bond theory – The hydrogen molecule - Polyatomic molecules - Molecular orbital theory – Bond properties - Polyatomic molecules - Molecular shape in terms of molecular orbitals - Molecular structure, properties and conformations.

Unit II Molecular Symmetry 10 h

Symmetry elements and operations – The symmetry classification of molecules – Applications to molecular orbital theory – Character tables and symmetry labels – Vanishing integrals and orbital overlap - Vanishing integrals and selection rule.

Unit III Molecular Interactions and Mechanics 9 h

Electric properties of molecules - Electric dipole moments - Polarizabilities - Relative permittivity's - Interactions between dipoles - Repulsive and total interactions - Molecular interactions in gases - Potential energy (force field) in molecular mechanics.

Unit IV Molecular Reaction Dynamics 10 h

Potential energy surfaces – Transition state theory – The Eyring equation – Thermodynamic aspects – Microscopic – Macroscopic connection - Zero-point vibrational energy - Molecular electronic, rotational, vibrational and translational partition functions .

Unit V Electron Transfer, Electronic Structure and Spectra 9 h

The rates of electron transfer processes – Theory of electron transfer processes – Crystal-field theory - Ligand-field theory - Electronic spectra of atoms - Electronic spectra of complexes - Charge-transfer bands .

Course Code	Course Name	Category	L	T	P	Credit
202PY2A4CA	MOLECULAR PHYSICS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamental knowledge on the structure and dynamics of the molecules through various theories
- The relation between molecular interactions and properties
- The phenomenological theories on reaction dynamics and transport properties

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the molecular structure and bonding	K2
CO2	Interpret the molecular symmetry	K2
CO3	Experiment with the molecular interaction and mechanics	K3
CO4	Identify the molecular reaction dynamics	K3
CO5	Examine quantum theory to electron transfer, electronic structure and spectra	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	M	M	M	M	L
CO3	S	S	S	M	M
CO4	S	S	S	M	M
CO5	S	S	S	S	S

S Strong **M Medium** **L Low**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
202PY2A4CA	Core – X	Molecular Physics	4	-	-	3	25	75	100	4
192PY2A4CB	Core – XI	Nuclear and Elementary Particle Physics	4	-	-	3	25	75	100	4
202PY2A4CC	Core - XII	Research Methodology	2	-	-	3	25	75	100	2
192PY2A4CP	Core Practical - VII	Microprocessor	-	-	4	4	40	60	100	2
192PY2A4DA	DSE – IV	Radiological Safety Aspects	4	-	-	3	25	75	100	4
192PY2A4DB		Instrumental Methods of Analysis								
192PY2A4DC		Plasma Physics								
192PY2A4CV	Core - XIII: Project	Project	-	-	12	4	80	120	200	8
		Total	**14**	-	**16**	-	-	-	**700**	**24**
		Grand Total	-	-	-	-	-	-	**2700**	**92**

Text Books

1 S. Shanmugam, Nanotechnology, MJP Publishers, (2011).

2 SubbiahBalaji, Nanobiotechnology, MJP Publishers (2010).

References

1 Guozhong Cao, Nanostructures and Nanomaterials Synthesis, Properties and Applications - World Scientific (2011).

2 Pradeep T- Nano: The Essentials- Tata McGraw-Hill Publishing Co.(2012).

3 Hand book on Nanotechnology - A.G. Brecket, 1st Edition 2008, Dominant publishers and distributors, New Delhi.

4 Nanostructures &Nanomaterials: Synthesis, Properties & Applications, GuozhongGao, Imperial College Press (2004).

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192PY2ASSB	**SELF STUDY: NANOSCIENCE**	**SEMESTER III**

Total Credit: 1

Syllabus

Unit I Introduction

Definition of nanoscience– Importance of nanoscience – Physical and chemical properties - Electronic - structural - mechanical - Optical - Magnetic properties – Applications.

Unit II Conduction in confined geometries

Nanomaterials - 2D, 1D, 0D - size and dimensionality effects - Partial confinement - Properties dependent on density of states - Quantum dots

Unit III Preparation of Nanomaterials

Top down and bottom up approach - Plasma arcing – Hydrothermal- Sol gel process - Ball milling - Sputtering – Electro deposition .

Unit IV Characterization Techniques

X-ray Diffraction (XRD) - Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Absorption spectroscopy - FTIR spectroscopy - Photoluminescence (PL).

Unit V Significant Nanomaterials and Applications

Nano electronics - Nanobots - Biological applications of nanoparticles – Carbon nanotubes (CNTs) - nanomechanics.

Text Books

1 Nithyananda K.V, 2019. Intellectual Property Rights: Protection and Management. Cengage Learning India Private Limited, Delhi, India.

2 Neeraj P &Khusdeep D, 2014. Intellectual Property Rights. PHI Learning Private Limited, Delhi, India.

References

1 Ahuja, V K, 3rd Edition, 2017. Law relating to Intellectual Property Rights. Lexis Nexis, Gurgaon, India.

2 Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights-An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf.

3 World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

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192PY2ASSA	SELF STUDY: IPR, Innovation and Entrepreneurship	SEMESTER III

Total Credit: 1

Syllabus

Unit I Introduction to IPR

Introduction to intellectual property right (IPR), Physical and Intellectual Property, Tangible and Intangible property, Traditional Knowledge, Different types of intellectual property rights (IPR), Patents, Trade mark, Trade secret, Copyright, Design and Geographical Indications.

Unit II International Instruments of IPR

World Trade and IPR-General Agreement on Trade and Tariff (GATT), World Intellectual Property Organization (WIPO), World Trade Organizations (WTO), Trade-Related Aspects of Intellectual Property Rights (TRIPS), Establishment, functions and guidelines of GATT, WIPO, WTO and TRIPS.

Unit III Indian Patent Act

Patent Act 1970-amendments of 1999, 2000, 2002 and 2005, Patentable subject matter, Patentability criteria, non-patentable inventions, Compulsory licenses.

Unit IV IPR Infringement

Infringement-direct, contributory and induced, Infringer, Defences to infringement, Remedies for infringement (civil and criminal) and penalties, Appellate Board.

Unit V Current Scenario

India's New National IP Policy, 2016-Govt. of India, Step towards promoting IPR, Govt. Schemes in IPR, Career Opportunities in IP, IPR in current scenario with case studies, Advantages and disadvantages of IPR.

Text Books

1 Rai G.D,1987, Solar energy utilization, Khanna Publishers, New Delhi.

2 Sukhatme S.P, 1984, Solar energy-principles of thermal collection & storage, YMH, New Delhi.

Reference Books

1 Maheshawar Sharon, Madhuri Sharon, 2010, Nanoform and Applications, Mc Graw-Hill, Delhi.

2 Romer. R.H, Freeman W.H, 1976, Energy -An Introduction to physics, S. Chand and Co, New Delhi.

3 John A.Drife and William, 1974, Solar energy thermal processes, New Delhi.

4 Rai. G.D, 2004, Non-Conventional Energy Sources, Khanna Publication, New Delhi.

5 Kreith and Kreider, 1978, Principles of solar engineering, McGraw Hill Publication, New Delhi.

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192PY2A3DC	SOLAR CELLS AND SOLAR ENERGY UTILIZATION	SEMESTER III

Total Credits: 4
Total Instructions Hours: 48 h

Syllabus

Unit I Heat Transfer & Radiation Analysis 9 h

Conduction, Convection and Radiation - Solar Radiation at the earth's surface - Determination of solar time - Solar energy measuring instruments.

Unit II Solar Collectors 9 h

Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics - Focusing collector systems - Thermal performance evaluation of optical loss

Unit III Solar Heaters 9 h

Types of solar water heater - Solar heating system - Collectors and storage tanks - Solar ponds - Solar cooling systems

Unit IV Solar Energy Conversion 10 h

Photo Voltaic principles - Types of solar cells - Crystalline silicon/amorphous silicon and Thermo - electric conversion - process flow of silicon solar cells- different approaches on the process- texturization, diffusion, Antireflective coatings, metallization

Unit V Nanomaterials in Fuel Cell Applications 11 h

Use of nanostructures and nanomaterials in fuel cell technology - high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of nano technology in hydrogen production and storage

Course Code	Course Name	Category	L	T	P	Credit
192PY2A3DC	SOLAR CELLS AND SOLAR ENERGY UTILIZATION	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamentals aspects of solar energy utilization
- The tapping of solar energy and its conversion using various instrumentation
- The latest technology used in the production and storage of solar energy.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the heat transfer process at the earth's surface and its measurement.	K2
CO2	Summarize the feauture of solar collectors and its thermal evaluation.	K2
CO3	Contrast the operation of solar heaters and storage tanks.	K2
CO4	Make use of the concepts in solar energy conversion.	K3
CO5	Choose the materials for production and storage of solar energy.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	M	M	S	L	M
CO2	M	M	M	S	L	M
CO3	M	M	M	S	L	M
CO4	S	S	S	S	M	M
CO5	S	S	S	S	M	M

S Strong M Medium L Low

Text Books

1 C. Kittel, 2010, Introduction to Solid State Physics, 7th Ed, Wiley.

2 Ben G. Streetman, 1994, Solid State Electronic Devices, 3rd Ed., Prentice –Hall of India Private Limited.

References

1 Eleftherios N. Economou, 2010, The Physics of Solids – Essentials and Beyond, Springer.

2 M. Ali Omar, 2000, Elementary Solid State Physics: Principles and Applications, Addison- Wesley.

3 Rita John, 2014, Solid State Physics, Tata McGraw Hill Publications.

4 Alexander O. E. Animalu, 1978, Intermediate Quantum Theory of Crystalline solids, Prentice Hall of India, New Delhi.

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192PY2A3DB	**BAND GAP ENGINEERING IN SEMICONDUCTORS**	**SEMESTER III**

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Band Structure of Semiconductors 10 h

Direct, Indirect and Pseudo direct band gap semiconductors - Nature of band gaps from absorption curves - Temperature dependence of electrons - holes carriers' concentration for Intrinsic and Extrinsic bandgap semiconductor, Variation of Fermi level and band gap.

Unit II Mobility and Conductivity in Semiconductors 10 h

Influence of temperature on mobility- Recombination of electron hole pair - Electrical conductivity in semiconductors.

Excitons: Origin, electronic levels and properties, Radiative and non radiative recombination (Shockley – Read - Hall and Auger) processes.

Carrier Transport: continuity equations.

Optical Constants: Kramers - Kronig relations.

Unit III Band Gap Engineering 09 h

Structural effects – chemical potential – crystal field – impact on degenerate states – band gap and alloying - Strain-induced band-gap engineering- Engineering band gaps in Ternary: Chalcopyrite and pnictides, Pseudo Direct, Quaternary, Magnetic and Oxide Semiconductors - Layered Semiconductors - Organic semiconductors.

Unit IV Semiconductors in Reduced Dimension 10 h

Carbon materials - Bonding in graphene – Hopping mechanism – Hamiltonian of two dimensional solid (massless Dirac Hamiltonian): Tight binding Hamiltonian which includes π and σ bands. - Dirac points, degeneracy at K point, Linear dispersion, a Controlling of band gap, spatial inversion, time reversal symmetries, saddle point singularity, Density of States. Tuning of band gap in graphene – Effect of twisted layers – Applications in opto-electronics, bio-medicine, energy storage and generation.

Unit V DFT Results of Semiconductors 09 h

Density Functional Theory (DFT) - An overview Kohn-Hohenberg theorems - Kohn-Sham equation - Exchange correlation potentials in semiconductors – Band structure as a tool in engineering band gaps.

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Course Code	Course Name	Category	L	T	P	Credit
192PY2A3DB	BAND GAP ENGINEERING IN SEMICONDUCTORS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The band structure of semiconductors.
- The physical properties of semiconductor and apply them in various applications.
- The band gap engineering in Nano scale dimensions.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline about band structure of semiconductors	K2
CO2	Identify the physical characteristics of semiconductors	K3
CO3	Apply the concept of band gap engineering	K3
CO4	Examine the principle and working of semiconductors in electronics, spintronics and valleytronics	K4
CO5	Explain the density functional theory of semiconductors	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	S	S	S	S	M
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	M	M	M	S	L

S **Strong** **M** **Medium** **L** **Low**

Text Books

1 B. Basu, 2001, An Introduction to Astro Physics, 2 nd Edition. Prentice Hall of India Private Limited, New Delhi.

2 V.B. Bhatia, 2001, Text Book of Astronomy and Astrophysics with Elements of Cosmology, Narosa publications.

References

1 T. Padmanavan, 2010, Theoretical Astrophysics (Vols I, II, III), Cambridge University Press.

2 A. R. Choudhuri, 2010, Astrophysics for Physicists, Cambridge University Press, New York.

3 L.A. Anchordoqu, 2007, Lectures on Astronomy, Astrophysics, and Cosmology.

4 S. Kumaravelu, 1993, Astronomy, Janki Calendar Corporation, Sivakasi.

5 H. Zirin, 1988, Astrophysics of the Sun, Cambridge University Press.

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192PY2A3DA	INTRODUCTORY ASTRONOMY, ASTROPHYSICS AND COSMOLOGY	SEMESTER III

Total Credits: 4
Total Instructions Hours: 48 h

Syllabus

Unit I History of Astronomy 10 h

Introductory history of astronomy - Ptolemy"s Geocentric Universe - Copernicus" Heliocentric Universe - Tycho Brahe and Galileo"s Observations - Kepler"s laws of planetary motion - Newtonian concept of gravity - Highlights of Einstein"s special and general theory of relativity - Curved space time - Evidence of curved space time-Bending of light - Time dilation.

Unit II Stars and Galaxies 09 h

Stars and galaxies - Distances - Trigonometric parallax - Inverse square law-Magnitude of stars - Apparent magnitude - Absolute magnitude and Luminosity - Color and temperature - Composition of stars - Velocity, mass and sizes of stars - Types of stars - Temperature dependence - Spectral types - Hertzsprung - Russell (HR) Diagram - Spectroscopic Parallax.

Unit III Lives and Death of Stars 10 h

Stellar evolution - Mass dependence - Giant molecular cloud - Protostar - Main sequence star - Subgiant, Redgiant, Supergiant - Core fusion - Redgiant (or) Supergiant - Planetary nebula (or) Supernova - White dwarfs - Novae and Supernovae - Neutron stars - Pulsars - Black holes - Detecting Black holes - The Sun - Its size and composition - Sun's interior zones - Sun's surface - Photosphere - Chromosphere - Corona - Sun's power source - Fusion reaction mechanism.

Unit IV Cosmology I 10 h

Introduction to cosmology - Basic observations and implications - Olber's Paradox - expanding universe - Gravitational redshift - Doppler effect - Hubble's law and the age of the universe - Cosmological principle - The Perfect cosmological principle - Observation and interpretation of cosmic microwave background radiation (CMBR) - Evidence supporting the general Big Bang theory - Salient features of steady state theory.

Unit V Cosmology II 09 h

Fate of the universe - Dependence on mass (Curvature of Space) - Critical density - Open universe - Closed universe - Homogenous and isotropic Freidman - Fate of the universe - Deriving the geometry of the universe from the background radiation - Flatness problem - Horizon problem - Inflation and its effect on the universe - The cosmological constant.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A3DA	INTRODUCTORY ASTRONOMY, ASTROPHYSICS AND COSMOLOGY	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The analytical skills and astronomical state.
- The physical laws and concepts of astronomy and cosmology.
- The assumptions and uncertainties involved in astronomy and cosmology.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the theories related to origin of the Universe.	K2
CO2	Summarize various parameters related to astronomy.	K2
CO3	Identify the types of stars based on their properties.	K3
CO4	Explain the principles related to cosmology.	K2
CO5	Solve various problems related to cosmology.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	M	M	M	S	L
CO3	S	S	S	M	L
CO4	M	M	M	S	L
CO5	S	S	S	M	L

S Strong M Medium L Low

References

1 Jones B K, 1986, Electronics for Experimentation and research, Prentice- Hall.

2 Zbar P B., Malvino A P and Miller M A, 1994, Basic Electronics: A text lab manual, Tata McGraw Hill.

3 Bell D.A, 2009, Laboratory manul for electronic devices and circuits, 4th edition, oxford university press.

4 Gaykwad. A, 2006, Operational Amplifier and linear Intergrated circuits, 11 th editions, Prentice Hall.

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192PY2A3CQ	ELECTRONICS-III	SEMESTER III

Total Credits: 2
Total Instructions Hours: 4 h

S.No	Contents
1	Wien Bridge Oscillator (Sine wave and square wave).
2	Logarithmic Amplifier using OP-AMP.
3	Binary added weighted resistor- using OP-AMP.
4	Dual slope Digital to Analog converter using OP-AMP.
5	Binary adder and Subtractor using IC 7483 and IC 7486.
6	Study the static and drain characteristics of a JFET.
7	Characteristics of Photodetector.
8	Study the voltage doubler.
9	4 bit binary adder and Subtractor using 7483.
10	Construction of monostable multivibrator using Op-AMP/NE 555.
11	Characteristics of SCR.
12	Study of characteristics of BJT.

Note: Any 10 Experiments

References

1. Raghvan V, 2004, Experiments in material science, 5th edition, PHI Learning Pvt. Ltd.

2. Smith E V, 1970, Manual for experiments in Applied Physics, Butterworths.

3. Malacara D, 1988, Methods of Experiments Physics, Series of Volume, Academic Press, Inc.

4. Dunlap RA, 1988, Experimental Physics: Modern methods, Oxford University Press.

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192PY2A3CP	NANOSCIENCE AND GENERAL PHYSICS	SEMESTER III

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Preparation of metal oxide nanoparticle and determine the band gap using UV-Vis spectrophotometer.
2	XRD analysis of the given XRD spectra.
3	Prepare the nanoparticles by chemical route and analysis by UV-Vis spectrophotometer.
4	Determination of viscosity of liquid –Mayer's disc method.
5	Determination of susceptibility by Quinke's method.
6	Determination of e/m by magnetron method.
7	Characteristics of solar cell.
8	Compressibility of liquid-ultrasonic interferometer.
9	Determination of Hartman's formula.
10	Determine the value of g by Kater pendulum.
11	Determination of wavelength of laser source- reflection grating.
12	Determination of high conductivity –Four probe method.

Note: Any 10 Experiments

Text Books

1. Ramesh S. Gaonkar, 2013, Microprocessor Architecture, Programming and Applications with 8085/8080, 6th edition, New Age International.
2. C. Latha and B. Murugeshwari, 2015, Microprocessors and Microcontrollers, Scitech Publications.

References

1. Douglas V. Hall, 1993, Microprocessors and Interfacing-Programming and Hardware, Tata McGraw Hill.
2. A.P.Godse and D.A.Godse, Microprocessors and Microcontrollers , Technical Publications.
3. Badri Ram, 2001, Advanced Microprocessors and Interfacing, Tata McGraw Hill.
4. Muhammad Ali Mazidi and Janice Mazidi, 2000, The 8051 Microcontroller and Embedded systems, Pearson Education.
5. Kenneth J. Ayala, 1996, The 8051 Microcontroller Architecture, Programming and Applications. 2nd Edition, Penram International publishing Pvt. Ltd.

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192PY2A3CC	MICROPROCESSORS AND MICROCONTROLLER	SEMESTER III

Total Credits: 4
Total Instructions Hours: 48 h

Syllabus

Unit I Microprocessors 8085 Architecture 10 h

Intel 8085 microprocessor: Introduction – Pin configuration - Architecture and its operations - Machine cycles of 8085. Interfacing of memory - Classification- I/O device and execution. Instruction classification: number of bytes, nature of operations - Instruction format.

Unit II 8085 Assembly Language Programming 10 h

Instruction set: Data transfer operations - Arithmetic operations - Logical operations – Branching and machine control operations. Addressing modes. Writing assembly language programs: Looping, counting and indexing. Counters and time delays - Stack - Subroutine

Unit III 8086 Microprocessor 09 h

Features of 8086 - Architecture – Pins and signals – Minimum mode and maximum mode signals – External memory addressing - 8 bit data transfer – 16 bit data transfer – Interrupt processing – Response to interrupt – Classification of interrupt – Interrupt priority. Addition, subtraction and multiplication programs.

Unit IV Interfacing of Microprocessor 8085 10 h

General purpose programmable Peripheral device: 8255A Programmable Peripheral Interface(PPI) – Block diagram – Mode 0 – BSR mode – A/D converter – 8257 DMA controller – Interfacing – Programming and Execution – Basic concept in serial I/O – Interfacing requirements – Transmission format - Synchronous vs Asynchronous Transmission.

Unit V Microcontroller 8051 Architecture and Programming 09 h

Introduction- Features of microcontroller and 8051 - Difference between microprocessor and microcontroller – 8051 Architecture - Pins and signals 8051- Memory organization – Special function register (SFR) – 8051 Interrupts - Execution – Sources – Enabling and disability – Priority- Timing level of Interrupts - Data types and directives Instruction set - Addition, subtraction and multiplication programs.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A3CC	MICROPROCESSORS AND MICROCONTROLLER	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The architecture and assembly language of 8085 and 8086 microprocessor.
- The interfacing of 8085 microprocessor.
- The architecture and programming of 8051 microcontroller.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the architecture of microprocessor 8085.	K2
CO2	Make use of instruction sets to write assemble language program.	K3
CO3	Experiment with the architecture and programming of 8086 microprocessor.	K3
CO4	Demonstrate the interfacing in 8085 microprocessor.	K2
CO5	Contrast microprocessor and microcontroller and perform basic arithmetic programs.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	L	M	L	M
CO2	S	L	S	M	M
CO3	S	M	S	M	S
CO4	S	L	S	M	M
CO5	S	M	S	S	S

S Strong M Medium L Low

References

1. J.L.Powell & B.Crasemann, 1961, Quantum Mechanics- Addison-Wesley Pub
2. P.A.M.Dirac, 2013, The principles of Quantum mechanics – Igal Meirovich Publication.
3. L.D.Landau and E.M.Lifshitz, 2013, Quantum Mechanics, 3rd edition. Pergamon
4. Thankappan.V.K., 2012, Quantum Mechanics – 3rd edition – New Age International Publishers.
5. Schiff .L.I, 1968, Quantum Mechanics – 3rd edition - McGraw Hill Ltd.

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192PY2A3CB	QUANTUM MECHANICS - II	SEMESTER III

Total Credits: 4
Total Instructions Hours: 60 h

Syllabus

Unit I Approximation Methods 12 h

Time independent perturbation theory - Non degenerate energy levels -First and Second order -Degenerate energy levels–Variation method –WKB approximation - Turning Points (no derivation) - WKB quantization - Application to simple harmonic oscillator –Hydrogen molecule, covalent bond and hybridization.

Unit II Scattering Theory 12 h

Introduction - Scattering amplitude –Total Scattering Cross Section - Partial wave analysis - Effective range theory for s wave - Optical theorem - Transformation from centre of mass to lab frame.

Unit III Time Dependent Perturbation Theory 12 h

Introduction - Transition probabilities - Constant and harmonic perturbations - transition probabilities - Fermi's golden rule - Selection rules for dipole radiation - Adiabatic approximation - Sudden approximation - Magnetic resonance - Semi-classical treatment of an atom with electromagnetic radiation

Unit IV Relativistic Quantum Mechanics 12 h

Klein-Gordon equation - Continuity equation - Plane wave solutions - Dirac equation - Dirac matrices - Equation of continuity - Spin of Dirac particle - Plane wave solutions - Interpretation of negative energy states - Antiparticle - Covariant form of Dirac equation.

Unit V Classical Fields and Second Quantization 12 h

Classical fields - Euler Lagrange equations - Hamiltonian formulation - Noether's theorem- Quantisation of real and complex scalar fields - Creation, destruction and number operators- Fock states- Second Quantisation of K.G. field.

Text Books

1	Aruldhas. G, 2008, Quantum mechanics, 2nd edition, Prentice hall of India Pvt.Ltd -
2	P.M. Matthews and K.Venkatesan, 2010. A textbook of Quantum Mechanics, 2 edition, McGraw Hill Education (India) Private Limited

Course Code	Course Name	Category	L	T	P	Credit
192PY2A3CB	QUANTUM MECHANICS – II	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of methods to describe microscopic properties of matter.
- The central concepts and laws of quantum mechanics.
- The basic Klein-Gordon and Dirac equations to formulate problems in quantum mechanics.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline on the approximation methods and its applications.	K2
CO2	Explain the scattering theory and Partial wave analysis	K2
CO3	Identify the use of time independent perturbation theory.	K3
CO4	Utilize the Klein-Gordon equation in Dirac equation.	K3
CO5	Analyze Euler Lagrange's equation and Hamiltonian formulation.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	M	S
CO2	S	S	M	S	S
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	S	M	S	S	S

S Strong M Medium L Low

Text Books

1	David J. Griffiths, 2013, Introduction to Electrodynamics, 4th Edition, Pearson.
2	K.K. Chopra and G.C. Agarwal, 2017, Electromagnetic Theory, 6th Edition, K. Nath & Co.

References

1	John David Jackson, 1999, Classical Electrodynamics, 3rd Edition, John Wiley & Sons.
2	S.L. Gupta and V. Kumar, 2017, Electrodynamics, 24th Edition, Pragati Prakashan.
3	B.B Laud, 2011, Electromagnetics, 3rd Edition, New Age International Publisher.
4	Sathya Prakash, 2019, Electromagnetic Theory and Electrodynamics, Kedarnath Ramnath and Co., Meerut.
5	Charles A. Brau, 2003, Modern Problems in Classical Electrodynamics, Oxford University Press.

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192PY2A3CA	ELECTROMAGNETIC THEORY	SEMESTER III

Total Credits: 4
Total Instructions Hours: 60 h

Syllabus

Unit I Electrostatics 12 h

Coulomb's law; The electric field – Line, Flux and Gauss's Law in differential form - Application of Gauss's law – Curl of E - Poisson's equation; Laplace's equation – Work and energy in electrostatics: Energy of a point charge distribution – Energy of continuous charge distribution – Induced charges – Capacitors - Laplace equation in one dimension and two dimensions – Dielectrics – Induced dipoles – Gauss's Law in the presence of dielectrics.

Unit II Magnetostatics 12 h

Lorentz force – Magnetic fields – Magnetic forces – Currents – Biot-Savart Law – Divergence and curl of B – Ampere's Law – Electromagnetic induction - Comparison of magnetostatics and electrostatics – Magnetic vector potential - Effect of magnetic field on atomic orbit – Ampere's Law in magnetized materials – Ferromagnetism.

Unit III Electromotive Force 12 h

Ohm's Law – Electromotive force – Motional emf – Faraday's Law – Induced electric field – Inductance – Energy in magnetic field – Maxwell's equation in free space and linear isotropic media – Continuity equation – Poynting theorem.

Waves in one dimension: Wave equation – Sinusoidal waves – Reflection and transmission – Polarization.

Unit IV Electromagnetic Waves 12 h

The wave equation for E and B – Monochromatic Plane waves – Energy and momentum in electromagnetic waves – Electromagnetic waves in matters - TE waves in rectangular wave guides – The co-axial transmission line - Scalar and vector potentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force law in potential form.

Unit V Relativistic Electrodynamics 12 h

Four vectors and Tensors – Transformation equations for charge and current densities - Transformation equations for the Electromagnetic Potentials – The Electromagnetic Field Tensor – Transformation Equations for Electric and Magnetic field Vectors – Covariance of Maxwell Equations in four Vector forms and in four Tensor forms – Covariance and Transformation Law of Lorentz Force.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A3CA	ELECTROMAGNETIC THEORY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The fundamental theories that explain electrostatics and magnetostatics.
- The electrodynamics principle for explaining the electromagnetic wave propagation.
- The analytical problems of relativistic systems in electrodynamics.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Summarize the fundamentals of electrostatics	K2
CO2	Outline the concepts of magnetostatics	K2
CO3	Develop the skills to solve problems of motion of charged particles in various fields	K3
CO4	Analyze the concept of electromagnetic theory in electromagnetic waves	K4
CO5	Examine the electrodynamics of radiating and relativistic systems	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	M	M	M	S	L
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S Strong M Medium L Low

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Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
192PY2A3CA	Core	Electromagnetic Theory	4	1	-	3	25	75	100	4
192PY2A3CB	Core	Quantum Mechanics– II	4	1	-	3	25	75	100	4
192PY2A3CC	Core	Microprocessors and Microcontroller	4	-	-	3	25	75	100	4
192PY2A3CP	Core Practical	Nanoscience and General Physics	-	-	4	4	40	60	100	2
192PY2A3CQ	Core Practical	Electronics-III	-	-	4	4	40	60	100	2
192PY2A3DA	DSE	Introductory Astronomy, Astrophysics & Cosmology	4	-	-	3	25	75	100	4
192PY2A3DB		Band Gap Engineering in Semiconductors								
192PY2A3DC		Solar cells and Solar Energy Utilization								
192PY2A4CV	Project	Project	4	-	-	-	-	-	-	-
192PY2A3CT	IT	Industrial Training	A to C							
		Total	**20**	**2**	**8**	-	-	-	**600**	**20**

EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S. No.	Course Code	Course Name
1	192PY2ASSA	IPR, Innovation and Entrepreneurship
2	192PY2ASSB	Nano Science

Text Books

1 Antonio Luque, Steven Hegedus, 2012,"Hand Book of Photovoltaic Science and Engineering", 2nd Edition. Wiley, New York.

2 Angele Reinders, Pierre Verlinden, WilfriedVansark, 2017, "Photovoltaic Solar Energy", 3rdEdition. Wiley, New York.

References

1 Kothari D P, Singhal K C, Rakesh Ranjan, 2014,"Renewable Energy Source and Emerging Technologies",2nd Edition, PHI Learning Private Limited, New Delhi.

2 Brabec C, Scherf U, Dyakonov V, 2008, "Organic Photovoltaics", 1st Edition, Wiley, New York.

3 John T, Tony W, 2005, "Renewable Energy Resources",2nd Edition, Taylor & Francis, London.

4 Chetan Singh Solanki, 2013, "Solar Photovoltaics: Fundamental Technologies & Applications", 2nd Edition, PHI Learning Private Limited, New Delhi.

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202PY2A2DC	PHOTOVOLTAIC SCIENCE	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Photovoltaics 10 h

Properties of irradiance - Photons - Solar irradiance - Reflection, refraction and transmission - Properties of Semiconductors : Crystal structure - Energy band structure – Conduction and valence band density of states – Equilibrium carrier concentrations – Light absorption – Recombination -Carrier transport - Semiconductor equations - Minority carrier diffusion equation – PN Junction diode electrostatics

Unit II Physics of Solar Cells 9 h

Solar cell boundary condition - Generation rate - Solution of the minority carrier diffusion- Terminal characteristics - Solar cell I to V characteristics- Properties of efficient solar cell - Life time and surface recombination effects.

Unit III Amorphous Silicon Solar Cell 10 h

Amorphous silicon: The first bipolar amorphous semiconductor – Designs for amorphous silicon solar cells – Staebler – Wronski effect – Atomic and electronic structure of hydrogenated amorphous silicon: Deposition techiniques – RF glow discharge deposition - Glow discharge deposition at different frequencies – Hot wire chemical vapor deposition.

Unit IV Cadmium Telluride Solar Cell 9 h

Cd Te Properties and Thin film - Fabrication methods - Condensation/Reaction of Cd and Te2 Vapors on a surface – Galvanic reduction of Cd and Te ions at a Surface - Precursor reaction at a surface -window Layers – Cd Te Absorber Layer and Cadmium chloride treatment - CdS/CdTe intermixing - Back contact- Solar cell characterization – Cd Te modules.

Unit V Dye Sensitized Solar Cells 10 h

Operating mechanism of dye-sensitized solar cell – Materials – Performance of highly efficient DSSCs – Electron transfer processes: Electron injection from dye to metal oxide - Electron transport in nanoporous electrode - Kinetic competition of the reduction of dye cation - Charge recombination between electron and I-3 ion.

Course Code	Course Name	Category	L	T	P	Credit
202PY2A2DC	PHOTOVOLTAIC SCIENCE	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The science behind photovoltaics.
- The characteristics and properties of solar cells.
- The construction and working of CdTe solar cells and DSSC.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the properties of photovoltaic and semiconductors	K2
CO2	Identify the properties and characteristics of solar cells.	K3
CO3	Classify about the amorphous silicon solar cell	K4
CO4	Construct and characterize CdTe solar cells by thin film fabrication methods.	K3
CO5	Analyze the operating mechanism of dye sensitized solar cell.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S Strong M Medium L Low

Unit V Characterization Tools 10 h

Working principles and instrumentation - XRD - XPS - AES - SIMS - LEED - AFM - SEM - STM.

Text Books

1. Bhat H.L, 2015, "Introduction to crystal growth Principles and Practice", CRC Press, Boca Raton, USA. (Unit 1)
2. Ananthapadmanabhan P. V and Venkataramani N, 1999, "Thermal Plasma Processing", Pergamon Materials series Vol.2. (Unit 2)
3. Roth A, 1990, "Vacuum Technology", 3rd Edition, North Holland. (Unit 3)
4. Rajendra Kumar Goyal, 2018, "Nanomaterials and Nanocomposites, Synthesis, Properties, Characterization Techniques and Applications", CRC Press, Boca Raton, USA. (Unit 4)
5. Hartmut Frey, Hamid R Khan, 2015, "Handbook of Thin Film Technology", Springer-Verlag, Berlin. (Unit 4, 5)

References

1. Chopra K. L, 1969, "Thin Films Phenomena", 1st Edition, McGraw Hill, New York.
2. Rajendran V, 2014, "Materials Science", Tata McGraw-Hill, New Delhi.

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202PY2A2DB	MATERIALS PHYSICS AND PROCESSING TECHNIQUES	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Crystal Growth 9 h

Significance of crystal growth - Crystal growth processes in laboratory and industrial scale - Classification of crystal growth methods - Growth from solutions - Nucleation: Homogeneous and heterogeneous, Solubility phase diagram - Saturation - Super saturation - Growth from gel - Growth from flux - Growth from melt - Bridgmann method - Czochralski crystal pulling technique - Sublimation method.

Unit II Plasma Processing 10 h

Nature of plasma - Types of plasma - Properties of plasma - V-I characteristics - Advantages of plasma processing - Thermal plasma: Principles of plasma generation - DC plasma torches - AC plasma torches - RF plasma torches - Plasma spraying - Structure of sprayed deposits - Plasma decomposition - Plasma melting and re-melting - Non-thermal plasma: Glow discharge plasma - Plasma reactors for surface treatment.

Unit III Vacuum Techniques 10 h

Units and range of vacuum - Surface processes and out gassing - Gas flow mechanism - Classification of pumps: Positive displacement pumps - Kinetic pumps - Entrapment pumps - Classification of pressure gauges: Total pressure gauges - Hydrostatic pressure gauges - Thermal conductivity gauges - Ionization gauges - Vacuum system: simple rotary, diffusion, turbo molecular, ultra-high vacuum and cryo-pumped systems.

Unit IV Growth Technique Of Thin films and Nanomaterials 9 h

Sputtering - Chemical vapor deposition - Pulsed laser deposition - Molecular beam epitaxy - Electrochemical deposition - SILAR method - Sol-Gel Technique - Hydrothermal growth - Ball Milling - Combustion synthesis - Microwave synthesis - Co- precipitation.

Course Code	Course Name	Category	L	T	P	Credit
202PY2A2DB	MATERIALS PHYSICS AND PROCESSING TECHNIQUES	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The parameters and properties of engineering materials and its application.
- The various materials growth, synthesis and processing techniques.
- The structural, morphology, and surface characterization techniques.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Experiment with the growth process of crystal.	K3
CO2	Explain the methods of plasma processing.	K2
CO3	Utilize the importance of Vacuum techniques.	K3
CO4	Categorize on growth methods of physical and chemical means.	K4
CO5	Examine the various characterization methods of materials.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	M	M	M	S	L
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S **Strong** **M** **Medium** **L** **Low**

Text Books

1. Rai G. D, 2014, "Solar Energy Utilization", Khanna Publishers, 5th Edition, New Delhi
2. Kothari D. P, Singal K. C and Rakesh Ranjan, 2008, "Renewable Energy Sources and Emerging Technologies", 4th Edition, Prentice Hall of India.

References

1. John Twidell & Tony Weir, 2006, "Renewable Energy Resources", Taylor & Francis Group.
2. Kreith and Kreider, 1998, "Principles of Solar Engineering", McGraw Hill Publication, New Delhi.
3. Rai G. D, 2004, "Non-Conventional Energy Sources", Khauna Publication, India.
4. Sukhatme S. P, 2002, "Solar Energy", 3rd Edition. Tata McGraw Hill Publishing Company Ltd, New Delhi.

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202PY2A2DA	ENERGY PHYSICS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Energy Resource 9 h

Electric energy from conventional sources - Thermal plants - IGCC power generation - Gas turbine plants - Nuclear power: Nuclear fission - Nuclear fusion - Energy reserve: Coal - Oil - Natural gas - Gas conservation - Gas based generating plants.

Unit II Renewable Energy 10 h

Wind energy: Types of rotors – Operation of wind turbines - Wind power generation curve – Horizontal axis wind turbine generator - Merits and demerits of wind energy – Hydrogen energy: Hydrogen production – Electrolysis - Thermal decomposition of water - Hydrogen fuel from sunflower oil - Characteristics and applications of hydrogen production - Hydrogen storage - Hydrogen fuel and its use.

Unit III Biomass Energy 10 h

Biomass conversion Technologies – Biochemical conversion - Biogas technology - Factors affecting biogas production - Biogas plants: Floating drum and fixed dome type biogas plant - Deenbandhu biogas plant - Community night soil based biogas plant - Power generation from liquid waste - Environmental benefits.

Unit IV Solar Energy 10 h

Solar energy measuring equipment - Pyrheliometers - Pyranometers - Solar radiation data - Solar thermal power generation - Stirling cycle - Brayton cycle - Solar energy utilization - Solar cooking - Solar green houses - Types of green houses - Application of solar energy in space.

Unit V Additional Alternate Energy Sources 9 h

Geothermal energy: Geothermal Resources - Power generation - Utilization of geothermal energy - Ocean energy: Tidal energy - Characteristics - Tidal power project - Types of tidal power plants - Advantage and Disadvantage of tidal power.

Course Code	Course Name	Category	L	T	P	Credit
202PY2A2DA	ENERGY PHYSICS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The energy resources and their availability.
- The technologies of biomass production and generation.
- The power generation, geothermal, tidal systems and applications of solar energy.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline about energy sources and their availability.	K2
CO2	Identify various non- conventional energy sources.	K3
CO3	Classify biomass energy and the production of bio gas.	K4
CO4	Examine the power generation equipment and applications of solar energy.	K4
CO5	Illustrate the principles, applications of geothermal and tidal energy.	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	M	M	M	S	L

S Strong M Medium L Low

Text Books

1. Kandasamy P, Thilagavathy.K Gunavathy. K., 2015, "Numerical Methods", 2nd Edition S Chand and Co., New Delhi

References

1. Sastry,S.S. 2006, "Introductory Methods of Numerical Analysis", 4th Edition, Prentice Hall, New Jersey.
2. Hoffman,D., 2004, "Numerical Methods for Scientists and Engineers", 2nd Edition, Taylor & Francis Group, New York.
3. Steven C, Raymond P., 2007, "Numerical Methods for Engineers and Scientists", 2nd Edition, TATA McGraw Hill Education, New Delhi.
4. Curtis , F. 2002, "Applied Numerical Analysis", 2nd Edition, Pearson Education, Asia.

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192MT2A2IB	NUMERICAL METHODS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Solution of Numerical Algebraic and Transcendental equations 8 h

Solution of Numerical Algebraic and Transcendental equations- Introduction-Bisection method- Method of False Position method- Geometrical interpretation-the iteration method –Newton's Raphson Method.

Unit II Solution of Simultaneous Linear Algebraic Equations 10 h

Solution of Simultaneous Linear Algebraic Equations -Direct method - Gauss Elimination Method - Gauss - Jordan Method - Inversion Matrix using Gauss elimination method – Method of Triangularization

Unit III Central Difference Interpolation Formulae (for equal intervals) 10 h

Central Difference Interpolation Formulae (for equal intervals) - Introduction-Gauss forward interpolation formulae- Gauss backward interpolation formulae-Stirling's formula and Bessel's formula.

Unit IV Numerical Differentiation and Integration 10 h

Numerical Differentiation- Introduction- Newtons Forward and Backward difference formula -Numerical integration: Trapezoidal Rule- Simpsons 1/3 Rule-Simpsons 3/4 rule- Boole's and Weddle's Rule.

Unit V Numerical Solution of Ordinary Differential Equations 10 h

Numerical Solution of Ordinary Differential Equations - Introduction- Solution by Taylor's Series- Picard's method of successive Approximations – Euler's Methods-Error Estimates for the Euler Method-Modified Euler's method-RungeKuttaMethod.

Note: 20% Theory and 80% Problem

Course Code	Course Name	Category	L	T	P	Credit
192MT2A2IB	NUMERICAL METHODS	EDC	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The system of Linear equations using various Numerical Methods
- The Ordinary and Partial Differential Equations
- The Numerical Differentiation and Integrations

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Apply the Numerical solution of Linear equations for bisection method	K2
CO2	Solve the set of Linear Algebraic equations.	K2
CO3	Interpret the concept of Numerical differentiation and integration	K3
CO4	Identify the Interpolation Formulae for equal intervals	K3
CO5	Solve the Ordinary Differential Equations	K2

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	M	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S Strong **M Medium** **L Low**

References

1 Ouseph. C.C , 2014, "Practical Physics and Electronics", Viswanathan Publishers Ltd.

2 Bhattacharya. A.B , 2011, "Advanced Electronic Practicals", New Central Book Agency (NCBA)

3 Chattopadhyay. D , 2015, "Advanced Course in Practical Physics", New Central Book Agency (NCBA)

4 Samir Kumar Ghosh, 2013, "Text Book of Advanced Practical Physics", New Central Book Agency (NCBA)

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202PY2A2CQ	CORE PRACTICAL: ELECTRONICS - II	SEMESTER II

Total Credits: 2
Total Instructions Hours: 48h

S.No	List of Experiments
1	Construction of colpitt's oscillator using Op-Amp
2	Study the schmitt trigger using OP-Amp
3	Study the characteristics of UJT
4	Construct Analog to Digital conversion using IC 74148
5	Construct inverting, non-inverting and voltage follower using Op-Amp
6	Study the characteristics of tunnel diode
7	Construction of bistable multivibrator using OP-Amp
8	Construct current to voltage and Voltage to current converter using Op-Amp
9	Find the parameters of Op-Amp using 741
10	Construction of low pass and high pass filter using Op-Amp
11	Construct second order filters using IC 741
12	Construct astable multivibrator using IC 741

Note: Any 10 Experiments

References

1. Chattopadhyay. D, 2015, "Advanced Course in Practical Physics", NCBA
2. Shrivastava H.P., 2012, "Textbook of Practical Physics", ABD Publishers.
3. Squires.G.L., 2010, "Practical Physics South Asian Edition", 4th Edition, Cambridge University Press
4. Samir Kumar Ghosh , 2016, "Text Book of Advanced Practical Physics", NCBA.

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202PY2A2CP	CORE PRACTICAL: SOLID STATE AND SPECTROSCOPY LAB	SEMESTER II

Total Credits: 2
Total Instructions Hours: 48h

S.No	List of Experiments
1	Determination of optical activity of specific rotation using Polarimeter.
2	Determination of refractive index of liquid using He-Ne laser
3	Determination of e / m by Thomson method
4	Determination of Rydberg's constant using Solar spectrum
5	Study of Band gap energy using Thermistor
6	Determination of Hall coefficient using Hall Effect
7	Determination of Refractive index of liquid by Newton's ring
8	Determination of Resistivity using Two probe method
9	Find Young's modulus of the material by Hyperbolic fringes
10	Study of dielectric constant and Curie temperature of magnetic materials
11	Determination of thermal conductivity of liquid and air by Lee`s disc method
12	Determination of Planck 's constant

Note: Any 10 experiments

Unit V Surface Enhanced Raman Scattering (SERS) and Surface Spectroscopy 9 h

Surfaces for SERS study – Enhancement mechanism – Surface selection rules - SERS microprobe – Applications of SERS

Electron energy loss spectroscopy (EELS) – Reflectance absorbance–IR spectroscopy (RAIRS) – Photo electron spectroscopy (PES) – X-ray photo electron spectroscopy (XPES).

Text Books

1 Aruldhas G, 2017, "Molecular Structure and Spectroscopy", 2nd Edition, Prentice Hall of India Pvt. Ltd & New Delhi.

2 Colin N Banwell and Elaine M McCash, 2016, "Fundamentals of Molecular Spectroscopy", 4th Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

References

1 William Kemp, 2002, "Organic Spectroscopy", 3rd edition, Palgrave Publishers Ltd, New York.,

2 Jag Mohan, 2004, "Organic Spectroscopy - Principles and Applications", Second Edition, Narosa Publishing House Pvt. Ltd, New Delhi.

3 Straughen. R P and Walker S, 1976, "Spectroscopy, Vols. I, II and III", Chapman & Hall, London.

4 Sharma YR, 2013, "Elementary Organic Spectroscopy - Principles and Chemical Applications", S. Chand & Company Pvt. Ltd, New Delhi.

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Course Code	Course Name	Category	L	T	P	Credit
202PY2A2CC	SPECTROSCOPY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The different techniques of spectroscopy and their applications.
- The Raman, nuclear magnetic and electron spin spectroscopy.
- The nuclear quadrupole resonance, SERS and surface spectroscopy.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Identify the modes of vibration and rotation in molecules using IR and Microwave spectroscopy.	K3
CO2	Apply the theory of Raman spectroscopy for structure determination.	K3
CO3	Examine the spectra of Nuclear magnetic Resonance and Electron Spin Resonance.	K4
CO4	Explain the principle of Nuclear Quadrupole Resonance and Mossbauer spectroscopy.	K2
CO5	Select the type of spectroscopy for interaction of electromagnetic waves with matter.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	M	M	M	S	L
CO5	S	S	S	S	M

S **Strong** **M** **Medium** **L** **Low**

202PY2A2CC	SPECTROSCOPY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Infrared and Microwave Spectroscopy 10 h

Vibrational energy of a diatomic molecule- Infrared selection rules -Vibrating diatomic molecule- Normal modes of vibration in crystal - Interpretation of vibrational spectra - Group frequencies - IR spectrophotometer instrumentation- Fourier transform infrared spectroscopy (Principle and Working) - Applications.

Rotation of molecules – Expression for the rotational constant - Theory of microwave spectra of linear and symmetric top molecules – Techniques and instrumentation - Chemical analysis by microwave spectroscopy.

Unit II Raman Spectroscopy 9 h

Theory of Raman scattering - Rotational Raman spectra - Vibrational Raman spectra - Mutual exclusion principle - Raman spectrometer - Sample handling techniques - Polarization of Raman scattered light - Structure determination using IR and Raman spectroscopy - Raman investigation of phase transitions -Resonance Raman scattering.

Unit III Nuclear Magnetic and Electron Spin Resonance Spectroscopy 10 h

Theory of NMR method – Resonance condition – NMR Instrumentation – Relaxation processes - Bloch equations - Chemical shift – Spin-spin coupling – Interpretation of certain NMR spectra.

Principle of ESR - ESR spectrometer – Total hamiltonian – Hyperfine structure – ESR spectra of free radicals in solution.

Unit IV Nuclear Quadrupole Resonance and Mossbauer Spectroscopy 10 h

Principle of nuclear quadrupole resonance – Transitions for axially and non-axially symmetric systems – NQR instrumentation – Chemical bonding – Hydrogen bonding.

The Mossbauer effect -Recoilless emission and absorption - Experimental techniques -Isomer shift – Quadrupole Interaction - Magnetic hyperfine interaction – Applications.

Course Code	Course Name	Category	L	T	P	Credit
202PY2A2CB	QUANTUM MECHANICS - I	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The foundation of quantum mechanics and wave equations.
- The applications of quantum mechanics to various dimensional equations.
- The matrix formulations and scattering theory of quantum mechanics.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the concepts of quantum mechanics and the applications of wave equation.	K2
CO2	Solve one dimensional problems related to eigen values	K3
CO3	Apply quantum mechanics to three dimensional wave equations and angular momentum.	K4
CO4	Generalize Heisenberg and spin quantum theory.	K2
CO5	Explain scattering representation and born approximations.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	S	S	M	S
CO3	S	S	M	S	S
CO4	S	S	S	M	M
CO5	S	S	S	S	S

S **Strong** **M** **Medium** **L** **Low**

Crystal imperfections - Frenkel and Schottky defects - Dislocation - Surface Imperfections - Polorans and Excitons

Text Books

1 Gupta S L and Kumar V, 2017, "Solid State Physics", K. Nath & Co., Meerut

2 Charles Kittel, 2016, "Introduction to Solid State Physics", 8th Edition, Wiley India Pvt. Ltd, New Delhi.

References

1 Pillai S O, 2018, "Solid State Physics", 8th Edition, New Age international Publisher, New Delhi.

2 Rita John, 2014, "Solid State Physics", Tata McGraw Hill Publications, New Delhi.

3 Wahab M A, 1999, "Solid State Physics – Structure and Properties of Materials", Narosa Publishing House (P) Ltd, New Delhi.

4 Puri R K and Babbar V K, 2014, "Solid State Physics", S.Chand & Co, New Delhi.

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202PY2A2CB	QUANTUM MECHANICS - I	SEMESTER II

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Foundations of Wave Mechanics and Quantum Mechanics 12 h

Postulates of quantum mechanics - Linear operator - Eigen values and functions – Hermitian Operator - Dirac's notation - Momentum Representation: Operator for momentum – Interpretation of the wave function: Probability of interpretation, current density, expectation value - Ehrenfest's theorem.

Unit II One Dimensional Energy Eigen value Problems 14 h

Equation of motion: Schrödinger, Heisenberg and Interaction representation. Square well potential with rigid walls - Square well potential with finite walls - Square well potential barrier - Alpha emission.

Unit III Three-Dimensional Problems and Angular Momentum 14 h

Hydrogen atom – Rigid Rotator - Three dimensional square well potential - Angular momentum operator – Eigen value and Eigen function of L2 and Lz– Eigen value of J2 and Jz. Addition of angular momenta: Clebsh Gordan coefficients, Recursion Relations.

Unit IV Heisenberg Method and Spin of Quantum Theory 10 h

The Heisenberg method - Martic representation of Wave function, operator - Hilbert space - Dirac's Bra-Ket notation - Linear harmonic oscillator in matrix method. Pauli's exclusion principle- Inclusion of spin – Spins functions for 2, 3 electrons.

Unit V Scattering Theory 10 h

Scattering by a perfectly rigid sphere - Scattering by a coulomb field - Green's functions – Born approximation and its validity – Scattering by a square well potential – Scattering from an exponential potential.

Text Books

1 G. Aruldhas, 2016, "Quantum Mechanics", 2nd Edition, PHI Learning (P) Ltd, New Delhi.

2 Gupta, Kumar, Sharma, 2015, "Quantum Mechanics", 33rd Edition, Jai Prakash Nath Publications, Meerut.

References

1 Kakani .S. L, Chandalia .H. M, 2007, "Quantum Mechanics Theory and Problems", 4th Edition, S.Chand & Co, New Delhi.

2 Ghosh .P. K, 2014, "Quantum Mechanics", Narosa Publishing House (P) Ltd, New Delhi.

3 Eugen Merzbacher, 2017, "Quantum Mechanics" 3rd Edition, Wiley India (P) Ltd, New Delhi.

4 Rajasekar Shanmuganathan, Velusamy R, 2014, "Quantum Mechanics I- The Fundamentals", CRC Press, New Delhi.

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202PY2A2CA	CONDENSED MATTER PHYSICS	SEMESTER II

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Crystal Structure and Binding 12 h

Crystalline solids - Bravais Lattice - Miller planes and spacing - Structural features of NaCl, CsCl, Diamond, ZnS - Reciprocal lattice – Reciprocal lattice to BCC and FCC crystals. Ionic bond - Madelung constant for NaCl lattice - Covalent bond – Heitler-London Theory – Metallic bond – Van der wall`s bond: Crystal of inert gases

Unit II Lattice Vibration and Thermal Properties 12 h

Theory of Wave motion of one dimensional atomic lattice - Group and phase velocity - Phonons – Phonon momentum – Inelastic scattering of neutron by phonons. Thermal properties: Einsteins theory of specific hest – Debye`s model of lattice specific heat - Umklapp process

Unit III Free Electron and Band Theory 12 h

Failure of classical free electron theory - Fermi-Dirac distribution - Matthiessen's rule – magnetoresistance. Bloch theorem - Kronig – Penney model - Extended, Reduced and periodic zone schemes – Tight binding approximation – Brillouin Zone - Construction of Fermisurfaces - De Haas–van Alphen effect

Unit IV Magnetism and Dielectrics 12 h

Classification of magnetic materials – Quantum theory of paramagnetism - Adiabatic demagnetization - Quantum theory of ferromagnetism - Heisenberg's interpretation of Weiss field - Magnons - Thermal excitation of magnons. Dielectric constant – Electrostriction and piezoelectricity - Ferroelectricity – Ferroelectric domains - applications

Unit V Superconductivity and Crystal Imperfections 12 h

Magnetic properties of super conductor - Type I and Type II Super conductors - Isotope effect – Thermodynamic effect and superconducting transition: entropy and specific heat - London equation - DC Josephson effect - AC Josephson effect – High temperature super conductors – Applications.

Course Code	Course Name	Category	L	T	P	Credit
202PY2A2CA	CONDENSED MATTER PHYSICS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The crystalline structure, lattice vibration of atoms
- The free electron, band theory and magnetism
- The concept of dielectric and super conductor

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the crystal structure and bonding of atoms	K2
CO2	Illustrate the lattice vibration of atoms and thermal properties	K2
CO3	Solve free electron theory by Fermi Dirac distribution and bloch theorem	K3
CO4	Identify the classification and theory of magnetic materials and dielectric	K3
CO5	Examine the theory on superconductivity and its applications and imperfection in crystals	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	S	L
CO2	M	M	M	S	L
CO3	S	S	S	S	M
CO4	S	S	S	S	M
CO5	S	S	S	S	S

S Strong M Medium L Low

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
202PY2A2CA	Core - V	Condensed Matter Physics	4	1	-	3	25	75	100	4
202PY2A2CB	Core - VI	Quantum Mechanics – I	4	1	-	3	25	75	100	4
202PY2A2CC	Core - VII	Spectroscopy	4	-	-	3	25	75	100	4
202PY2A2CP	Core Practical - III	Solid State and Spectroscopy	-	-	4	4	40	60	100	2
202PY2A2CQ	Core Practical - IV	Electronics-II	-	-	4	4	40	60	100	2
192MT2A2IB	EDC - I	Numerical Methods	4	-	-	3	25	75	100	4
202PY2A2DA	DSE - II	Energy Physics	4	-	-	3	25	75	100	4
202PY2A2DB		Materials Physics and Processing Techniques								
202PY2A2DC		Photovoltaic Science								
Total			**20**	**2**	**8**	-	-	-	**700**	**24**

Text Books

1 Mills, D.L. 1998. Nonlinear Optics - Basic Concepts, Springer, Berlin.

2 Laud, L.L. 1991. Lasers and Nonlinear Optics, 2nd Edition. New Age International (P) Ltd, New Delhi.

References

1 Subhash Chandra Singh, HaiboZeng, ChunleiGuo, and WeipingCai. 2012. Nanomaterials: Processing and Characterization with Lasers, Wiley VCH Verlag GmbH & Co. KGaA.

2 Walter Koechner. 1993. Solid state Laser Engineering, 6th edition. Springer.

3 M.N. Avadhanulu Dr. P.S. Hemne. 2013. An Introduction to Lasers theory and applications, S. Chand and Co.

4 Skoog. D.A, Holler. F.J and Crouch. S.R. 2007. Principles of Instrumental analysis, Thomson Brroks/Cole, Belmont, Ca.

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192PY2A1DC	LASER PHYSICS AND NON LINEAR OPTICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Lasers-Fundamentals and Types 9 h

Basic Construction and Principle of Lasing-Einstein Relations and Gain Coefficient - Creation of a Population Inversion- Three - Level System - Four - Level System - Laser types - He-Ne Laser-CO2 Laser - Nd:YAG Laser- Semiconductor Laser.

Unit II Laser Operation 9 h

Optical Resonator - Laser Modes - Axial modes - Transverse modes -Modification in Basic Laser Structure - Basic Principle of Mode Locking - Active Mode Locking - Passive Mode Locking - Q-Switching.

Unit III Laser Beam Characteristics 9 h

Wavelength – Coherence - Mode and Beam Diameter – Polarizations -Introduction to Gaussian Beam width - Rayleigh Range - Guoy Phase Shift - 3-D Gaussian Beams - ABCD Law for Gaussian Beam -The Complex Radius of Curvature - Tensorial ABCD Law.

Unit IV Focusing of Laser Beam 10 h

Diffraction - Limited spot size - Spherical Aberration - Thermal Lensing Effects - Depth of Focus - Tight focusing of laser beam - Angular Spectrum Representation of Optical Near Field - Focusing of Higher order laser modes - Radially Polarized Doughnut mode.

Unit V Non Linear Optics 11 h

Introduction - Nonlinear Optical Media - The Nonlinear Wave Equation - Scattering Theory Born Approximation - Second-order Nonlinear Optics-Second - Harmonic Generation (SHG) - The Electro-Optic Effect - Three-Wave Mixing - Frequency and Phase Matching - Third Harmonic Generation - Optical Kerr Effect - Self-Focusing.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A1DC	LASER PHYSICS AND NON LINEAR OPTICS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The basis of laser and its operation.
- The characteristics and focusing of laser beam.
- The theory and applications of non- linear optics.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the principle and construction of various lasers.	K2
CO2	Identify the operation technique of lasers.	K3
CO3	Construct the laser beam characteristics.	K3
CO4	Inspect the focusing of Laser beam.	K4
CO5	Examine the Non linear optical media and make use in various applications.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	M	M
CO2	S	L	S	M	S
CO3	S	L	S	M	S
CO4	S	M	S	S	S
CO5	S	M	S	S	S

S **Strong** **M** **Medium** **L** **Low**

Text Books

1 Markov, I.V. 2004. Crystal Growth for Beginners: Fundamentals of Nucleation, Crystal growth and Epitaxy,2nd edition.

2 Santhanaragavan, P and Ramasamy, P. 2001. Crystal Growth Process and Methods, KRU Publications, Kumbakonam.

References

1 Brice,J.C. 1986. Crystal Growth Process, John Wiley, New York.

2 Ohring, M. 2002. Materials Science of Thin Films, 2nd Edition. Academic Press, Boston.

3 Kaufmann, E.N. 2012. Characterization of Materials, Volume-I, John Wiley, New Jersey

4 Goswami, A. 2008. Thin Film Fundamentals, New Age, New Delhi.

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192PY2A1DB	CRYSTAL GROWTH AND THIN FILM PHYSICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Basic Concepts, Nucleation and Kinetics of Growth 10 h

Ambient phase equilibrium – Equilibrium of finite phases - Equation of Thomson-Gibbs – Types of nucleation – Formation of critical nucleus – Classical theory of nucleation – Rate of nucleation – Growth from vapor phase, solutions and melts – Epitaxial growth – Growth mechanism and classification – Kinetics of growth of epitaxial films.

Unit II Crystallization Principles and Growth Techniques 9 h

Classes of crystal system – Crystal symmetry – Solvents and solutions – Solubility diagram – Metastable zone and induction period – Miers TC diagram – Solution growth – Low and high temperatures solution growth – Slow cooling and solvent evaporation methods.

Unit III Gel, Melt and Vapor Growth Techniques 9 h

Principle of gel technique – Various types of gel - Structure and importance of gel – Methods of gel growth and advantages - Melt technique – Czochralski growth- Bridgeman method – Horizontal gradient freeze – Hydrothermal growth – Vapor-phase growth – Physical vapor deposition – Chemical vapor deposition.

Unit IV Thin Film Deposition Techniques 10 h

Vacuum evaporation - Hertz-Knudsen equation - Evaporation from a source and film thickness uniformity - E-beam, pulsed laser and ion beam evaporations - Mechanisms and yield of sputtering processes – DC, magnetically enhanced, reactive sputtering – Spray pyrolysis – Electro deposition – Sol-gel technique.

Unit V Characterization Techniques 10 h

X–ray diffraction – Powder and single crystal – Fourier transform infrared analysis – Elemental dispersive X-ray analysis – Transmission and scanning electron microscopy – UV-Vis-NIR spectrometer – Vickers micro hardness – Basic principles and operations of AFM and STM - X-ray photoelectron spectroscopy for chemical analysis – Photoluminescence.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A1DB	CRYSTAL GROWTH AND THIN FILM PHYSICS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The various experimental techniques for crystal growth.
- Choose various growth techniques for thin film deposition.
- Summarize various characterization techniques like XRD, SEM, TEM, AFM.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Develop the concepts of crystal growth technique through Nucleation and Kinetics of growth.	K3
CO2	Relate the various experimental techniques for crystal growth.	K2
CO3	Identify various preparation methods like gel, melt and vapor growth techniques of crystal.	K3
CO4	Construct the thin films deposition in various techniques.	K3
CO5	Analyze the various characterization techniques for both crystal and thin film samples.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	M	S
CO2	S	L	S	L	M
CO3	S	L	S	L	M
CO4	S	M	S	L	M
CO5	S	M	S	M	S

S **Strong** **M** **Medium** **L** **Low**

Text Books

1 S.C.Santra. 2017. Environmental Sciences, new central book agency, ISBN: 9788173814044.

2 A.K.De. 2006. Environmental chemistry, 5th Edition. new age international publishers.

References

1 Kothari D.P, Singal K.C and Rakesh Ranjan. 2014. Renewable energy sources and emerging technologies, second edition. New Delhi.

2 R.Lal and M.K Shukla. 2004. Principles of soil physics, Marcel Dekker, New York.

3 Egbert Boeker & Rienk Van Groundelle. 2011. -Environmental Physics - John Wiley- 2nd edition

4 Baker. K.H and Herson D.S. 1994. Bioremediation, McGraw-Hill Inc, New York.

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192PY2A1DA	ENVIRONMENTAL PHYSICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Atmosphere and Ecosystems 10 h

Environmental components - Evolution of atmosphere - Chemical and photochemical reactions in the atmosphere - Hydrosphere - Lithosphere - Ecosystems: Law of thermodynamics and energy flow in ecosystem - Ecosystem productivity - Material cycle in ecosystem - Carbon cycle, Oxygen cycle - Biological control of chemical factors in the environment.

Unit II Soil Physics and Bioremediation 9 h

Properties of water in relation to porous media - Soil texture - Clay colloidal surface - Geometry of pore space and pore size distribution - Soil strength and its measurements - Soil pollution - Control of soil pollution - Geomicrobial transformations - Principles of Bioremediation - Biodegradation in soil ecosystem.

Unit III Current Environmental Issues 10 h

Physico chemical and biological characteristics of waste water - Calculation of chlorine dosage - Sludge processing and disposal methods - Tannery - Industrial effluent treatment - Global carbon dioxide impact on environment - Radiation hazards - Measurement and effect of radiations - Deforestation.

Unit IV Instrumental Techniques of Analysis 10 h

Atomic absorption spectrophotometry - Inductively coupled plasma emission spectroscopy - Agarrose gel electrophoresis - Radiochemical analysis - Isotope dilution - Application of isotopes in biological and environmental studies - Ion-selective electrodes - Gravimetry - Air quality monitoring techniques.

Unit V Environmental Law and Policy 9 h

Concept and evaluation methodology - Industrial ecology - The water act, 1974 - The environmental protection act,1986 - The forest act, 1968 - The atomic energy act, 1962 - International environmental policy - Land use policy for India.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A1DA	ENVIRONMENTAL PHYSICS	DSE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The various types of Diodes, transistors and their applications.
- Acquire knowledge on operational amplifiers and apply them in various applications.
- Acquire knowledge on semiconductor memories and A/D and D/A convertors.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Relate the natural resources and its biological control of chemical factors in the ecosystem.	K2
CO2	Build the dynamics of physical soil components and their phases of bioremediation.	K3
CO3	Identify the physio-chemical and biological hazards on environment.	K5
CO4	Analyze the environmental hazards through various instrumental techniques.	K4
CO5	Motive to learn the various environmental law and policy of India.	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	L	M
CO2	S	L	S	M	S
CO3	S	L	S	M	S
CO4	S	M	S	S	M
CO5	S	M	S	S	M

S **Strong** **M** **Medium** **L** **Low**

References

1 Jones B K. 1986. Electronics for Experimentation and research, Prentice- Hall.

2 Zbar P B., Malvino A P and Miller M A. 1994, Basic Electronics: A text lab manual, Tata McGraw Hill, New Delhi.

3 A.P. Malvino. 1992. Basic Electronics - A text lab manual - Tata McGraw Hill.

4 S.P. Singh. 2003. Advanced Practical Physics – Vol I & II – Pragati Prakasan Meerut.

202PY2A1CQ	ELECTRONICS - I	SEMESTER I

Total Credits: 2
Total Instructions Hours: 48 h

S.No	List of Experiments
1	Build the Waveform generation of Sine Wave using OP-AMP.
2	Construction of Hartley oscillator using OP-AMP.
3	Construction of an Astable Multivibrator.
4	Construction of Differentiator, Integrator circuit using OP-AMP.
5	Construction of Adder, Subtractor, Sign Changer circuit using OP-AMP.
6	Assemble the Serial and parallel sequential circuits using Shift Register.
7	Determine the shift of output voltage using Clipping and Clamping circuits.
8	Construct the Modulus counter using IC 7490.
9	Determine the Analog to digital Converter using Op-Amp.
10	Build the Triangular waveform generation using Op-Amp.
11	Construct the Phase Shift Oscillator.
12	Make the Square Wave form using OP-AMP.

Note: Any 10 Experiments

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202PY2A1CP	THERMODYNAMICS AND OPTICS	SEMESTER I

Total Credits: 2
Total Instructions Hours: 48h

S.No	List of Experiments
1	Determination of Stefans constant.
2	Determination of specific heat capacity of metal-Forbes Method.
3	Determination of specific heat capacity of Liquid -Ferguson Method.
4	Young's Modulus- Elastic constants of the material -Elliptical fringes.
5	Determination of the wavelength of laser source – transmission grating.
6	Determine unknown resistance using a Kelvin double bridge experiment.
7	Determination of refractive index of liquid-Air wedge.
8	Determination of Audio Frequency-Bridge method.
9	Characteristics of LDR.
10	Determination of Planck 's constant.
11	Thermal conductivity of liquid and air by Lee`s disc method.
12	Determination of wavelength of laser - single slit/Double slit.

Note: Any 10 Experiments

References

1 Dunlap RA. 1988. Experimental Physics: Modern methods, Oxford University Press, New Delhi.

2 Smith E V. 1970. Manual for experiments in Applied Physics, Butterworths.

3 Malacara D. 1988. Methods of Experiments Physics, Series of Volume, Academic Press, Inc.

4 B.L. Worsnop and H.T. Flint - Advanced Practical Physics for students - Methusen& Co (1950)

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Text Books

1. Jain, R.P. 2007. Modern Digital Electronics, Tata McGraw Hill.
2. Coughlin, R.F and Driscol, F.F. 1996. Op-Amp and linear integrated circuits Prentice Hall of India, New Delhi.

References

1. Ramakant A. Gayakwad. 2015. Op-Amps and Linear Integrated Circits, 4th Edition. Pearson Education.
2. Albert Malvino and David J Bates. 2007. Electronic Principles, 7th Edition. McGraw Hill
3. Mehta, V.K. 2001. Principles of Electronics, 6th Revised Edition. S.Chand and Company.
4. David, A. 2007. Electronic Devices and Circuits, 4th Edition, Prentice Hall.

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192PY2A1CD	ELECTRONICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Semiconductor Diodes 9 h

Introduction to Semiconductor - PN Junction diode – Zener diode - Gunn diode- Tunnel diode - Photo diode - Schottky diode – Impatt diode - Characteristics and Applications.

Unit II Transistor Biasing and Optoelectronic Devices 9 h

Thevenin's and Norton's theorems - Transistor action - PNP - NPN transistors – Transistor biasing and stabilization - Need for biasing - Operating point - Two port Network - Hybrid model – JFET – UJT- SCR.

Unit III Operational Amplifier Applications 10 h

Operational Amplifier- CMRR-Slew rate -Instrumentation amplifier – V to I and I to V converter – Op-amp stages- Equivalent circuits - Sample and Hold circuits. Applications of Op-Amp: Inverting, Non- inverting Amplifiers- circuits – Adder-Subtractor- Differentiator- Integrator- Schmitt Trigger – Triangular wave generator – Sine wave generator – Active filters: Low, High and Band pass first and second order Butterworth filters.

Unit IV Semiconductor Memories 10 h

Classification of memories and sequential memory – Static Shift Register, ROM, PROM and EPROM principle and operation Read & Write memory - Static RAM, Content Addressable Memory - Principle, block diagram and operation. Programmable Logic Array (PLA) - Operation. Charge Couple Device (CCD) - Principle, Construction, Working and Data transfer mechanism.

Unit V A/D and D/A Converter 10 h

Sampling theorem-Time division multiplexing – Quantization – DAC- Weighted resistor method – Binary Ladder network – ADC – Successive approximation, Dual slope and Counter method – Voltage to Frequency conversion and Voltage to Time conversion

Course Code	Course Name	Category	L	T	P	Credit
192PY2A1CD	ELECTRONICS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The various types of Diodes, transistors and their applications.
- Acquire knowledge on operational amplifiers and apply them in various applications.
- Acquire knowledge on semiconductor memories and A/D and D/A convertors.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline about various semiconductor diodes.	K2
CO2	Identify and Construct various transistors biasing and Opto Electronic devices	K3
CO3	Interpret the operational amplifier with their applications	K5
CO4	Examine the principle and working of various semiconductor memories.	K4
CO5	Solve analog to digital convertors (ADC) and digital to analog convertors (DAC)	K3

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	L	M	L	M
CO2	S	L	S	M	S
CO3	S	M	S	S	S
CO4	S	M	S	M	S
CO5	S	L	S	M	S

S **Strong** **M** **Medium** **L** **Low**

Text Books

1 Goldstein, H. Poole, C and Safko, J. 2002. Classical Mechanics, 3rd Edition. Pearson Education Asia, New Delhi.

2 Aruldhas, G. 2015. Classical Mechanics, PHI Learning Private Limited, New Delhi.

References

1 Gutpa, S.L. Kumar, V and Sharma, H.V. 2016. Classical Mechanics, Pragati Prakashan, Meerut.

2 Gupta, K.C. 2018. Classical Mechanics of Particles and Rigid Bodies, 3rd Edition. New Age International Publishers, New Delhi.

3 Rana, N.C and Joag, P J. 2015. Classical Mechanics, Tata McGraw Hill, New Delhi.

4 Upadhaya, J.C. 2017. Classical Mechanics, 2nd Edition. Himalaya Publishing House Pvt. Ltd.

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192PY2A1CC	CLASSICAL MECHANICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Lagrangian Formulation 10 h

Lagrangian formulation: System of particles - Constraints and degrees of freedom - Generalized coordinates, force and energy - Conservation laws - Conservations of linear and angular – Momenta - D'Alemberts principle of virtual work- Lagrange's equation of motion - Applications of Lagrange equations of motion: free particle in space - Atwood's machine.

Unit II Hamilton's Equation and Canonical Transformation 10 h

Calculus of variation - Principle of least action - Hamilton's principle -Hamilton`s function - Lagrange's equation from Hamilton's principle - Legendre transformation and Hamilton's equation of motion. Cyclic coordinates and conservation theorem - Canonical transformations-Hamilton's canonical equations - Generating functions - Poisson brackets and its properties.

Unit III Hamilton-Jacobi Theory and Small Oscillations 9 h

Hamilton - Jacobi equation for Hamilton's principle function - Example: Harmonic oscillator problem - Hamilton's characteristic function - Action-angle variable - Application to Kepler problem in action angle variables. Eigen value equation - Vibrations of linear triatomic molecule.

Unit IV Kinematics of Rigid Body 10 h

Independent coordinates of rigid body - Properties of transformation matrix - Euler angle and Euler's theorem - Infinitesimal rotation - Coriolis force - Angular momentum and kinetic energy of motion about a point - Non-inertial frames and pseudo forces - Euler's equations of motion - Torque free motion of a rigid body - Heavy symmetrical top.

Unit V Central Force Problem and Theory of Relativity 9 h

Reduction to the equivalent one body problem - Equation of motion and first integral - Classification of orbits - Kepler problem: Inverse-Square law of force - Transformation of scattering to laboratory coordinates. Orbits of artificial satellites, Virial theorem – Lorentz transformation, Relativistic Mechanics,

Momentum vectors.

Course Code	Course Name	Category	L	T	P	Credit
192PY2A1CC	CLASSICAL MECHANICS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of Lagrangian and Hamiltonian mechanics.
- Apply the fundamental concepts of Classical mechanics to the particle systems and rigid bodies.
- Emphasize the mathematical formulation of mechanics in problems.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Apply Lagrangain equation of motion to oscillator and pendulum.	K3
CO2	Construct the Hamilton equation and canonical transformation.	K3
CO3	Summarize the Hamilton-Jacobi Theory and Small oscillation	K2
CO4	Classify the Euler angle and equation through Kinematics of Rigid Body	K4
CO5	Evaluate the oscillations with simple examples through Central Force Problem and Theory of Relativity.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	M	M
CO2	S	L	S	M	M
CO3	M	L	S	L	M
CO4	S	M	S	M	S
CO5	S	S	M	S	S

S **Strong** **M** **Medium** **L** **Low**

transitions by order and by symmetry – Phase diagrams for pure systems – Clausius-Clapeyron equation – Gibbs phase rule

Text Books

1. Palash B Pal. 2017. An introductory course of statistical mechanics. Narosa Publishing House
2. Reif. 2010. Fundamentals of Statistical and Thermal Physics Paperback, Sarat Book Distributors

References

1. Kittel, C. 2004. Elementary Statistical Physics, John Wiley & Sons.
2. J. P. Agarwal, Satya Prakash.2008. Thermodynamics And Statistical Physics. Pragati Prakashan, Meerut.
3. Gupta and Kumar. 2003. Statistical Mechanics, Pragati Prakashan, Meerut.
4. Laud, B.B. 2012. Fundamentals of Statistical Mechanics Paperback, New Age International Private Limited.

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192PY2A1CB	THERMODYNAMICS AND STATISTICAL MECHANICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Thermodynamics, Microstates and Macrostates 12 h

Basic postulates of thermodynamics – Phase space and ensembles – Fundamental relations and definition of intensive variables – Intensive variables in the entropic formulation – Equations of state – Euler relation, densities - Gibbs-Duhem relation for entropy - Microstates and macrostates – Ideal gas – Microstate and macrostate in quantum systems – Density of states and volume occupied by a quantum state.

Unit II Microcanonical, Canonical and Grand Canonical Ensembles 12 h

Microcanonical distribution function – Two level system in microcanonical ensemble – Gibbs paradox – The canonical distribution function – Partition function and free energy of an ideal gas –The grand partition function – Relation between grand canonical and canonical partition functions.

Unit III Bose-Einstein, Fermi-Dirac and Maxwell- Boltzmann Distributions 12 h

Bose-Einstein and Fermi-Dirac distributions – Thermodynamic quantities – Non-interacting Bose gas and thermodynamic relations – Chemical potential of bosons – Thermodynamic relations for non-interacting Fermi gas – Fermi gas at zero and low temperature – Fermi energy and Fermi momentum - Maxwell-Boltzmann distribution law for microstates in a classical gas - Physical interpretation of the classical limit.

Unit IV Transport and Non-Equilibrium Processes 12 h

Derivation of Boltzmann transport equation for change of states without and with collisions – Boltzmann equation for quantum statistics – Equilibrium distribution in Boltzmann equation – Transport processes; One speed and one dimension – Equipartition and Virial theorems –Brownian motion - Non-equilibrium process; Joule-Thompson process - Free expansion and mixing - Thermal conduction.

Unit V Heat Capacities, Ising Model and Phase Transitions 12 h

Heat capacities of heteronuclear diatomic gas – Heat capacities of homonuclear diatomic gas – One-dimensional Ising model and its solution by variational method – Phase transitions and criterion for phase transitions – Classification of phase

Course Code	Course Name	Category	L	T	P	Credit
192PY2A1CB	THERMODYNAMICS AND STATISTICAL MECHANICS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The concepts of thermodynamics fundamental laws of Physics.
- The various statistical distributions and their applications in Physics.
- The concepts of phase transitions and thermodynamic functions.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Relatethe thermodynamics, microstates through thermodynamics postulates, quantities and relations	K2
CO2	Identify the micro and macroscopic properties of the mater.	K3
CO3	Inspect the classical and quantum distribution laws and their relations.	K2
CO4	Apply the transport properties, different phases of maters, equilibrium and non- equilibrium process.	K3
CO5	Explain and evaluate the heat capacities, ising model through phase transitions.	K4

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	L	M	L	M
CO2	S	L	S	M	M
CO3	S	M	S	M	S
CO4	S	L	S	M	M
CO5	S	M	S	S	S

S **Strong** **M** **Medium** **L** **Low**

Text Books

1	Sathya Prakash. 2016. Mathematical Physics with classical mechanics, Sultan Chand & Sons.
2	B.D. Gupta. 2009. Mathematical Physics , 3rd Edition. Vikas Publishing House

References

1	Rajput, B.S. 2008. Mathematical Physics, 20 th Edition. Pragati Prakashan
2	Dass, H . K and Rama Verma, S. 2010. Mathematical Physics, S.Chand and Company Ltd.
3	Chattopadhyay, P.K. 1990. Mathematical Physics, Wiley Eastern Limited.
4	Greenberg, M D. 2013. Advanced Engineering mathematics, 2nd Edition. Person new international

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192PY2A1CA	MATHEMATICAL PHYSICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Vector Analysis and Matrices 12 h

Vector algebra and vector Calculus - Concept of gradient, divergence and curl – Gauss`s divergence theorem, Green`s theorem and Stoke`s theorem (statement and proof) - Types of Matrices and their properties – Rank of a Matrix – Eigenvalue and Eigenvector – Cayley-Hamilton`s theorem.

Unit II Complex Variable 12 h

Analytical functions - Cauchy-Riemann equations - Line integrals - Cauchy's theorem - Cauchy integral formula - Taylor's and Laurent's expansions - Cauchy`s residue theorem – Poles – Evaluation of residues.

Unit III Special Functions 12 h

Legendre`s differential equations: Legendre polynomials - Generating functions – Recurrence relation; Bessel`s differential equation: Bessel polynomials - Generating functions – Recurrence relation; Hermite differential equation: Hermite polynomials - Generating functions – Recurrence relation; Laguerre differential equations: Laguerre polynomials - Generating functions – Recurrence relation.

Unit IV Differential Equations 12 h

Differential Equations: Linear Ordinary Differential equations - First order and second order equations and their various solutions – Gamma and beta functions. Partial differential equations: Solution of Laplace equation – Solution of wave and heat equations in two dimensions.

Unit V Tensor and Group theory 12 h

Tensors: Contravariant, covariant and mixed tensors – Addition and subtraction of tensors – Symmetry and Antisymmetry tensor-Group theory: Subgroups - Classes - Homomorphism and isomorphism – Reducible and irreducible representations - Character table for simple molecular types (C2v and C3v point group).

Course Code	Course Name	Category	L	T	P	Credit
192PY2A1CA	MATHEMATICAL PHYSICS	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The knowledge in mathematical physics and its applications.
- Develop expertise in mathematical techniques and problem solving skills
- Formulate, interpret and draw inferences from mathematical solutions

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the concept of gradient, divergence, curl and matrices.	K2
CO2	Identify the definite integrals using Complex variables.	K3
CO3	Make use of the Special function and its properties through the expansion of a function in terms of orthogonal polynomials.	K3
CO4	Examine the differential equations for first and second order equations.	K4
CO5	Value the concept of tensors and group theory.	K5

MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	M	M
CO2	S	L	S	L	M
CO3	S	L	S	L	M
CO4	S	M	S	S	S
CO5	S	S	S	S	S

S **Strong** **M** **Medium** **L** **Low**

i) Core, EDC, DSE, Project as mentioned in the scheme

ii) Internship / Industrial/ Institutional training as mentioned in the scheme

Students must undertake industrial / institutional training for a minimum of 15 days and not exceeding 30 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

Based on the performance Grade will be awarded as follows:

Marks Scored	**Grade to be awarded**
75 and above	A
60-74	B
50-59	C
< 50	Re-Appearance

a) Utilization of Library

Marks will be awarded to the student based on the hours spent in the library after the working hours and submission of report by the student.

Hours spent in Library	Marks	Type of Document submitted
2	1	Report/ Assignment/ Class presentation
4	2	
6	3	
8	4	
10	5	
12	6	

- During the Library hour, the student must spend time in reading the articles, books, journals of their subject of interest
- Each student should borrow minimum three books during the semester

b) Class Participation

Active participation in classroom discussion by the student will be evaluated based on Integration of knowledge, Interaction and Participation and demonstration of knowledge.

c) Papers / Reports/ Assignments/ Class Presentation

The student will be evaluated based on his ability to do analysis of application of theory to real world problems or creative extension of class room learning and his/her ability to communicate the given topic effectively and clearly. The following are the distribution of marks for the continuous internal assessment in PG practical courses

4. FOR PROGRAMME COMPLETION

Programme Completion (for students admitted during the A.Y.2019-20 and Onwards)

Student has to complete the following:

- The maximum marks for each theory and practical course (including the project work and Viva-Voce examination in the final Semester) shall be 100 with the following breakup.

(i) **Theory Courses**

Continuous Internal Assessment (CIA) : 25 Marks

End Semester Exams (ESE) : 75 Marks

(Online Exam: 10 Marks &Written Exam: 65 Marks)

(ii) **For Practical Courses**

Continuous Internal Assessment (CIA) : 40 Marks

End Semester Exams (ESE) : 60 Marks

Continuous Assessment OBE Rubrics Score Sheet

Degree: __________ Branch: _____________ Semester: __________

Course Code: _________ Course: _____________________________

Max. Marks: Internal:_____ External: ________ Total: _______

S. No.	REG. NO.	THEORY / PRACTICAL & LIBRARY CLASS PARTICIPATION (15) (Compulsory)				RUBRICS ASSESSMENT (SELECT ANY ONE)									Total Marks out of : 30	Total Marks out of : 16 / 10 / 08 / 04
						PAPERS / REPORTS (15)			ASSIGNMENTS (15)			CLASS PRESENTATION (15)				
		Library	Integration of Knowledge	Interaction & Participation	Demonstration of Knowledge	Organization & Knowledge	Format & Spelling	Reference / Experiments	Demonstration of Knowledge	Format & Spelling	Reference	Content & Coherence	Creativity and Speaking Skills	Duration of Presentation		
		6	3	3	3	5	5	5	5	5	5	5	5	5		
1																

The following are the distribution of marks for Project and Viva voce examinations/Industrial Training and Continuous Internal Assessments and passing minimum marks for the project courses/Industrial Training of PG programmes

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	**Passing Minimum for External alone**		
100	60	30	40	50
200	120	60	80	100

The following are the distribution of marks for the Continuous Internal Assessment in PG Project/ Industrial Training courses.

S. No.	For- PG Project courses/ Industrial Training	Distribution of Marks	
1	Review-I	8	16
2	Review-II	8	16
3	Review-III	8	16
4	OBE- Rubrics	16	32
	TOTAL MARKS	**40**	**80**

The following are the distribution of marks for the External Examination (CE) in PG Project / /Industrial Training courses

S. No.	For- PG Project courses/ Industrial Training Courses	Distribution of Marks	
1	Record Work and Presentation	40	80
2	Viva-Voce	20	40
	TOTAL MARKS	**60**	**120**

- The end semester examinations shall normally be conducted after completing 90 working days for each semester.

The following are the distribution of marks for the External Assessment in PG Theory courses

S. No.	For Theory– PG courses	Distribution of Marks	
1	Comprehensive (Written) Examination	65	50
2	Online MCQ Examination	10	--
	TOTAL MARKS	**75**	**50**

The following are the distribution of marks for External examinations (CE) and Continuous Internal Assessment (CIA) and passing minimum marks for the practical courses of PG programmes.

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for External alone		
100	60	30	40	50
200	120	60	80	100

The following are the distribution of marks for the Continuous Internal Assessment (CIA) in PG practical courses

S. No.	For Theory – PG Practical courses	Distribution of Marks	
1	Tests: Two tests out of which one shall be during the mid semester and the other to be conducted as model test at the end of the semester.)	24	48
2	OBE- Rubrics	16	32
	TOTAL MARKS	**40**	**80**

The following are the distribution of marks for the External Assessment in PG practical courses

S. No.	For Theory – PG Practical courses	Distribution of Marks	
1	Experiment-I	25	50
2	Experiment-II	25	50
3	Record & Viva-Voce	10	20
	TOTAL MARKS	**60**	**120**

2.11 Representation

Qualification	Credit
Participation in State / National level celebrations such as Independence day, Republic day Parade, National Integration camp etc.,	1

3. EXAMINATIONS

The following are the distribution of marks for External and Internal i.e., Comprehensive examination and Continuous Internal Assessment and passing minimum marks for theory papers of PG programmes.

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for External alone		
100	75	38	25	50
50	50	25	----	25

The following are the Distribution of marks for the Continuous Internal Assessment in the theory papers of PG programmes.

S. No.	For Theory- PG courses	Distribution of Marks
1	TESTS I (2 hours)	5
2	TESTS II / End semester Model test (3 hours)	10
3	OBE- Rubrics	10
	TOTAL MARKS	**25**

2.6 CA /ICSI/ CMA

Qualification	Credit
Qualifying foundation/Inter level/Final in CA/ICSI/CMA etc.	1

2.7 Sports and Games

The Student can earn extra credit based on their achievement in sports as given below:

Qualification	Credits
Achievement in University/State /National/ International	1

2.8 Online Courses

Pass in any one of the online courses

Qualification	Credit
SWAYAM/NPTEL/Spoken Tutorial etc.,	1

2.9 Publications / Conference Presentations (Oral/ Poster) /Awards

Qualification	Credit
Research Publications in Journals/oral/poster presentation in Conference	1

2.10 Innovation / Incubation / Patent / Sponsored Projects / Consultancy

Qualification	Credit
Development of model/ Products/ Prototype/ Process/App/Registration of Patents/ Copyrights/ Trademarks/Sponsored Projects/Consultancy	1

2.2 Proficiency in Hindi

Qualification	Credit
A pass in the Hindi examination conducted by Dakshin Bharat Hindi Prachar Sabha	1

Examination passed during the programme period only will be considered for extra credit

2.3 Self-study Course

Qualification	Credit
A pass in the self-study courses offered by the department	1

The candidate should register in the self-study course offered by the department only in the III semester

2.4 Typewriting/Short hand

A Pass in shorthand /typewriting examination conducted by Tamil Nadu Department of Technical Education (TNDTE) and the credit will be awarded.

Qualification	Credit
A pass in the type writing / short hand examination offered by TNDTE	1

2.5 Diploma / Certificate

Courses offered by any recognized University / NCVRT

Qualification	Credit
A pass in any Certificate /Diploma/PG Diploma Course	1

d) Project Work:

It is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. The Project work will be given in lieu of a Core paper.

e) Extra credits

Extra credits will be awarded to a student for achievements in co-curricular activities carried out outside the regular class hours. The guidelines for the award of extra credits are given in section two, these credits are not mandatory for completing the programme.

e) Advanced Learner Course (ALC):

ALC is doing work of a higher standard than usual for students at that stage in their education. Research work carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days.

2. EXTRA CREDITS

- Earning extra credit is mandatory. However, it is not essential for programme completion.
- Extra Credits will be awarded to a student for achievement in co-curricular/ extracurricular activities carried other than the regular class-hours.
- A student is permitted to earn a maximum of 10 extra Credits during the programme duration of PG from I to IV Semester.
- Candidate can claim a maximum of 1 credit under each category listed.

The following are the guidelines for the award of Extra credits:

2.1 Proficiency in Foreign Language

Qualification	Credit
A pass in any foreign language in the examination conducted by an authorized agency	1

Regulation
(2019-2020)

PG Programme

Effective from the academic year 2019-20 and applicable to the students admitted to the Degree of Master of Arts/Commerce/Management/Science.

1. NOMENCLATURE

1.1 Faculty: Refers to a group of programmes concerned with a major division of knowledge. Eg. Faculty of Computer Science consists of Programmes like Computer Science, Information Technology, Computer Technology, Computer Applications etc.

1.2 Programme: Refers to the Master of Arts/Management/Commerce/Science Stream that a student has chosen for study.

1.3 Batch: Refers to the starting and completion year of a programme of study. Eg. Batch of 2015–2017 refers to students belonging to a 2-year Degree programme admitted in 2015 and completing in 2017.

1.4 Course: Refers to a component (a paper) of a programme. A course may be designed to involve lectures / tutorials / laboratory work / seminar / project work/ practical training / report writing / Viva voce, etc or a combination of these, to effectively meet the teaching and learning needs and the credits may be assigned suitably.

a) **Core Courses**

A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

b) **Extra Departmental Course (EDC)**

A course chosen generally from a related discipline/subject, with an intention to seek exposure in the discipline relating to the core domain of the student.

c) **Discipline Specific Elective Course (DSE)**: DSE courses are the courses offered by the respective disciplinary/ interdisciplinary programme.

Semester IV (Elective IV)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	192PY2A4DA	Radiological Safety Aspects
2.	192PY2A4DB	Instrumental Methods of Analysis
3.	192PY2A4DC	Plasma Physics

EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S. No.	Course Code	Course Name
1	192PY2ASSA	IPR, Innovation and Entrepreneurship
2	192PY2ASSB	Nano Science

CERTIFICATE PROGRAMMES

The following are the programme offered to earn extra credits:

S. No.	Programme Code and Name	Course Code	Course Name
1	2PY5A: Certificate Course in Nanomaterials Preparation Techniques	192PY5A1CA	Nanomaterials Preparation Techniques
2	2PY5B: Certificate Course in Nanomaterials Characterization	192PY5B1CA	Nanomaterials Characterization

DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I & IV

Semester I (Elective I)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	192PY2A1DA	Environmental Physics
2.	192PY2A1DB	Crystal Growth and Thin Film Physics
3.	192PY2A1DC	Laser Physics and Non-linear Optics

Semester II (Elective II)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	202PY2A2DA	Energy Physics
2.	202PY2A2DB	Materials Physics and Processing Techniques
3.	202PY2A2DC	Photovoltaic Science

Semester III (Elective III)

List of Elective Courses

S. No.	Course Code	Name of the Course
1.	192PY2A3DA	Introductory Astronomy, Astrophysics & Cosmology
2.	192PY2A3DB	Band Gap Engineering in Semiconductors
3.	192PY2A3DC	Solar cells and Solar Energy Utilization

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
202PY2A4CA	Core – XII	Molecular Physics	4	-	-	3	25	75	100	4
192PY2A4CB	Core – XIII	Nuclear and Elementary Particle Physics	4	-	-	3	25	75	100	4
202PY2A4CC	Core - XIV	Research Methodology	2	-	-	3	25	75	100	2
192PY2A4CP	Core Practical - VII	Microprocessor	-	-	4	4	40	60	100	2
192PY2A4DA	DSE – IV	Radiological Safety Aspects	4	-	-	3	25	75	100	4
192PY2A4DB		Instrumental Methods of Analysis								
192PY2A4DC		Plasma Physics								
192PY2A4CV	Core - XI: Project	Project	-	-	12	4	80	120	200	8
		Total	**12**	-	**16**	-	-	-	**700**	**24**
		Grand Total	-	-	-	-	-	-	**2700**	**92**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
192PY2A3CA	Core - VIII	Electromagnetic Theory	4	1	-	3	25	75	100	4
192PY2A3CB	Core – IX	Quantum Mechanics – II	4	1	-	3	25	75	100	4
192PY2A3CC	Core – X	Microprocessors and Microcontroller	4	-	-	3	25	75	100	4
192PY2A3CP	Core Practical – V	Nanoscience and General Physics	-	-	4	4	40	60	100	2
192PY2A3CQ	Core Practical - VI	Electronics-III	-	-	4	4	40	60	100	2
192PY2A3DA	DSE - III	Introductory Astronomy, Astrophysics & Cosmology	4	-	-	3	25	75	100	4
192PY2A3DB		Band Gap Engineering in Semiconductors								
192PY2A3DC		Solar Cells and Solar Energy Utilization								
192PY2A4CV	Core - XI: Project	Project	4	-	-	-	-	-	-	-
192PY2A3CT	IT	Industrial Training	A to C							
		Total	**20**	**2**	**8**				**600**	**20**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
202PY2A2CA	Core - V	Condensed Matter Physics	4	1	-	3	25	75	100	4
202PY2A2CB	Core - VI	Quantum Mechanics – I	4	1	-	3	25	75	100	4
202PY2A2CC	Core - VII	Spectroscopy	4	-	-	3	25	75	100	4
202PY2A2CP	Core Practical - III	Solid State and Spectroscopy	-	-	4	4	40	60	100	2
202PY2A2CQ	Core Practical - IV	Electronics-II	-	-	4	4	40	60	100	2
192MT2A2IB	EDC - I	Numerical Methods	4	-	-	3	25	75	100	4
202PY2A2DA	DSE - II	Energy Physics	4	-	-	3	25	75	100	4
202PY2A2DB		Materials Physics and Processing Techniques								
202PY2A2DC		Photovoltaic Science								
		Total	**20**	**2**	**8**	**-**	**-**	**-**	**700**	**24**

CURRICULUM

M.Sc. PHYSICS PROGRAMME

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
192PY2A1CA	Core – I	Mathematical Physics	4	1	-	3	25	75	100	4
192PY2A1CB	Core – II	Thermodynamics and Statistical Mechanics	4	1	-	3	25	75	100	4
192PY2A1CC	Core – III	Classical Mechanics	4	-	-	3	25	75	100	4
192PY2A1CD	Core – IV	Electronics	4	-	-	3	25	75	100	4
202PY2A1CP	Core Practical – I	Thermodynamics and Optics	-	-	4	4	40	60	100	2
202PY2A1CQ	Core Practical – II	Electronics - I	-	-	4	4	40	60	100	2
192PY2A1DA	DSE - I	Environmental Physics	4	-	-	3	25	75	100	4
192PY2A1DB		Crystal Growth and Thin Film Physics								
192PY2A1DC		Laser Physics and Non-linear Optics								
		Total	**20**	**2**	**8**	**-**	**-**	**-**	**700**	**24**

Sd/- 18/05/21
BoS Chairman/HoD
Department of Physics
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS - 18-5-21 | AC - 9-8-21 | GB - 17-8-21

Academic Council ★ Dr.N.G.P. Arts and Science College
Dr.V. Rajendran CHAIRMAN

Guidelines for Programmes offering for Semesters:

Part	Subjects	No. of Papers	Credit	Semester No.
III	Core Theory	13	12 x 04 = 48 01 x 02 = 02	I - IV
	Core Practical	07	07 x 02 = 14	I - IV
	Elective	04	04 x 04 = 16	I - IV
	EDC	01	01 x 04 = 04	II
	Project Work	01	01 x 08 = 08	IV
TOTAL CREDITS			**92**	-

PROGRAMME OUTCOMES:

On the successful completion of the program, the following are the expected outcomes.

PO Number	PO Statement
PO1	Apply theoretical knowledge of principles and concepts of Physics to practical problems.
PO2	Develop skills in planning and carrying out advanced physics experiments.
PO3	Solve scientific problems by applying a combination of theory, numerical simulation, and experiments.
PO4	Relate critically to scientific models.
PO5	Examining specific phenomena theoretically and experimentally, to contribute to the generation of new scientific insights or to the innovation of new applications of physics research.

Dr. N.G.P.ARTS AND SCIENCE COLLEGE (Autonomous)

REGULATIONS 2019-20 for Post Graduate Programme

(Outcome Based Education model with Choice Based Credit System)

M.Sc. Degree

(For the students admitted during the academic year 2021-22 and onwards)

Programme: M.Sc. Physics

Eligibility:

A pass in the course of B.Sc Degree Examination with Physics as Major and Mathematics and Chemistry as Ancillary subjects, or an examination accepted as equivalent there to accept by the academic council.

Programme Educational Objectives:

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To produce graduates with advanced knowledge in Physics and requisite skills, in order to use their knowledge in Physics in a wide range of practical applications.
2. To develop creative thinking and the power of imagination to enable graduates work in research in academia and industry for broader applications.
3. To relate the training of Physics graduates to the employment opportunities within the country.
4. To promote societal values through Physics related activities.