REVISED SYLLABI FOR
FIRST DEGREE PROGRAMME IN PHYSICS
UNDER
LEARNING OUTCOME-BASED CURRICULUM (LOC) FOR POSTGRADUATE PROGRAMME
(M.Sc. Degree Program in Physics)

(2020 admission onwards)

DEPARTMENT OF PHYSICS

BISHOP MOORE COLLEGE MAVELIKARA

PROGRAMME LEARNING OBJECTIVES (PLOs)

PLO1	**Professional Skill Development** To develop skills for independent and life-long learning, making use of the latest resources including e-resources To be able to apply the advanced knowledge acquired for the solution of complex problems in professional, social and personal life To acquire communication and presentation skills and become employable in the job market
PLO2	**Core Competency Development** To nurture the enquiring mind with profound and extensive knowledge To develop a multidisciplinary perspective and contribute to the knowledge capital of the world in general and the country in particular
PLO3	**Innovative Curriculum of Global Relevance** To develop in depth understanding and global competency in the subject of study To acquire global competency in the area of research and create new knowledge in the domain
PLO4	**Environmental Sensitivity and Sustainability** To apply the acquired knowledge towards creating a sustainable environment To engage in socially relevant research towards creating a sustainable environment To be shaped into proactive citizens sensitive to environmental and social issues
PLO5	**Ethical Principles and Holistic Development** To become competent and responsible citizens, committed to service and communal harmony, steadfast to the cause of women and the marginalized To nurture the enquiring mind to be liberated by truth, reflected in research devoid of plagiarism and truthful publication of results To create new knowledge as well as affordable methods and systems towards championing the cause of the marginalized

	To evolve as socially responsible individuals committed to service and communal harmony To be moulded into holistically developed individuals with international standards
PLO6	**Accessibility and Academic Excellence** To be able to apply the scientific knowledge, aesthetics of art and commercial acumen acquired from the programme in real-life situations, work environments and in entrepreneurial endeavours To develop a global perspective and engage in collaborative research with institutes of international eminence

PROGRAMME OUTCOMES (POs)

PO1	**Global Competency in Core Discipline** Postgraduate students will be able to attain extensive knowledge and global competency in their core subject area
PO2	**Research Aptitude** Postgraduate students will develop an ability to apply research intelligence leading to investigations and innovations
PO3	**Self-directed and Lifelong Learning** Postgraduate students will be able to apply the imbibed knowledge to develop a passion for self-directed and lifelong learning
PO4	**Professional Ethics** Postgraduate students will be able to learn and practise ethical principles in their learning, investigations and publication of results
PO5	**Discovery of Passion** Postgraduate students will be able to identify their field of passion in the concerned subject and to put forth efforts to make their passion as their profession
PO6	**Sensitivity to Societal Problems**

	Postgraduate students will be able to conceive ways and means to address critical issues faced by humanity at the regional, national and international levels

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1	Understand advanced physical concepts and phenomena
PSO 2	Enhance problem solving skills for integrated problem solving approaches in Physics
PSO 3	Imbibe superior experimental skills for handling sensitive instruments for carrying out advanced experiments in Physics
PSO 4	Develop research oriented learning and analytical capabilities
PSO 5	Acquire capability for higher order thinking leading to motivation for research

COGNITIVE LEVELS (CLs)

CL1	**Remember**
CL2	**Understand**

CL3	**Apply**
CL4	**Analyse**
CL5	**Evaluate**
CL6	**Create**

BISHOP MOORE COLLEGE MAVELIKARA

DEPARTMENT OF PHYSICS

(2020 - Restructured curriculum)

OVERALL COURSE STRUCTURE (M.Sc. Physics)

Sem	Paper Code	Course Title	T/P	Category	Hours/ Week	Maximum Marks		
						IA	IUE	Total
I	PH 211	Classical Mechanics	T	MC	6	25	75	100
I	PH 212	Mathematical Physics	T	MC	6	25	75	100
I	PH 213	Basic Electronics	T	MC	6	25	75	100
I	PH 251	General Physics Practicals	P	MC	3	-	-	-
I	PH 252	Electronics & Computer Science Practicals	P	MC	4	-	-	-
Total for Semester I (S1)			**-**	**-**	**25**	**75**	**225**	**300**
II	PH 221	Modern Optics & Electromagnetic theory	T	MC	6	25	75	100
II	PH 222	Thermodynamics, Statistical Physics & Basic Quantum Mechanics	T	MC	6	25	75	100
II	PH 223	Computer Science & Numerical Techniques	T	MC	6	25	75	100
II	PH 251	General Physics Practicals	P	MC	3	25	75	100
II	PH 252	Electronics & Computer Science Practicals	P	MC	4	25	75	100
Total for Semester II (S2)			**-**	**-**	**25**	**175**	**375**	**500**
Summer Internship Two Months								
III	PH 231	Advanced Quantum Mechanics	T	MC	6	25	75	100

III	PH 232	Atomic and Molecular Spectroscopy	T	MC	6	25	75	100
III	PH 233	M Materials Science-I	T	ME	6	25	75	100
III	PH 261	Advanced Physics Practicals	P	MC	4	-	-	-
III	PH 262	Advanced Electronics Practicals	P	MC	3	-	-	-
Total for Semester III (S3)			**-**	**-**	**25**	**75**	**225**	**300**
IV	PH 241	Condensed Matter Physics	T	MC	6	25	75	100
IV	PH 242	Nuclear & Particle Physics	T	MC	6	25	75	100
IV	PH 243	M Materials Science-II	T	ME	6	25	75	100
IV	PH 261	Advanced Physics Practicals	P	MC	4	25	75	100
IV	PH 262	Advanced Electronics Practicals	P	MC	3	25	75	100
IV	PH 201	Project	-	-	-	25	75	100
IV	PH 202	Viva voce	-	-	-	-	-	100
Total for Semester IV (S4)			**-**	**-**	25	**150**	**550**	**700**
Grand Total						**425**	**1375**	**1800**

L - Lecture ; P – Practical; IA - Internal Assessment ; MC- Main Core, ME- Main Elective - University Exam

COURSE DESCRIPTIONS

Course Code	PH 211
Course Title	**Classical Mechanics**
Credits	02
Hours/week	06
Category	Core Course (CC) -Theory
Semester	I
Regulation	2020

Course Overview

1. Drawbacks of Newtonian approach and necessity of new approaches to solve advanced problems in classical mechanical systems.
2. Introduction to constraints, applying conservation theorems to dynamic systems
3. Lagrangian and Hamiltonian formulations of classical mechanics.
4. Extension of Hamilton to Hamilton Jacobi formulation, Poisson brackets and canonical transformations.
5. Rigid body dynamics and physical quantities in non-inertial frames
6. Eigen value equation for various oscillatory systems
7. General and special theory of relativity
8. Nonlinear dynamics and chaos

Course Objective

1. To introduce and demonstrate Lagrangian formulation through applications.
2. To demonstrate the use of Hamiltonian formulation and Hamilton-Jacobi equations.
3. To illustrate the motion of rigid bodies using Euler angles and Euler's equations.
4. To provide basic and advanced concepts of special and general theory of relativity
5. To analyze the nonlinear dynamical systems and to explain the concepts of classical chaos.

Prerequisites	• Classical Mechanics (or Mechanics) at the Undergraduate • Mathematical Physics (or Mathematics) at the Undergraduate Level

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Lagrangian Mechanics** Mechanics of a particle and system of particles-constraints- D'Alembert's principle and Lagrange's equations-simple applications of Lagrangian formulation-Hamilton's principle techniques of calculus of variations-derivation of Lagrange's equations from Hamilton's principle-conservation theorems and symmetry properties. **Two body central force problem** Reduction to one body problem-equations of motion-equivalent one-dimensional problem differential equation for the orbit in the case of integrable power law potentials- Virial theorem- Kepler's problem-inverse square law of force-scattering in central force field transformation of the scattering problem to laboratory coordinates. **Theory of small oscillations** Equilibrium and potential energy-theory of small oscillations-normal modes- two coupled pendula- longitudinal vibrations of carbon dioxide molecule.	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6
II	**Hamiltonian Mechanics** Generalised momentum and cyclic coordinates-conservation theorems-Hamilton's equations examples in Hamiltonian dynamics (harmonic oscillator, motion of a particle in a central force field, charged particle in an electromagnetic field, compound pendulum)-canonical transformations-generating functions- poisson brackets- Liouoville's theorem. **Hamilton-Jacobi equations** Hamilton-Jacobi equation-harmonic oscillator as an example-separation of variables in Hamilton-Jacobi equation-action angle variables-Kepler's problem. **Rigid body dynamics** Generalised coordinates of rigid body-Euler's angles- infinitesimal rotations as vectors angular momentum and intertia tensor- Euler's equations of motion of a rigid body-force free	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6

	motion of symmetrical top-motion of heavy symmetrical top.			
III	**Special and General Theory of Relativity** Postulates of special theory- four-vectors and tensors- relativistic particle dynamics- Lorentz transformations -relativistic Lagrangian- mass-energy equivalence- covariant Lagrangian, Relativistic Langrangian, Mass energy equivalence. General theory of relativity principle of equivalence applications - ideas of Riemannian geometry-space time curvature geodesics –Einstein's equations of General theory of relativity, Observational evidence to general theory of relativity. **Introduction to non-linear dynamics** Linear and nonlinear systems-integration of second order non-linear differential equations pendulum equation-phase plane analysis of dynamical systems-linear stability analysis-limit cycles. **Elements of classical chaos** Bifurcation- logistic map-strange attractors-Lyapunov exponent and Chaos-ideas of fractals- solitary waves- Kdv equations and solutions	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6

Books for Study:

1. H. Goldstein, C.Pooleabd S. Safko, Classical Mechanics ,3rd Edn, Pearson Education Inc (2008 Print) V.B. Bhatia, Classical Mechanics with introduction to nonlinear oscillations and chaos, Narosa Publishing House (1997)
2. J.C. Upadyaya, Classical Mechanics , Revised Edition, Himalaya Publishing Company (2005)
3. G. Aruldas, Classica lMechanics , Prentice Hall of India Pvt Ltd (2008 Print)
4. K.D.Krori, Fundamentals of Special and General Relativity , PHI Learning Pvt Ltd (2010)
5. S.K. Srivastava, General Relativity and Cosmology , PHI learning Pvt Ltd (2008)
6. P.G Drazin and R.S Johnson, Solitons – an Introduction , Cambridge University Press (1989)

Books for Reference:

1. N.C. Rana and B.S. Joag, Classical Mechanics, Tata McGraw Hill (1991)
2. M. Tabor Chaos and integrability in nonlinear dynamics, John wiley & Sons (1989)
3. R.K. Pathria, The Theory of Relativity, Second Edition, Over Publications (2003)
4. Laxmana ,"Nonlinear Dynamics" Springer Verlag,(2001)

Web Resources

1. Classical Physics Video Prof. V. Balakrishnan IIT Madras http://nptel.iitm.ac.in/video.php?subjectId=122106027
2. Special Topics in Classical Mechanics Video Prof. P.C. Deshmukh IIT Madras

http://nptel.iitm.ac.in/courses/115106068/

3. Physics I - Oscillations & Waves Video Prof. S. Bharadwaj IIT Kharagpur http://nptel.iitm.ac.in/video.php?subjectId=122105023
4. Chaos, Fractals & Dynamic Systems Video Prof. S. Banerjee IIT Kharagpur http://nptel.iitm.ac.in/video.php?subjectId=108105054

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	Review Newtonian mechanics in depth	CL1; CL2; CL3; CL4; CL5
CO2	Apply variational principle, Euler-Lagrange equation of motion and symmetries for analyzing the mechanical systems	CL1; CL2; CL3; CL4; CL5
CO3	Analyze different kind of 1-particle and 2-particle systems within the Lagrangian formalism	CL1; CL2; CL3; CL4; CL5
CO4	Analyze motion of a rigid body (for example symmetrical top) within the Lagrangian formalism	CL1; CL2; CL3; CL4; CL5; CL6
CO5	Determine normal modes of various interacting systems of particles	CL1; CL2; CL3; CL4; CL5; CL6
CO6	Analyze different kinds of mechanical systems within the Hamiltonian formalism	CL1; CL2; CL3; CL4; CL5; CL6
CO7	Review Hamilton-Jacobi formalism as the closest approach from Classical Mechanics to Quantum Mechanics	CL1; CL2; CL3; CL4; CL5; CL6
CO8	Analyze stability of dynamical systems and to explain the concepts of classical chaos.	CL1; CL2; CL3; CL4; CL5; CL6

Course Code	PH 212
Course Title	Mathematical Physics
Credits	
Hours/week	06
Category	Core Course (CC) -Theory
Semester	I
Regulation	2020

Course Overview

1. This course introduces the various aspects of complex analysis and uses of residue theorem in real variable integrals
2. This course aims to introduce basic structure of linear vector space and various abstract operations.
3. This will enable them to bring out important special functions necessary for quantum mechanics and electrodynamics.
4. Will be introduced to the techniques of Fourier transform and its applications to various physical problems and basics of Laplace transform
5. This course will also discuss the various rules of probability, distribution functions that are relevant to statistical and quantum mechanics.

Course Objective

1. This course is aimed to equip the students with the mathematical techniques used for developing strong background in the basic and advanced level problems.
2. To calculate the real variable integrals using residue theorem.
3. To familiarize and use the Linear vector space concepts to quantum mechanics and other relevant branches of physics.
4. To study exclusively the solution method for various special functions.
5. To apply Fourier transform techniques to various physical systems.

6. To apply the rules of probability and also use the distribution functions in the relevant physical process 7. The course describes about curvilinear coordinates, Fourier series and transforms, probability distributions, partial differential equations and different integral transforms, special functions, tensors and group theory	
Prerequisites	• Notion of set theory, mapping between sets and invertibility of maps. • Definition of group. • Differential equations with constant coefficients, partial differentiation.

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Vector Analysis and Matrices** Review of vector analysis-vector calculus operators-orthogonal c u r v i l i n e a r coordinates gradient, divergence, curl, Laplacian in cylindrical and spherical polar coordinates orthogonal and unitary matrices- Hermitian matrices- diagonalization of matrices- normal matrices- Cayley-Hamilton theorem **Complex analysis** Cauchy-Riemann conditions-Cauchy's integral theorem and formula-singularities and mappingcalculus of residues-dispersion relations Fourier series and applications (8 hours) General principles of Fourier series, Complex representation, Parseval's identity, Fourier's Integrals, Fourier transforms and its properties. **Probability** Definitions and simple properties of probability-random variables- Chebychev inequality and moment generating function-discrete and continuous probability distributions-binomial distributions- poisson distributions- Gauss Normal distribution-error analysis and least square fitting-chi-square and student 't' distributions	36	CO1; CO2; CO3	CL1; CL2; CL3; CL4; CL5
II	**Differential equations** Partial differential equations-first order equations-separation of variables-singular points series solutions and Frobenius method- non-homogeneuous partial differential equations Green's functions-Laplace transforms and inverse Laplace transforms-applications to solution of simple differential equations Special functions	36	CO4; CO5; CO6	CL1; CL2; CL3; CL4;

	Bessel functions of the first kind-orthogonality-Neumann functions-Hankel fuctions modified Bessel functions-spherical Bessel functions-Legendre functions-generating function-recurrence relations and orthogonality-associated Legendre functions spherical harmonics-Hermite functions-Lagurerre functions-Chebyshev polynomials hypergeometric functions.			CL5; CL6
III	**Tensor analysis** Notations and conventions in tensor analysis-Einstein's summation convention-covariant and contravariant and mixed tensors-algebraic operations in tensors-symmetric and skew symmetric tensors-tensor calculus- Christoffel symbols-kinematics in Riemann space Riemann-Christoffel tensor. **Group theory** Definitions of a group-elementary properties-sub groups-homomorphism and isomorphism of groups-representation of groups-reducible and irreducible representations-simple applications in crystallography and molecular symmetry- Lie groups- SU(2) groups and their representations	36	CO7;CO8	CL1; CL2; CL3; CL4; CL5; CL6

Books for Study:

1. G.B. Arfken and H.J. Weber, Mathematical methods for Physcisits ,6 th Edition,Elsavier (2005).
2. H.K. Dass and R. Verma, Mathematical Physics , S.Chand & Co Pvt Ltd (1997)
3. A.W. Joshi, Matrices and Tensors in Physics ,3 rd Edition,New Age International Pub (1995) B.D. Gupta, Mathematical Physics , 4th Edition, Vikas Publishing House (2004)
4. A.W. Joshi, Elements of Group Theory for Physicists , Fourth Edition, New Age International Pub (1997).
5. S.C. Bagchi, S.Madan, A, Sitaram,V.B Tewari, A first course in representation theory and linear Lie groups, Universities Press (India) Pvt Ltd (2000).
6. C. Harper, Introduction to Mathematical Physics, Prentice Hall (1986)

Books for Reference:

1. Harry Lass, Vector and Tensor Analysis, McGraw Hill Pub (1950)
2. M.L.Jain,Vector Spaces and Matrices in Physics, Alpha Science International (2001)
3. W.W.Bell, Special Functions for Scientists and Engineers, Dover Publications (2004)
4. W.K.Tung, Group theory in Physics, World Scientific Pub Co (1999)
5. A.K. Ghatak, I.C. Goyalamd S.T. Chua, Mathematical Physics, Macmillan India (1985)

Web Resources

1. Mathematics I Video Prof. Swagato K. Ray,Prof. Shobha Madan,Dr. P. Shunmugaraj http://nptel.iitm.ac.in/video.php?subjectId=122104017
2. Mathematics II Video Prof. Sunita Gakkhar, Prof. H.G. Sharma, Dr. Tanuja Srivastava IIT Roorkee http://nptel.iitm.ac.in/video.php?subjectId=122107036

3. Mathematics III Video Prof. P.N. Agrawal, Dr. Tanuja Srivastava IIT Roorkee http://nptel.iitm.ac.in/video.php?subjectId=122107037

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To apply and analyze the various vector and matrix operations and to perform complex analysis for solving physical problems.	CL1; CL2; CL3; CL4; CL5; CL6
CO2	Should be able to calculate the period of a given a function and utilize the concepts of Fourier series, obtain its Fourier transform.	CL1; CL2; CL3; CL4; CL5; CL6
CO3	To explain and differentiate different probabilistic distributions.	CL1; CL2; CL3; CL4; CL5; CL6
CO4	To apply partial differential equations and special functions for solving mathematical problems	CL1; CL2; CL3; CL4; CL5; CL6
CO5	Understand the Definition and properties of Laplace transform and use them to solve ODEs with given boundary conditions.	CL1; CL2; CL3; CL4; CL5; CL6
CO6	Solve PDE by applying separation of variable method in the cases with rectangular and circular boundaries in 1, 2 and 3 dimensions.	CL1; CL2; CL3; CL4; CL5; CL6
CO7	Understand the concepts, terminology and principles of analysing groups and apply concepts of group theoretical operations	CL1; CL2; CL3; CL4; CL5; CL6
CO8	Learn the terminology, concepts and principles of analysing tensors. Learn tensor algebra. Learn Christoffel symbols and Reimann curvature tensor which are crucial to understand general relativity.	CL1; CL2; CL3; CL4; CL5; CL6

Course Code	PH 213
Course Title	BASIC ELECTRONICS
Credits	
Hours/week	06
Category	Core Course (CC)-Theory
Semester	I
Regulation	2020
Course Overview	

1. This course deals with the types of network theorems used in circuit analysis. Students will learn to obtain the equivalent circuit using Thevenin's theorem and Norton's theorem and apply in electrical circuit analysis.
2. Students will gain knowledge on semiconductor devices like JFET, MOSFET, UJT, SCR and their applications.
3. Students will be introduced to the various applications of logic gates.
4. An introduction to operational amplifiers and the applications of OPAMPs for analog computation, filters and waveform generators will be given.
5. Importance of D/A and A/D conversions using OPAMPs will be discussed.

Course Objective

1. This course is aimed to introduce the students with the basic knowledge of analog and digital circuits.
2. To understand and appreciate the operation and applications of semiconductor devices.
3. To learn the concepts of various amplifier circuits, solid state electronic devices, sequential digital circuits, optoelectronics devices and measurements using electronic instruments.
4. To develop skills to understand and construct circuits using operational amplifiers.

Prerequisites	Basic course on Electronics or Electric circuits

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Selections from electronic circuits** Frequency response of an amplifier circuits-power and voltage gain- impedance matching Bode plots- Miller effects- rise time bandwidth relations- frequency analysis of BJT and FET amplifier stages **Operational amplifier and its applications** Opamp - frequency response, poles and zeroes, transfer functions (derivation not required), expression for phase angle- Active filters-first order and second order Butterworth transfer function-first order and second order active filters- low pass, high pass and band pass filters- comparators-OP Amp as a voltage comparator-zero crossing detectors- Schmitt trigger-voltage regulators- square, triangular and saw tooth wave form generators- Weinberg oscillator- monostable and astable multivibrator circuits using IC 555 timer- Phase Locked Loop circuits (PLL) **Microwave Solid State Electronic Devices** Tunnel diode-varacter diode-IMPATT diode- QWITT diode- TRAPATT diode- Gunn diode	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6
	Arithmetic and Data Processing Digital Circuits Binary adder and subtractor- arithmetic logic unit- binary multiplication and division arithmetic circuits using HDL- multiplexers- demultiplexers- BCD to decimal decoder- seven segment decoder- parity generators and checkers- magnitude	10	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6

II	comparator- programmable logic arrays **Sequential Digital Circuits** Flip flops- edge triggered- SR flip flops- JK flip flop- D- flip flop- JK master-slave flip flop- different types of registers (SISO, SIPO, PISO, PIPO)- universal shift registers applications- counter asynchronous and synchronous electronic counters- decade counters- digital clock.			
III	**Optoelectronics** Optical fibre as a wave guide-mode theory of circular wave guide- -modes in step index fibres- signal distortion in optical fibres- group delay, material dispersion, wave guide dispersion- sources of attenuation- absorption, scattering, bending loss, core and cladding loss- optical sources- LED's- structure, quantum efficiency and power- laser diodes modes and threshold conditions, rate equations, efficiency and resonant frequency photo detector- pin and avalanche photodiodes- principles- optical amplifier- basic applications and types, semiconductor optical amplifiers, erbium doped fibre amplifiers. **Electronic Instrumentation** Electronic measurements and instruments- comparison between analog and digital instruments- performance and dynamic characteristics-ideas of errors and measurement standards- voltmeters-ammeters- CRO- Block diagram, CRT, CRT circuits, vertical deflection system- delay line, multiple trace, horizontal deflection system, oscilloscope probes and transducers, oscilloscope techniques, storage oscilloscope, digital storage oscilloscope- classification of transducers-active and passive transducers-force and displacement transducers- strain gauges- temperature measurements- thermistors- thermocouples-flow measurements.	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6

Books for Study:

1. A. Malvino and D.J.Bates, Electrinics Prinicples ,7th Edition, Tata McGraw Hill (2007)
2. R.A. Gayakwad, Operational Amplifiers and Linear integrated Circuits , Prentice Hall of India (2000)
3. M.S. Tyagi, Introduction to semiconductior materials and devices , Wiley India (2005)
4. B.G. Streetman, S.K. Banerjee, Solid state electronic devices . Pearsoninc (2010)
5. J. Millman, C. Halkias and C.D. Parikh, Integrated Electronics , Tata McGraw Hill (2010)
6. D.P. Leach,A.P. Malvino, and G. Saha , Digital principles and applications ,Tata Mc Graw Hill (2011)
7. G.Keiser, Optical Fibre Communication ,3rd edition, Mc Graw Pub (2000)
8. Lal Kishore , Electronic measurements and Instrumentation , Dorling Kindersley (India) Pvt Ltd (2010)

9. W.D. Cooper, A.O. Helfrik and H. Albert, Electronic Instrumentation and measurement Techniques, PHI (1997)
10. Electronic Devices and Circuits Theory, Robert L. Boylestad, Louis Nashelsky, Pearson 10th edition (2009).

Books for Reference:

1. T.F. Bogart Jr, J.S. Beasley and G. Reid, Electronic devices and circuits, Sixth Edition, Pearson Inc (2004)
2. Thomas. L. Floyd, Digital Fundamentals, 10 th edition, Dorling Kindersley (India) Pvt Ltd (2011)
3. Joachion Piprek, Semiconductor Optoelectronic Devices, Academic Press (2003)

Web Resources

1. Electronics Video Prof. D.C. Dube IIT Delhi,
2. http://nptel.iitm.ac.in/courses/115102014/
3. Digital Integrated Circuits Video Prof. Amitava Dasgupta IIT Madras http://nptel.iitm.ac.in/video.php?subjectId=108106069
4. https://nptel.ac.in/courses/108/105/108105159/
5. https://nptel.ac.in/courses/108/108/108108122/
6. https://nptel.ac.in/courses/108/105/108105132/
7. https://nptel.ac.in/courses/108/108/108108114/

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	Identify and develop ideas about BJT and FET amplifier circuits and analyze their frequency response	CL1; CL2; CL3; CL4
CO2	Understand the principles of operational amplifiers, design and develop various electronic circuits using opamp	CL1; CL2; CL3; CL4; CL5; CL6
CO3	Understand and analyse various digital and sequential circuits	CL1; CL2; CL3
CO4	Develop a knowledge about different microwave solid state devices and electronic instruments	CL1; CL2
CO5	Understand and differentiate various principles of optical communication systems	CL1; CL2; CL3

Course Code	PH 221
Course Title	**Modern Optics and Electromagnetic Theory**
Credits	
Hours/week	06

Category	Core Course (CC)-Theory
Semester	II
Regulation	2020

Course Overview

1. This course covers linear and non-linear optical phenomenon
2. This course aims to bridge the gap between the fundamental principles taught in electromagnetism and its practical application to specific fields such as materials, physics, and chemistry related to energy storage and harvesting.
3. It aims to provide students with an introduction to the principles and behaviors of dynamical electric and magnetic systems, and a theoretical foundation in classical field theory.
4. Students will examine the electrodynamics starting from the nature of electrical force up to the level of in-depth solutions of Maxwell equations.
5. It aims to study the propagation of electromagnetic waves and the different types of waves
6. To study the relativistic electrodynamics, radiation and antenna theory.

Course Objective

1. To discuss the relation between Electrostatic field and Electrostatic Potential.
2. To make use of Ampere's law to calculate the magnetic fields.
3. To use Maxwell equations in analyzing the electromagnetic field due to time varying charge and current distribution.
4. To analyze charged particle dynamics and radiation from localized time varying electromagnetic sources.

5. To generalize the concepts of guided structures like transmission line, means of transporting energy or information, commonly used in power distribution and communication.

Prerequisites	• Notion of set theory, mapping between sets and invertibility of maps. • Definition of group. • Differential equations with constant coefficients, partial differentiation.

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Modern Optics** Multiple beam interference-Fabry-Perot interferometer- theory of multilayer films antireflection films and high reflectance films - Fresnel- Kirchoff integral theorem and formula- Fraunhofer and Fresnel diffraction patterns and theory-applications of Fourier transforms to diffraction- acoustic- optic modulation- basic ideas of Raman-Nath diffraction and Bragg diffraction- holography as wavefront reconstruction-propagation of light in crystals- optical activity and Faraday rotation **Non-linear Optics** Harmonic generation- second harmonic generation- phase matching- third harmonic	36	CO1	CL2; CL3

	generation- optical mixing- para magnetization of light- self focusing- multi quantum photoelectric effect- two photon process and theory- multiphoton processes- three photon processes- second harmonic generation- parametric generation of light..			
II	**Electromagnetic Waves** Electromagnetic wave equations- electromagnetic waves in non-conducting media- plane waves in vacuum-energy and momentum of electromagnetic waves-propagation through linear media- reflection and transmission at normal and oblique incidence-electromagnetic waves in conductors-modified wave equations and plane waves in conducting media reflection and transmission at a conducting interface **Relativistic Electrodynamics** Vector and scalar potential- gauge transformations- Coulomb gauge and Lorentz gauge Magnetism as a relativistic phenomenon- transformation of the field-electric field of a uniformly moving point charge-electrodynamics in tensor notation-electromagnetic field tensor- potential formulation of relativistic electrodynamics **Radiation** Dipole radiation- electric dipole radiation- magnetic dipole radiation- radiation from an arbitrary source- point charges- power radiated by a point charge- radiation reaction	36	CO2; CO3;	CL3; CL4; CL5
III	**Transmission lines** Transmission line parameters and equations-input impedance-standing wave ratio and power- The Smith Chart-applications of transmission lines **Waveguides** Rectangular wave guides-transverse magnetic (TM) modes-Transverse electric (TE) modes- wave propagation in the wave guide-power transmission and attenuation **Antennas** Radiation from Hertzian dipole-half wave dipole antenna-quarter wave monopole antenna- antenna characteristics -antenna arrays-effective area and Friji's equations	36	CO4; CO5	CL3; CL4; CL5; CL6
Books for Study:				

1. G.R. Fowles,, Introduction to Modern Optics , Second Edition, Dover Publications (1989).
2. A. Yariv, Introduction to Optical electronics , Holt, Reinhart and Winston (1976).
3. A. Ghatak and K. Thyagarajan, Optical Electronics , Cambridge University Press (1998)
4. D. Roody and J. Coolen, Electronic Communications , Fourth Edition, Dorling Kindersley (India) Pvt Ltd (2008)
5. D.J. Griffiths , Introduction to Electrodynamics , PHI Learning India Pvt Ltd (2007).
6. M.N.O. Sadiku, Elements of electromagnetics , Oxford University Press (2007).
7. B.B. Laud, Lasers and Non-linear Optics , Second Edition, Wiley-Eastern Limited (1991)

Books for Reference:

1. 1 J.R. Meyer-Arendt, Introduction to Classical and Modern Optics, Prentice Hall Intl (1995)
2. J.C. Palais, Fibre optic communications, Fifth Edition, Pearson Education Inc (2005)
3. E.C. Jordan and K.G. Balmain, Electromagnetic waves and radiating systems, Second Edition, Pearson Education (2002)
4. D.K.Cheng, Field and Wave electromagnetics , Second Edition ,Addison Wesley (1999).
5. L.Ganesan and S.S.Sreejamole,Transmission lines and wave guides, Second Edition, Tata McGraw Hill (2010)

Web Resources

1. https://web.njit.edu/~vitaly/621/notes621_old.pdf
2. NPTEL video lectures available online https://nptel.ac.in/
3. https://himafi.fmipa.unej.ac.id/wp-content/uploads/sites/16/2018/09/Introduction-toElectrodinamic.pdf
4. https://ocw.mit.edu/courses/physics/8-07-electromagnetism-ii-fall-2012/lecture-notes/
5. https://www.freebookcentre.net/physics-books-download/Lecture-Notes-onElectrodynamics.html
6. https://www.worldcat.org/title/introduction-to-electrodynamics/oclc/1004614008

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To demonstrate the linear and nonlinear optical phenomena.	CL2; CL3
CO2	To explain and discuss propagation of electromagnetic waves through different media.	CL3; CL4; CL5
CO3	To restate formulations and relativistic effects in electrodynamics.	CL3; CL4; CL5
CO4	To analyze the propagation of electromagnetic waves through waveguides.	CL3; CL4
CO5	To use radiation theory in developing different antennas.	CL4; CL5; CL6

Course Code	PH 222
Course Title	**Thermodynamics, Statistical Physics and Basic Quantum Mechanics**
Credits	

Hours/week	06
Category	Core Course (CC)-Theory
Semester	II
Regulation	2020

Course Overview

1. This course is aimed to introduce the concepts of thermodynamic equations, foundations of classical and quantum statistics.
2. This course will also provide basic rules for classification of phase transitions and a preliminary attempt to understand non-equilibrium phenomena.
3. An introduction to linear vector space and the associated algebra
4. Use Schroedinger formalism to solve 1 and 3D problems to understand the concepts exclusive to quantum mechanics.

Course Objective

1. To estimate and use the statistical concept of entropy and relate its partial derivative with thermo dynamical parameters.
2. To understand the concept of ensemble, ensemble averages and partition function and apply them to classical ideal gas and system of harmonic oscillators.
3. To study exclusively when and how to use Bose-Einstein (BE) and Fermi-Dirac (FD) statistics.
4. To distinguish between classical and quantum statistics and the need to use them for explaining some exotic phenomena in both BE and FD statistics.
5. To appreciate and use the concept of fluctuation in statistics. Identify those parameters that are used to classify phase transitions.
6. To learn quantum mechanics from the abstract concept of linear vector space, linear operators, and their algebra, unitary transformation and its consequence.
7. Make extensive use of Schroedinger representation to learn about the newer concepts of quantization of energy, and angular momentum and tunneling across barrier.
8. To understand and appreciate the commutative and non-commutative algebra in the special context of angular momentum in general.

Prerequisites	• Basic ideas on the laws of thermodynamics and relations between thermodynamic variables. •

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Thermodynamic Relations and Consequences** Thermo dyanamic functions and Maxwells's equations-Clausius -Claepyrans equations Properties of thermos dyanamic potentials-Gibbs-Helmoltz relation-thermodynamic equilibrium Nernst –heat theorem and its consequences-Gibb's phase rule-chemical potential-vapour	36	CO1; CO2;	CL1; CL2;

	pressure relation and chemical constants **Foundations of Classical Statistical Physics** Phase space-ensembles-Lioville's theorem-statistical equilibrium-microcanonical ensemble partition functions and thermodynamic quantities-Gibb's paradox-Maxwell-Boltzmann distribution laws-grand canonical ensemble ideas of Raman-Nath diffraction and Bragg diffraction-holography as wavefront reconstruction-propagation of light in crystals-optical activity and Faraday rotation .		CO3; CO4; CO5; CO6	CL3; CL4; CL5; CL6
II	**Quantum Statistics** Quantum statistics of classical particles-density matrix in microcaonical, canonical and grand canonical ensembles-Bose Einstein statistics and Bose Einstein distribution law-Maxwell Boltzmann statistics and Maxwell Boltzmann distribution law—Fermi Dirac statistics and Fermi Dirac distribution law-comparison of three types of statistics-applications of quantum statistics-Planck radiation laws-Bose Einstein gas and Bose Einstein condensation—Fermi Dirac gas-electron gas in metals-thermionic emission-statistical theory of white dwarfs **Phase Transitions** Triple point-Vanderwal's equation and phase transitions-first and second order phase transitions- Ehrenfest's equations- Ising model	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6
III	**Foundations of Quantum Mechanics** Basic postulates if quantum mechanics- Hilberts space- observables- Hermitian operators general statistical interpretation-Uncertainty principle-minimum uncertainty wave packet energy time uncertainty principle-Dirac notation-Matrix representation of state vectors and operators-change of representations- eigenvalue problem in matrix mechanics-energy and momentum representations-unitary transformations involving time- Schrodinger, Heisenberg and interaction pictures. **Exactly Solvable Problems in Quantum Mechanics** One dimensional eigen value problems-square well potential-potential barrier-alpha particle emission-Bloch waves in periodic potential-linear harmonic oscillator problem using wave mechanics and operator methods-free particle	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6

	wave functions and solutions-three dimensional eigen value problems-particle moving in spherical symmetric potential-rigid rotator-hydrogen atom problem-three dimensional potential well-Deuteron			

Books for Study:

1. R. K. Pathria, Statistical Mechanics , Pergamon Press (1991)
2. Satya Prakash, Statistical Mechanics , Kedarnath Ram Nath Publishers, Meerut and Delhi (2009)
3. B.K. Agarwal and Hari Prakash, Quantum Mechanics , Prentice Hall of India (2002)
4. S. Devanarayanan, Quanrtum Mechanics , Sci Tech Publications (India) Pvt Ltd (2005)
5. D.J. Griffiths, Introduction to Quantum Mechanics , Second Edition, Pearson Education Inc ((2005)
6. G. Aruldas, Quantum Mechanics , Second Edition, PHI learning Pvt Ltd (2009).
7. J. J Sakurai , Modern Quantum Mechanics, Second edition, Pearson (2010).
8. N. Zettili, Quantum Mechanics concepts and Applications, Second edition, Wiley (2009).

Books for Reference:

1. R.K. Srivastava and J. Asok , Statistical Mechanics, Wiley Easter Ltd (2005)
2. S.K. Sinha, Statistical Mechanics-Theory and Applications, Tata Mc Graw Hill
3. P.M. Mathews and K.Venkitesan, A Text Book of Quantum Mechanics, Tata Mc Graw Hill (2010)
4. A. Ghatak and S. Lokanathan ,Quantum Mechanics Theory and Applications, Kluewer Academic Publishers (2004).
5. V.K. Thankappan, Quantum Mechanics, Second Edition, New Age International Pvt Ltd (2003).

Web Resources

1. Basic Thermodynamics Video Prof. S.K. Som IIT Kharagpur http://nptel.iitm.ac.in/video.php?subjectId=112105123
2. http://web.mit.edu/8.333/www/lectures/superfluidity/SuperfluidiHe.html
3. www.nptel/videos.in/2012/11/quantum-physics.html 12.
4. https://nptel.ac.in/courses/115106066/

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To explain the basic thermodynamic relations, Maxwell's equations and its consequences.	CL1; CL2; CL3; CL4; CL5; CL6
CO2	To equip the students to demonstrate and apply classical and quantum statistics in different physical phenomena.	CL1; CL2; CL3; CL4; CL5; CL6
CO3	To distinguish the different phase transitions using Ising model.	CL1; CL2; CL3; CL4; CL5; CL6
CO4	Outline and apply foundations of quantum mechanics.	CL1; CL2; CL3; CL4; CL5; CL6

CO5		CL1; CL2; CL3; CL4; CL5; CL6

Course Code	PH 223
Course Title	**Computer Science and Numerical Techniques**
Credits	
Hours/week	06
Category	Core Course (CC)-Theory
Semester	II
Regulation	2020

Course Overview

1. This course provides introduction to computer architecture, architecture of microprocessor 8085, the different addressing modes and assembly language programming.
2. Introduction to Python, data types, variables, simple functions, math, and flow control will be covered in this course.
3. It focusses mainly on problem solving skills using computational tools relevant to science and C++ programming and numerical methods.

Course Objective

1. To understand the architecture and instruction set of microprocessor 8085
2. To write assembly language programs using the instruction set for microprocessor 8085
3. Learn the data types, simple functions, math and flow control in Python and gain competence in writing and executing programs in Python.

Prerequisites	• Basic ideas on the laws of thermodynamics and relations between thermodynamic variables. •

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Foundations of Computer Science** Introduction to computers-computer architecture-memory (RAM and ROM, cache) and storage-I/O devices- operating systems-data communications, computer networks and topology **Introduction to Microprocessors** Evolution of microprocessors-microcontrollers and digital signal processors- Intel 8085 8 bit microprocessor- pin description-functional description- 8085 instruction format-addressing modes of 8085- interrupts of 8085- memory	36	CO1; CO2	CL1; CL2; CL6

	interfacing- 8085 machine cycles and Bus timings- assembly language programming of 8085 Introduction to Python Programming Python - Python shell, number, variables, comparisons and logic, Python objects - strings, lists, tuples, loops; control flow, file input and output functions			
II	**Programming with C++** C++- flow control-conditional statements-iterative statements-switch statements-conditional operators as an alternative to IF-nested loops-break statements-ext( ) functions-structured data types-arrays-storage classes-multidimensional arrays-sorting of strings-functions-built in and user defined- accessing function and passing arguments to functions-calling functions with arrays-scope rule for functions and variables-structures in C++-classes abd objects – definition- class declaration-class function definitions-creating objects-use of pointers in the place of arrays-file handling in C++-basic file operations-serial and sequential files-reading and writing on to disks.	36	CO3	CL3; CL4; CL6
III	**Numerical Techniques** Solution of simultaneous linear algebraic equations-Gauss elimination method-Gauss 26 Jordan method-inverse of a matric using Gauss elimination method-Finite differences forward and backward differences-central differences-difference of a polynomial-error propagation in difference table-Interpolation with equal intervals-Gregory Newton forward and backward formula- error in polynomial interpolation-central difference interpolation formula-Gauss's forward and backward formula- Striling's formula Lagrange interpolation formula-numerical differentiation-numerical integration using general quadrature formula-Trapezoidal rile-Simsons 1/3 and 1/8 rules-numerical solutions to ordinary differential equations-Euler and modified Euler methods-Runge Kutta methods-numerical solution to partial differential equations-solutions to Poisson and Laplace equations	36	CO4	CL2; CL3; CL4; CL5; CL6
Books for Study: 1. ITL Education Solutions Ltd, Introduction to Computer Science , Second Edition, Dorling Kindersley (India) Pvt Ltd (2011)				

2. V.N. Vedamurty and N. Iyengar, Numerical Methods ,Vikas Publishing Pvt Ltd (1998)
3. K. Udayakumar, and B.S. Umasankar,The 8085 microprocessor ,Dorling Kindersley (India) Pvt Ltd (2008)
4. Christian Hill, Learning Scientific Programming with Python , Cambridge University Press (2015)
5. V. Carl Hamacher, Z.G.Vranesic and S.G. Zaky, Computer Organization , Fourth Edition, McGraw Hill International Edition (1996)
6. Peter Norton etal., Beginning Python, Wiley Publishing (2005)
7. Abishek Yadav, Microprocessor 8085 8086 ,University Science Press, New Delhi (2008)
8. D.Ravichandran, Programming in C++ ,Tata McGraw Hill (2011)
9. M.T.Somasekhara, Programming in C++, PHI Pvt Publishing (2005).
10. B. Ram, Fundamentals of Microprocessors and Microcontrollers, Dhanpat Rai Publications (2008).
11. S. S. Sastry, Introductory method of Numerical analysis, Fifth Edition, PHI (2012).

Books for Reference:

1. V. Rajaraman, Fundamentals of Computers, Fifth Edition, PHI (2010)
2. R.S.Gaonkar, Microprocessor-Architecture, Programming and Applications with 8085
3. S.S. Sastry, Introductory method of Numerical analysis, Fifth Edition, PHI
4. P. Ghosh, Numerical Methods with computer programs in C++,PHI learning Pvt Ltd
5. Bjorne Stroustrup, The C++ Programming Language ,Fourth Edition, Addison Wesley

Web Resources

1. https:nptel.ac.in/courses/108/103/108103157/
2. https://nptel.ac.in/courses/108/105/108105102/
3. https://onlinecourses.nptel.ac.in/noc22_ee12/preview
4. https:nptel.ac.in/courses/106/106/106106212/
5. Python Tutorial Release 2.6.1 by Guido van Rossum, Fred L. Drake, Jr., editor. This Tutorial can be obtained from website ttp://www.altaway.com/resources/python/tutorial.pdf

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level	PSO Addressed
CO1	Understand and identify different hardware components of a computer and operating systems	CL1; CL2	PSO1
CO2	Understand the internal architecture of microprocessor 8085 and create assembly language programs	CL1; CL2; CL6	PSO1; PSO2; PSO3
CO3	Understand the concepts of the programming languages of Python and C++ , develop programs and apply them to solve problems in Physics	CL3; CL4; CL6	PSO1; PSO2; PSO3; PSO4
CO4	Identify the suitability of different numerical methods and apply them to solve physical problems	CL2; CL3; CL4; CL5; CL6	PSO2; PSO4

Course Code	PH 251
Course Title	General Physics Practicals
Credits	
Hours/week	03
Category	Core Course (CC)-Practical
Semester	I & II
Regulation	2020

Course Overview

Demonstrate and understand various general physics experiments for acquiring fundamental concepts.

The importance of having hands-on experience to measure physical quantities and use practical methods to understand theoretical concepts.

Course Objective

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Prerequisites	Basic knowledge of the usage of scientific apparatus

SYLLABUS

Sl.No	Content	Hours	COs	Cognitive Level
01.	Determination of elastic constants by Cornu's method (elliptical and hyperbolic fringes)	03	CO1; CO2; CO3; CO4; CO5	CL1; CL2; CL3; CL4; CL5; CL6
02.	Analysis of absorption spectra of liquids using spectrometer			
03.	Study of ultrasonic waves in liquids			
04.	Determination of e/k using Ge and Si transistors			
05.	Anderson Bridge –determination of self and mutual inductance			
06.	Michelson Interferometer experiments			
07.	Identification of Fraunhofer lines in solar spectra			
08.	Verification of Richardson's equation using diode valve			
09.	LED experiments (a) wavelength determination (b) I-V characteristics (c) output power variations with applied voltage etc			
10.	Thermal diffusivity of brass			
11.	BH curve-anchor ring			

12.	Study of photoelectric effect and determination of of Planck's constant			
13.	Determination of Stefan's constant			
14.	Experiments using Laser: (a) Laser beam characteristics (b) Diffraction grating (c) Diffraction at different types of slits and apertures (d) refractive index of liquids (e) particle size determination			
15.	Young's modulus of different materials using strain gauge			
16.	Determination of magnetic force in a current carrying conductor			
17.	Optical fibre characteristics – numerical aperture, attenuation and bandwidth of given specimen.			
18.	Variation of dielectric constant with temperature of ferroelectric material.			
19.	Dielectric constant of non-polar liquid.			
20.	Cauchy's constants of liquids and liquid mixtures using hollow prism and spectrometer			
21.	Surface tension of a liquid using Jaeger's method			
22.	Experiments using Phoenix Kit (a) Capacitor charging/discharging experiments (b) Dielectric constant of glass			

References

1. B.L. Worsnop and H.T. Flint - Advanced Practical Physics for students - Methusen & Co (1950)
2. E.V. Smith - Manual of experiments in applied Physics - Butterworth (1970)
3. R.A. Dunlap - Experimental Physics - Modern methods - Oxford University Press (1988)
4. D. Malacara (ed) - Methods of experimental Physics - series of volumes - Academic Press Inc (1988)
5. S.P. Singh –Advanced Practical Physics – Vol I & II – Pragati Prakasan, Meerut (2003) – 13th Edition
6. A.C. Melissinos and J.Napolitano, Experiments in Modern Physics, Academic Press, 2003
7. K.Muraleedhara Varier, A Practical Approach to Nuclear Physics, Narosa Publishing House (2018)

Books for Reference:

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Web Resources

1. https://vlab.amrita.edu/?sub=1&brch=282&sim=1005&cnt=1
2. https://vlab.amrita.edu/?sub=1&brch=282&sim=1512&cnt=1
3. https://vlab.amrita.edu/?sub=3&brch=45&sim=539&cnt=900
4. https://vlab.amrita.edu/?sub=1&brch=282&sim=1507&cnt=1
5. https://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1
6. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAE/exp2/index.html
7. https://he-coep.vlabs.ac.in/Experiment6/index1.html 8. https://

8.	python-iitk.vlabs.ac.in/exp/arithmetic-operations/simulation.html

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To measure and analyze various physical quantities for determining a material's physical property.	CL1, CL3, CL4
CO2	Interpret and analyze the obtained result and sketch the variations wherever required	CL3, CL4
CO3	To calculate error in various general physics experiments and to get an idea about accuracy in calculations	CL4
CO4	To develop experimental skills	CL4, CL5, CL6
CO5	To understand the complex theoretical concepts through experiments	CL1, CL2, CL3, CL4

Note :

1. All the experiments should involve error analysis. Internal evaluation to be done in the respective semesters and grades to be intimated to the controller at the end of each semester itself. Practical observation book to be submitted to the examiners at the time of examination.
2. Total of 10 experiments to be done from 22
3. At least 5 experiments are to be done by a student from Sl.No 1 to 10 and 2 experiments from Sl.No 11 to 22
4. The PHOENIX/EXPEYES Experimental Kit developed at the Inter University Accelerator Centre, New Delhi, may be used for the experiments wherever possible

Course Code	PH 252
Course Title	**Electronics and Computer Science Practicals**
Credits	
Hours/week	03
Category	Core Course (CC)-Practical
Semester	I & II
Regulation	2020

Course Overview

Demonstrate and understand various general physics experiments for acquiring fundamental concepts.

The importance of having hands-on experience to measure physical quantities and use practical methods to understand theoretical concepts.

Course Objective

Design, construct and verify various electronics circuits

Develop programs to solve numerical method problems using C++ programming language.

Prerequisites	Basic knowledge of the usage of scientific apparatus

SYLLABUS

Sl.No	Content	Hours	COs	Cognitive Level
01.	Single stage CE amplifier –Design and study of frequency response	04	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6
02.	Study of RC Phase shift oscillator circuits using Transistors			
03.	Construction and study of astable multivibrator and VCO circuits using Transistors			
04.	Study of OP Amp circuits (a) summing amplifier (b)difference amplifier			
05.	OP Amp as an integrator and differentiator			
06.	Characteristics of JFET and MOSFET			
07.	Characteristics of SCR			
08.	Design and study of negative feedback amplifier circuits			
09.	Study of Clipping and Clamping circuits			
10.	UJT Characteristics and UJT relaxation Oscillator			
11.	Emitter follower and source follower circuits			
12.	Weinberg oscillator using OP Amp			
13.	SR and JK Flip Flops -construction using Logic Gates and study of truth tables			
14.	Study of the frequency response of a tuned amplifier			
15.	Study of power amplifier circuits			
16.	Frequency multiplier using PLL			

17.	Study of Schmitt trigger circuits using transistors			
18.	Construction and study of cascade amplifier circuit using transistors.			
19.	Simple electronics experiments using Phoenix and Python based Kits.			
20.	Least square fitting			
21.	First derivative of tabulated function by difference table			
22.	Numerical integration (Trapezoidal rule and Simpson method)			
23.	Solution of algebraic and transcendental equations using Newton-Ralphson method			
24.	Solution of algebraic equations using bisection method			
25.	Numerical interpolation using Newton and Lagrangian methods			
26.	Monte Carlo simulation			
27.	Evaluation of Bessel and Legendre functions			
28.	Matrix addition, multiplication, trace, transpose and inverse.			
29.	Fourier series analysis			
30.	Study of motion of projectile in a central force field			
31.	Study of Planetary motion and Kepler's laws			

References

1. B.L. Worsnop and H.T. Flint - Advanced Practical Physics for students - Methusen & Co (1950)
2. E.V. Smith - Manual of experiments in applied Physics - Butterworth (1970)
3. R.A. Dunlap - Experimental Physics - Modern methods - Oxford University Press (1988)
4. D. Malacara (ed) - Methods of experimental Physics - series of volumes - Academic Press Inc (1988)
5. S.P. Singh –Advanced Practical Physics – Vol I & II – Pragati Prakasan, Meerut (2003) – 13th Edition
6. A.C. Melissinos and J.Napolitano, Experiments in Modern Physics, Academic Press, 2003
7. K.Muraleedhara Varier, A Practical Approach to Nuclear Physics, Narosa Publishing House (2018)

Books for Reference:

Web Resources

1. Basic Electronics and Lab Video Prof. T.S. Natarajan IIT Madras http://nptel.iitm.ac.in/video.php?subjectId=122106025
2. https://vlab.amrita.edu/?sub=1&brch=282&sim=1005&cnt=1
3. https://vlab.amrita.edu/?sub=1&brch=282&sim=1512&cnt=1
4. https://vlab.amrita.edu/?sub=3&brch=45&sim=539&cnt=900
5. https://vlab.amrita.edu/?sub=1&brch=282&sim=1507&cnt=1
6. https://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1
7. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAE/exp2/index.html
8. https://he-coep.vlabs.ac.in/Experiment6/index1.html 8. https://

9.	python-iitk.vlabs.ac.in/exp/arithmetic-operations/simulation.html

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	Design and construct various electronic circuits and its validation.	CL1; CL2; CL3; CL6
CO2	Analyse the errors in various electronics experiments.	CL4; CL5
CO3	Develop and execute programs using C++	CL2; CL3; CL5; CL6

Note :

1. All the experiments should involve error analysis. Internal evaluation to be done in the respective semesters and grades to be intimated to the controller at the end of each semester itself. Practical observation book to be submitted to the examiners at the time of examination.
2. Total of 10 experiments to be done from 22
3. At least 5 experiments are to be done by a student from Sl.No 1 to 10 , 3 experiments from Sl.No 11 to 19 and 8 experiments from Sl.No 20 to 31
4. The PHOENIX/EXPEYES Experimental Kit developed at the Inter University Accelerator Centre, New Delhi, may be used for the experiments wherever possible

Course Code	PH 231

Course Title	**Advanced Quantum Mechanics**
Credits	
Hours/week	06
Category	Core Course (CC)-Theory
Semester	III
Regulation	2020

Course Overview

1. This course describes a thorough conceptual understanding of different approximation methods to perturbed systems.
2. To give an outline of the study of perturbed system from microscopic point of view.
3. Quantum mechanical description of scattering and their applications
4. An extension of quantum mechanics to a system of particles and theories of approximation methods to many body problems.
5. An introduction to the conservation laws and their associated symmetries
6. Extensive use of abstract operator algebra to learn about angular momentum and its importance.

Course Objective

1. To solve time independent perturbed systems using various methods and give an account of splitting of atomic spectral lines an estimate of ground state energy of simple systems
2. To calculate the transition probabilities and set selection rules for spectral transition for different types of time dependent perturbation.
3. To solve time independent perturbed systems using various methods and give an account of splitting of atomic spectral lines an estimate of ground state energy of simple system.
4. To provide a formulation for scattering phenomena and correlate it with experimental results
5. To construct the wave function for a collection of identical particles. Also appreciate the conservation laws associated with different symmetries.
6. To introduce approximation methods for solving many body problem.
7. To understand and appreciate the commutative and non-commutative algebra in the special context of angular momentum in general.
8. To construct and solve Dirac equation for a free particle and particle in a central potential.

Prerequisites	• A thorough understanding of mechanics. • Knowledge of partial differential equation and variable separable method

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
	Variation Method The variational principle-Rayleigh Ritz method-variation method for excited states-ground state of Helium and Deutron. **WKB Approximation** WKB method-connection formulas-barrier potential-			

I	penetration-alpha particle emission-bound states in a potential well **Time dependent and time-independent perturbation theory** Time independent perturbation- basic concepts- non-degenerate energy levels- anharmonic oscillator ground state of helium- effect of electric field on the ground state of hydrogen- degenerate energy levels- effect of electric field on the n=2 state of hydrogen- spin-orbit interaction. Time dependent perturbation- first order, harmonic, transition to continuous states, absorption and emission of radiation- Einstein's coefficients- selection rules.	36	CO1;	CL1; CL2; CL3; CL4; CL5; CL6
II	**Symmetry and Conservation Laws** Symmetry transformations-space translation and conservation of angular momentum-time translation and conservation of energy-rotation in space and conservation of angular momentum-space inversion-time reversal **Quantum Theory of Scattering** Scattering cross section and scattering amplitude-partial wave analysis and scattering by a central potential-scattering by attractive square well potential-scatteriing length-expression for phase shifts-Born approximation-scattering by Coulomb potential-Laboratory and centre of mass coordinate transformations. **System of identical particles** Identical particles- Pauli's exclusion principle-inclusion of spin-spin function for a two electron system-Helium atom-central field approximation-Thomas Fermi model of an atom-Hartree and Hartree-Fock equations.	36	CO2;	CL1; CL2; CL3; CL4; CL5; CL6
III	**Angular Momentum** Angular momentum in operators and commutation relations-eigen values and eigen functions of L 2 and Lz –general angular momentum-eigen values of J2 and Jz-angular momentum matrices- 28 spin angular momentum –spin vectors for a spin ½ system-addition of angular momentum Clebsch-Gordan coefficients. **Relativistic Quantum Mechanics** Klein-Gordon equations and its relevance-particle in a Coulomb's field-Dirac's relativistic theory-Dirac's equation for a free particle-Dirac matrices-covariant form of Dirac's equations probability density-plane wave solutions-negative energy starts-spin in Dirac's theory-magnetic moment of an electron-relativistic corrections of Hydrogen atom spectrum-spin orbit correction Lamb shift	36	CO3; CO4;	CL1; CL2; CL3; CL4; CL5; CL6
Book for Study				

1. G.Aruldas, Quantum Mechanics ,Second Edition, PHI learning Pvt Ltd (2009)
2. D.J.Griffiths, Indroducion to Quanum Mechanics , Second Edition, Pearson Education Inc (2005)
3. J.J.Sakurai, Advamced Quantum Mechanics, Pearson Education Inc (2009)

Books for Reference:

1. P.M.Mathews and K.Venkitesan, A Text Book of Quantum Mechanics, Tata McGraw Hill (2010)
2. A.Ghatak and S.Lokanathan ,Quantum Mechancis Theory and Applications, Kluwer Academic Publishers (2004)
3. V.K.Thankappan,Quantum Mechancics, Second Edition, New Age International Pvt Ltd (2003)
4. S.Devanarayanan,QuanrtumMechanics, Sci Tech Publications (India) Pvt Ltd (2005)
5. L.H.Ryder,Quantum Field Theory Second Edition, Cambridge University Presss (1996)
6. Steven Weinberg, Quantum Theory of Fields (in Three Volumes), Cambridge University Presss (2002)
7. Quantum Mechanics (Schaum's Outline) :YoavPelegetal. Tata McGraw Hill Private Limited, 2/e.
8. Quantum Mechanics: 500 Problems with Solutions: G Aruldhas, Prentice Hall of India.

Web Resources

1. https://archive.nptel.ac.in/courses/115/101/115101107/
2. https://www.digimat.in/nptel/courses/video/115102023/L01.html
3. https://www.digimat.in/nptel/courses/video/115106066/L39.html
4. https://www.digimat.in/nptel/courses/video/115106065/L25.html
5. https://www.digimat.in/nptel/courses/video/115108074/L01.html
6. https://www.digimat.in/nptel/courses/video/104101124/L01.html
7. www.nptel/videos.in/2012/11/quantum-physics.html
8. https://nptel.ac.in/courses/115106066/

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	Choose appropriate approximation methods to evaluate the energy corrections in perturbed systems.	CL1; CL2; CL3; CL4; CL5; CL6
CO2	Devise theoretical methods to explain scattering phenomena and compare with experimental results.	CL1; CL2; CL3; CL4; CL5; CL6
CO3	Employ the concept of commutative and non-commutative algebra in explaining orbital and spin angular momentum.	CL1; CL2; CL3; CL4; CL5; CL6
CO4	Infer the requirements of relativistic quantum mechanics.	CL1; CL2; CL3; CL4; CL5; CL6

Course Code	PH 232
Course Title	**Atomic and Molecular Spectroscopy**
Credits	
Hours/week	06
Category	Core Course (CC)-Theory
Semester	III
Regulation	2020

Course Overview

1. This course focuses on the fundamentals of rotational, infrared, Raman, electronic and NMR spectroscopic analysis.
2. This course helps the students to understand the working principles of spectroscopic instruments like FTIR, NMR, Mossbauer and other spectrometers.
3. In this course students learn to analyze the spectroscopic fingerprints and interpret them for chemical analysis.
4. Resonance spectroscopic techniques (ESR and NMR) will be discussed in detail.
5. This course demonstrates applications like atomic, nuclear and molecular structural analysis of various materials

Course Objective

1. To understand the vibrational and rotational spectroscopic principles.
2. To know the fundamentals of FTIR, NMR techniques.
3. To use spectroscopic instruments like FTIR for analyzing the samples.
4. To understand the theory of electronic spectroscopy and ESR instrumentation.
5. To explain the theory of Mossbauer spectroscopy, instrumentation and interpretation

Prerequisites	● Basic knowledge in electromagnetic radiations

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Atomic Spectroscopy** Spectra of Atoms - Spectroscopic terms– selection rules– exchange symmetry of wave functions- Pauli's exclusion principle. Many electron atoms- Building principle- the spectra of Li and hydrogen like elements, The L-S and j-j coupling schemes- total angular momentum – term symbols- The spectra of Helium-Zeeman effect – The magnetic moment of atom, Lande's g factor- The normal Zeeman effect- Emitted frequencies in anomalous Zeeman transitions- Nuclear spin and Hyperfine structure, Stark Effect, Paschen Bach effect	36	CO2	CL1; CL4;

	Molecular Symmetry Symmetry operations-symmetry elements-algebra of symmetry operations-multiplication tables matrix representation of symmetry operators-molecular point groups-reducible and irreducible representations-great orthogonality theorem-character tables for C 2V and C3V point groups, symmetry species of point groups-IR and Raman activity **Photoelectron and Photo-acoustic Spectroscopy** Photoelectron spectroscopy-experimental methods-photoelectron spectra and their interpretation-Auger electron and X ray Fluorescence spectroscopy-Photo-acoustic effect basic theory-experimental arrangement-applications.			
II	**Molecular Rotational Spectroscopy** Classification of molecules-rotational spectra of diatomic molecules-isotope effect and intensity of rotational lines-non rigid rotator-linear polyatomic molecules-symmetric and asymmetric top molecules-microwave spectrometer-analysis of rotational spectra. **IR Spectroscopy** Vibrational spectra of diatomic molecules-characteristic IR spectra-vibrations of polyatomic molecules- anharmonicity- Fermi resonance-hydrogen bonding-normal modes of vibration in a crystal- interpretation of vibrational spectra- IR spectrometer- Fourier transform IR spectroscopy **Electronic Spectra of Molecules** Vibrational coarse structure and analysis of bound systems- Deslanders table-Frank-Condon principle-vibrational electronic spectra-rotational fine structure- Fortrat parabola-electronic angular momentum in diatomic molecules	36	CO1;	CL1; CL2; CL4;
III	**Raman Spectroscopy** Theory of Raman scattering-rotational and vibrational Raman spectra-Raman spectrometer-structure determination using Raman and IR spectroscopy-nonlinear Raman effects-Hyper Raman effect stimulated Raman scattering-coherent anti-stokes Raman scattering **ESR and NMR Spectroscopy** Principle of NMR-ESR spectrometer-Hyperfine	36	CO1; CO3; CO6	CL1; CL2; CL3; CL4;

	structure-ESR spectra of Free radicals Magnetic properties of nuclei-resonance condition-NMR instrumentation-chemical shift-NMR spectra of solids-NMR imaging-interpretation of NMR spectra Mossbauer spectroscopy (8 hours) Recoilless emission and absorption-Mossbauer spectrometer-experimental techniques isomer shift- quadrupole interaction-magnetic hyperfine interaction			

Book for Study

1. J.M. Hollas, Modern Spectroscopy , Fourth Edition, John Wiley &Sons (2004)
2. G. Aruldas, Molecular Structure and Spectroscopy , PHI learning Pvt Ltd (2007)
3. Suresh Chandra, Molecular Spectroscopy , Narosa Publishing Co (2009)
4. H E White, Introduction to Atomic Spectroscopy McGraw-Hill Inc. 1st Edition. (1934).

Books for Reference:

1. C.N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, Fourth edition, Tata McGraw Hill (1995).
2. D.N. Satyanarayana, Vibrational spectroscopy-Theory and applications, New Age International Pvt Ltd (2004)
3. J.L.McHale, Molecular Spectroscopy, Pearson education Inc (2008).

Web Resources

1. JLExp13.pdf (mit.edu)
2. https://nptel.ac.in/courses/115101003
3. B-2 Mossbauer Spectroscopy - Physics 191r (harvard.edu)

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level	PSOs addressed
CO1	Understand and explain the fundamental concepts and applications of microwave, IR, Raman and other spectroscopic methods.	CL1,CL2,CL4	PSO1,PSO3
CO2	Understand the importance and principles of molecular symmetry. Attain basic ideas d atomic spectroscopy.	CL1,CL4	PSO1
CO3	Analyze the NMR and FTIR spectra of various samples and identify their chemical structure.Make use of electronic spectroscopy for chemical analysis.	CL4,CL3	PSO4, PS05
CO4	Choose suitable spectroscopic technique and examine the chemical composition of a material.	CL4,CL5,CL1	PSO4,PSO5

CO5	Apply the knowledge acquired and use spectroscopic instruments to examine new materials.	CL5,CL3	PSO3, PSO5

Course Code	PH 233M
Course Title	**Materials Science** –I
Credits	
Hours/week	06
Category	Elective Course (CC)-Theory
Semester	III
Regulation	2020

Course Overview

To understand and familiarize fundamentals of materials, structure and its imperfections, growth techniques and associated nucleation theories.

Course Objective

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Prerequisites	• Basic knowledge in electromagnetic radiations

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Classification of Materials, Functional Classification of Materials** Size effects on the optical, electrical, magnetic and mechanical properties. Size effects on the optical properties of semiconductor nanostructures, weak excitonic confinement, strong excitonic confinement. Materials for Aerospace, Biomedical, Electronic, Energy technology, Environmental technology, Magnetic, Photonic and Structural Applications- Smart materials. Structural classification of Materials- Crystalline-Single crystals- polycrystalline materials Grains and grain	36	CO1; CO2; CO3; CO4; CO5;	CL1; CL2; CL3; CL4; CL5;

	boundaries. **Crystal Structures of Ionic Materials** Cesium chloride, Fluorite, Perovskite and Corundum type structures-Covalent structures. Imperfections in crystals **Types of Imperfections in Crystals** Point defects-Interstitial defects-Substitutional defects Frenkel and Schottky defects-Line Kronger-Vink notation for defect chemical reaction Dislocations and Diffusion in crystals - Dislocations- Burgers vectors – edge and screw dislocations –slip-significance of dislocations-Schmid's law-Surface defects-Domain boundaries- Importance of defects –Diffusion - Applications of Diffusion-Stability of atoms and ions-Mechanism for diffusion-Activation energy for diffusion- Permeability of polymers Composition profile-Diffusion and materials processing		CO6	CL6
II	**Formation of Crystalline Materials** Ambient phase equilibrium – Super saturation – Equilibrium of finite phases - Equation of Thomson- Gibbs – Types of nucleation – Formation of critical nucleus – Classical theory of nucleation – Homo and heterogeneous formation of 3D nuclei – Rate of nucleation – Growth from vapor phase, solutions and melts – Epitaxial growth – Growth mechanism and classification – Kinetics of growth of epitaxial films – Mechanisms and controls for nanostructures in 0 and 1 dimensions. **Crystallization Principles and Growth Techniques** Classes of crystal system – Crystal symmetry – Solvents and solutions – Solubility diagram – Super solubility – Expression for super saturation – Metastable zone and induction period – Miers TC diagram – Solution growth – Low and high temperatures solution growth – Slow cooling and solvent evaporation methods – Constant temperature bath as a crystallizer. **Gel, Melt and Vapor Growth Techniques** Principle of gel technique – Various types of gel -- Structure and importance of gel – Methods of gel growth and advantages -- Melt technique – Czochralski growth – Floating zone – Bridgeman method – Horizontal gradient freeze – Flux	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6

	growth – Hydrothermal growth – Vapor-phase growth – Physical vapor deposition – Chemical vapor deposition – Stoichiometry.			
III	**Thin Film Physics** Film Preparations : Vacuum evaporation - Evaporation theory - Rate of evaporation - Hertz-Kundsen equation - Free evaporation and effusion - Evaporation mechanisms - Directionality of evaporating molecules - vapour sources - wire and metal foils - Electron bean gun - flash evaporation - sputtering - Glow discharge sputtering - Bias sputtering - Reactive sputtering - Triode sputtering - Magnetron sputtering - Ion beam sputtering – Pulsed laser deposition – Molecular beam epitaxy- Chemical methods – Thermal CVD – Plasma enhanced CVD – Spray Pyrolysis – Sol Gel method – Spin and Dip coating – Electro plating and Electroless plating – Deposition mechanisms. **Nucleation Theories** Condensation process - Theories of Nucleation – Capillarity theory – Atomistic theory – Comparison – stages of film growth – Incorporation of defects during growth - Film thickness measurements - Optical methods – Ellipsometry	36	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6

Book for Study

1. S.V. Gaponenko, Optical properties of semiconducting nanocrystals, Cambridge University Press (1997)
2. A. K. Bandhyopadhyay, Nanomaterials, New Age International Publishers (2007)
3. Solid State Physics, A.J.Dekker, Macmillan, (1967).
4. The Science and Engineering of Materials: Donald R Askeland and Pradeep P Phule 6 Edition- Thomson Brooks/Cole.
5. I.V. Markov, Crystal Growth for Beginners: Fundamentals of Nucleation, Crystal Growth andEpitaxy (2004) 2nd edition.
6. P. Santhanaragavan and P. Ramasamy, Crystal Growth Process and Methods (KRU Publications, Kumbakonam, 2001).
7. A. Goswami, Thin Film Fundamentals (New Age, New Delhi, 2008).
8. Maissel and Glang, Hand Book of Thin Film Technology
9. K.L. Choppra, Thin Film Phenomena
10. Dupy and Kachard, Physics of Non-Metallic Thin Films
11. T. Pradeep: NANO: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw- Hill Educatio

Books for Reference:

1. Materials science and engineering- Vth Edn- V Raghavan(PHI)
2. Material science by S.L.Kakani & Amit Kakani, 2nd edition 2010, reprint 2011

3. Material Science & Engineering, R.K. Rajput (Jain Book Agency)
4. Material Science and Engineering, I. P . Singh, & Subhash Chander (Jain Book Agency)

Web Resources

1. https://archive.nptel.ac.in/courses/112/106/112106293/
2. https://archive.nptel.ac.in/courses/113/104/113104075/
3. https://archive.nptel.ac.in/courses/113/102/113102080/
4. https://nptel.ac.in/courses/113104075

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To identify and distinguish various crystal structures and the associated imperfections.	CL1; CL2; CL3; CL4; CL5; CL6
CO2	To prepare and demonstrate the synthesis of crystalline materials by different growth techniques.	CL1; CL2; CL3; CL4; CL5; CL6
CO3	To demonstrate different methods for growth of thin films.	CL1; CL2; CL3; CL4; CL5; CL6
CO4	To discuss various nucleation theories of film growth and analyze the synthesized thin films	CL1; CL2; CL3; CL4; CL5; CL6
CO5		CL1; CL2; CL3; CL4; CL5; CL6

Course Code	PH 241
Course Title	**Condensed Matter Physics**
Credits	
Hours/week	06
Category	Main Course (CC)-Theory
Semester	IV
Regulation	2020

Course Overview

1. An introduction to the various symmetries in 3-dimension crystalline materials, their classification and experimental method of determining crystal structure will be given.
2. The theoretical models involving lattice contribution to the study of elastic and thermal properties of the materials will be dealt.
3. The dynamics of the collective electrons behavior in explaining the transport and dielectric phenomena will be discussed in detail.
4. A detailed discussion will be on the theoretical principles behind the origin of magnetism and classification and properties of magnetic materials.
5. The microscopic physics behind the novel phenomena of superconductivity and associated properties, and an insight into the high temperature superconductivity will be discussed.
6. To introduce the synthesis and characterization techniques of nanomaterials.

Course Objective

1. To understand the various crystal structures, the microscopic theory behind the diffraction technique.
2. To distinguish materials as metals, semiconductor and insulator using band structure and study their transport phenomena.
3. To provide theoretical and experimental means of determining the Fermi surface an exclusive property of conductors.

	4. To study the theories of different types of magnetism and dielectrics **5.** To learn the theories supporting superconducting phenomenon and its applications.
Prerequisites	• Basic knowledge in electromagnetic radiations

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Crystal physics** Lattice points and space lattice-basis and crystal structure-unit cells and lattice parameters symmetry elements in crystals –space groups-Bravais lattice-density and lattice constant relation-crystal directions, planes and Miller indices-reciprocal lattice-allotropy and polymorphism in crystals-imperfections in crystals. **Lattice vibrations and thermal properties** Dynamics of identical atoms in crystal lattice-dynamics of linear chain-experimental measurement of dispersion relation-anharmonicity and thermal expansion-specific heat of solids-classical model-Einstein's model-Debye model-thermal conductivity of solids-role of electrons and phonons-thermal resistance of solids. **Free electron and band theory** Electrons moving in one dimensional potential well-Fermi-Dirac statistics-effect of temparature on Fermi distribution-electronic specific heat-electrical conductivity of metals- Wiedmann-Franz- Lorentz law-electrical resistivity of metals-Hall effect-energy bands in solids-Kronig- Penny model-construction of Brillouin zones-nearly free electron model conductors, semiconductors and insulators-elementary ideas of Fermi surfaces	36	CO1; CO4	CL1; CL3; CL4; CL5; CL6
II	**Semiconductors** Free carrier concentration in semiconductors-mobility of charge carriers-temperature effects electrical conductivity of semiconductors-Hall effect in semiconductors – semiconductor junction properties. **Dielectric and magnetic properties of materials** Dipole moment-polarisation-local electric field in an atom-dielectric constant and its measurement-polarizability-classical theory-Peizo, Pyro and Ferro electric properties of Crystals-Ferreoelectric domains-classification of magnetic materials-atomic theory of magnetism- Langevin's theory-paramagnetism and quantum theory-Weiss molecular exchange field-ferromagnetic domains-anti ferromagnetism-Ferrites.	36	CO2; CO5	CL1; CL2; CL3; CL4; CL6
	Superconductivity			

III	Experimental attributes to superconductivity-critical temperature, critical current and critical magnetic field of superconductors-effects of magnetic field on superconductors-Type I and II superconductors-intermediate and vortex states-thermal conductivity, specific heat and energy gap in superconductors-microwave and IR properties-coherence length-Theories of superconductivity-London equations-Ginzberg-Landau theory-BCS theory-AC and DC Josephson effects in superconductors- Examples and properties of High Temperature Superconductors. **Introduction to Nano Science and Technology** Introduction to nanomaterials, properties, classification of nanomaterials, quantum confinement effects, Density of states-nano material preparation techniques-sputtering chemical vapor deposition-pulsed laser deposition-sol-gel technique-characterization of nano materials-X-Ray diffraction- Scanning Probe Microscopy-atomic force microscopy-SEM and TEM techniques-carbon nano structures-elements of nano electronics.	36	CO3; CO4; CO5	CL2; CL3; CL4; CL5; CL6

Book for Study

1. N.W. Ashcroft and N.D. Merwin, Solid State Physi,c Csenage Learning India (2001)
2. Charles.C. Kittel, Introduction to Solid State Phy, wsiiclesy Student Edition (2007)
2. M. Ali Omar, Elementary Solid State Phy, sPiecasrson Education Inc (1999)
3. K.K. Chattopahyay, A.N. Banerjee, Introduction to Nano Science and NanoTechnolo,g Pyrentice Hall of India (2009)
4. Gabor L Hornyak, H F Tibbals and Joydeep Dutta, Introduction to Nanoscience and Nanotechnology, CRC press (2009)

Books for Reference:

1. S.O. Pillai, Solid State Physi,c Tshird Edition New Age International Pvt. Ltd (1999).
2. M.A. Wahab, Solid State Physi,c Nsarosa Publishing House (1999).
3. R.J. Singh, Solid State Physics, Dorling Kindersley (India) Pvt Ltd (2012).
4. P. Phillips, Advanced Solid State Physics, Second Edn, Cambridge University Press (2012).

Web Resources

1. Solid State Physics - NPTEL Online Courses, Prof. Amal Kumar, IIT Kharagpur Das, https://nptel.ac.in/courses/115105099
2. A brief course on Superconductivity- NPTL Online Course, Dr. Saurabh Basu, IIT Guwahati, https://nptel.ac.in/courses/115103108
3. Concepts in Magnetism and Superconductivity-NPTL Online Course , Prof. Arghya Taraphder , IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc22_ph31/preview
4. Nanotechnology, Science and Applications, Prof. Prathap Haridoss, IIT Madras, https://onlinecourses.nptel.ac.in/noc19_mm21/preview

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	Discuss the properties of crystals, fundamentals of lattice vibrations and to formulate models to explain solid characteristics.	CL1; CL4; CL5; CL6
CO2	Explain the theoretical concepts of semiconductors, dielectric, magnetic and superconducting materials.	CL1; CL2; CL3
CO3	To describe the synthesis and characterization techniques of nanomaterials.	CL2; CL3
CO4	To apply the concepts in condensed matter physics to meet the challenges in day-to-day situations.	CL3; CL5; CL6
CO5	To find the applications of advanced functional materials in industries.	CL2; CL4; CL6

Course Code	PH 242
Course Title	**Nuclear and Particle Physics**
Credits	
Hours/week	06
Category	Elective Course (CC)-Theory
Semester	IV
Regulation	2020

Course Overview

1. To familiarize the fundamental properties of nucleus, its structure, models, nuclear reactions, nuclear detectors and accelerators.
2. To introduce the concept of elementary particles and their interactions.

Course Objective

1. To acquire knowledge on nuclear size, shape and forces like physical properties.
2. To understand nuclear model and reactors
3. To study nuclear reactions and background concepts
4. To understand radioactive concepts and theories
5. To Explore and study elementary particles and their models

Prerequisites	• Basic knowledge in electromagnetic radiations

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Nuclear forces** Deuteron-neutron –proton scattering and proton-proton scattering at low energies-non central forces- nuclear exchange force-meson theory of nuclear forces **Nuclear models** Detailed studies on liquid drop, shell and collective models of the nuclei. **Nuclear reactions** Conservation laws-energetic nuclear reactions-Q value equation-partial wave analysis of nuclear reaction cross section- compound nuclear hypothesis-resonance reactions-Brit-Wigner one level formula-optical model-theory of stripping reactions.	36	CO1; CO2	CL1; CL2; CL4;
II	**Nuclear fission** Mechanism of nuclear fission-calculation of critical energy based on liquid drop model-fission products and energy release-fission chain reactions-neutron cycle and four factor formula-general features and classification of nuclear fission reactors. **Nuclear fusion** Nuclear fusion in stellar interiors-proton-proton reactions-carbon-nitrogen cycle-thermo nuclear reactions in the laboratory-conditions for the construction of nuclear fusion reactor critical ignition temperature-Lawson criterian-plasma confinement in fusion- principles of pinch, magnetic an inertial confinement.	36	CO1; CO2;	CL1; CL2; CL3; CL4; CL5;
III	**Nuclear detectors and particle accelerators** Gas filled detectors-ionization chamber and proportional counters-GM counter-scintillation detectors-semiconductor detectors- Cerenkov detector-bubble chamber. Particle accelerators electrostatic accelerators-cyclotron accelerators-synchrotrons-linear accelerators-colliding beam accelerators. **Elementary particle physics** Elementary particle interactions-symmetries and conservation laws-quark model of elementary particles-colored quarks and gluons-ideas of charm, beauty and truth-quark dynamics-ideas of grand unified theories of fundamental forces	36	; CO3; CO4;	CL1; CL2; CL3; CL4; CL5;

Book for Study

1. D.C. Tayal, Nuclear Physi,c5sthEdition,Himalaya Publishing Co (2008)

2. J. Verma, R.C.Bhandari, D.R.S.Somayajulu , Fundementals of Nuclear P,h yCsBicSs Publishers and Distributors (2005).
3. K.S. Krane, Introductory Nuclear Phy,s Wicsiley India Pvt. Ltd (1988)

Books for Reference:

1. 1 S.B. Patel, Nuclear Physics-An Introduction, New Age International Pvt. Ltd (1996).
2. B.R. Marhu, Nuclear and Particle Physics- an Introduction, Second Edition, Wiley (2012)
3. S.N. Ghoshal, Nuclear Physics, S. Chand Ltd (1997)
4. M.P. Khanna, Introduction to Particle Physics, PHI (2011)
5. J. Freidberg, Plasma Physics and Fusion Energy, Cambridge University Press (2007)
6. 6. FF.Chen, Introduction to Plasma Physics, Springer, London (2002)

Web Resources

1. Nuclear Physics: Fundamentals and Applications, IIT Kanpur

Prof. H.C. Verma, https://archive.nptel.ac.in/courses/115/104/115104043/

2. Nuclear and Particle Physics Prof. Poulose Poulose, IIT Guwahati,

https://onlinecourses.nptel.ac.in/noc22_ph41/preview

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level	PSOs addressed
CO1	To outline and analyze nuclear properties, structure,models and resctions	CL1,CL2,CL4	PSO1
CO2	To illustrate the mechanisms of nuclear fission and fusion reactions	CL1,CL4,CL5	PSO4
CO3	Discuss various nuclear detectors and particle accelerators.	CL5,CL3,CL2	PSO2, PSO3
CO4	To classify elementary particles and discuss their interactions.	CL4,CL1	PSO5

Course Code	PH 243M	
Course Title	**Materials Science** –II	
Credits		
Hours/week	06	
Category	Elective Course (CC)-Theory	
Semester	III	
Regulation	2020	

Course Overview

This course introduces optical and thermal properties of materials, synthesis of nanostructured materials, its characterization and applications. It also gives elements of nanoelectronics and its applications.

Course Objective

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Prerequisites	• Basic knowledge in electromagnetic radiations	

SYLLABUS

Unit	Content	Hours	COs	Cognitive Level
I	**Optical and Thermal Properties** Electronic materials and properties- Electrical conductivity-Conductivity of metals and alloys superconductivity- conduction in ionic materials-semiconductors-Insulators-dielectrics-polarisation in dielectrics-Photonic materials and properties-Electromagnetic Spectrum-Reflection, refraction, absorption and transmission-Selective absorption and transmission-Emission phenomenon luminescent and phosphorescent materials Optical Properties of Materials- Absorption, Photo conductivity, General consideration of Luminescence, excitation, absorption and emission processes of luminescence, configuration coordinate diagram, energy level diagram. Radiative and nonradiative processes. Different kinds of Luminescence-Electroluminescence, photoluminescence. Color centers, different kinds of color centers in the context of luminescence in alkali halides Electrostriction-piezoelectricity piezoelectricity and ferroelectricity-Thermoelectric power- Seebeck effect, Peltier effect, and Thomson relation, figure of merit, Concept of phonon, Thermal conductivity due to phonons and electrons, conflicting thermoelectric properties.	36	CO1; CO2; CO3	CL1; CL2; CL3; CL4; CL5; CL6
II	**Nanostructured Materials and Properties** Size and dimensionality effects - size effects - potential wells - partial confinement – conduction electrons and dimensionality – quantum well-quantum wires-quantum dots-Fermi gas and density of states - Carbon based nano-materials-Fullerenes-carbon nanotubes- nano shells-graphene biological and smart nanomaterials. Properties of nanomaterials - electrical-optical-mechanical and thermodynamical properties. Synthesis of nanomaterials- CVD-Sol-gel-Combustion hydrothermal- Colloidal growth-nanotube synthesis-Lithographic process-: Lithography, Nanolithography, split gate technology, self-assembly, limitation of lithographic process**.** **Non lithographic techniques:** Plasma arc discharge sputtering, evaporation **Tools of nanomaterials**	36	CO2; CO3; CO4;	CL1; CL2; CL3; CL4; CL5; CL6

	X-ray diffraction-FTIR spectroscopy-Raman Spectroscopy-Band assignments- UV-Vis Spectroscopy-Determination of band gap-Tauc's plot – **For qualitative study only (Non evaluative)** Scanning probe microscopy-STMAFM- NSOM-Electron Microscopies-TEM-HRTEM and SEM.			
III	**Introduction to Nanoelectronics** Properties dependent on density of states - excitons - single-electron tunnelling - applications infrared detectors - quantum dot lasers-. Introduction to Spintronics-History and overview of spin electronics; Classes of magnetic materials; Quantum Mechanics of spin; Spin relaxation mechanisms; spin relaxation in a quantum dots. Magneto resistance, Ordinary Magneto resistance, Giant Magneto resistance, Colossal Magnetoresistance, Micro-electromechanical systems (MEMSs) and Nano-electro-mechanical systems (NEMSs), **Qualitative study only (Non evaluative)** Resonant Tunnelling Diode, Quantum Cascade lasers, Single electron transistor -: Coulomb Blockade, single electron transistor, other SET and FET structures. Molecular Machines, Nano biometrics- Molecular and Nano-electronics-Microbial Fuel Cells-Hydrogen storage-Nano medicine-Biological applications-Photonic nanocrystals and integrated circuits-Quantum computers Introduction to Spintronics- :Spin Galvanic effect; Spin LEDs: Fundamental and applications, Spin photoelectronic devices, Electron spin filtering, Materials for spin electronics, Spin-Valve and spin-tunnelling devices: Read Heads, MRAMS, Field Sensors, Spintronic Biosensors, Spin transistors, Quantum Computing with spins.	36	CO5; CO6; CO7	CL1; CL2; CL3; CL4; CL5; CL6

Book for Study

1. M.S. Ramachandra Rao, Shubra Singh, Nanoscience and Nanotechnolgy,Fundamentals to Frontiers, Wiley 2017,
2. Thermoelectrics: Basic Principles and New Materials Development, by G.S. Nolas, J. Sharp,
3. H.J. Goldsmid, Springer, 2001
4. Introduction to Thermoelectricity, by H. Hulian Goldsmid, Springer, 2010
5. Nano The Essential-T Pradeep; Mc Graw Hill Education
6. The Science and Engineering of Materials: Donald R Askeland and Pradeep P Phule 6
7. Edition- Thomson Brooks/Cole.
8. Guozhong Cao Nano Structures and Nano materials , Synthesis Properties and Applications.
9. Principles of Electronic Materials and Devices , S.O.Kasap .Tata Mc Graw Hill
10. Crystallography and crystal defects, A. Kelley, G.W. Groves & P. Kidd, Wiley

11. Crystallography applied to Solid State Physics, A.R. Verma, O.N. Srivastava, NAI
12. Solid State Physics, A.J.Dekker, Macmillan, (1967).

Books for Reference:

1. Solid State Physics, S.L. Gupta and V.Kumar, Pragati Prakashan.
2. Introduction to Theory of Solids, H.M. Rosenberg, Prentice Hall.
3. Solid State Physics,J.S. Blakemore, W.B.Saunders & Co. Philadelphia.
4. Solid State Physics, N.W. Ashcroft & N.D. Mermin, Brooks/ Cole (1976).
5. Crystal Defects and Crystal Interfaces, W. Bollmann, Springer Verlag.
6. Elementary solid State physics M.Ali Omar-Pearson
7. Solid State Physics R.J.singh-Pearson
8. Introduction to Nanotechnology, Charles P. Poole, Jr. and Frank J.Owens, Wiley, (2003) 92
9. Nanotechnology An Introduction to Synthesis properties and Applications of
10. Nanomaterials: Thomas Varghese and K.M.Balakrishna-Atlantic Publishers.
11. MEMS/NEMS: micro electro mechanical systems/nano electro mechanical systems
12. Volume1, Design Methods, Cornelius T.Leondes, Springer, (2006).
13. 21. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard
14. Raguse "Nanotechnology", Overseas Press New Delhi (2005).
15. 22 W. R. Fahrner (Ed.) "Nanotechnology and Nanoelectronics", Springer 2006.

Web Resources

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	Identify and distinguish various crystal structures and the associated imperfections. Demonstrate the synthesis of crystalline materials by different growth techniques.	CL1; CL2; CL3; CL4; CL5
CO2	Understand the different perspectives of the carrier absorption and its transport properties. Familiarize different methods for growth of thin films.	CL1; CL2; CL3; CL4; CL5; CL6
CO3	To familiarize with the theoretical tools like density of states etc. Familiarize with the modern ideas like, quantum well and the associated properties.	CL1; CL2; CL3; CL4; CL5
CO4	Understand various nucleation theories of film growth and analyze the synthesized thin films	CL1; CL2; CL3; CL4; CL5; CL6

CO5	Understanding of magnetism in condensed matter.Understand the fundamental science and quantum mechanics behind nanoelectronics.	CL1; CL2; CL3; CL4; CL5
CO6	Familiarize the spin-dependant electron transport in magnetic devices. Learn the terminology, concepts and principles of Magnetoresistance.	CL1; CL2; CL3; CL4; CL5
CO7	Differentiate between microelectronics and nanoelectronics. Understand the impact of nanoelectronics onto information technology, communication and computer science.	CL1; CL2; CL3; CL4; CL5; CL6

Course Outcome	Program Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Evaluation	Program Outcomes								Total
	CO1	CO2	CO3	CO4	CO5	CO6	CO7		
Internal									25
External									75
Total									100

Mapping course outcomes with Internal Assessment

Components	CO1	CO2	CO3	CO4	CO5	Total
Assignment						5
Seminar						5
Test						5
Attendance						5

Total	5	5	5	5	5	25

Mapping course outcomes with External Assessment

Components	CO1	CO2	CO3	CO4	CO5	Total
Short Questions (5 x 3=15 Marks)						15
Essay Questions (3x5 =45 Marks)						05
Problems (5x 3=15 Marks)						15
Total						75

Rubric for Seminar

Components	Excellent (100 %)	Good (80 %)	Average (60 %)	Poor (50 %)	COs
Quality of content	Complete information with suitable examples	Complete information without suitable examples	Ignorant in Partial information with examples	Partial information without examples	All
Quality of Presentation	Perfect	Good	Average	Poor	
Question and Answers	Perfect	Good	Average	Poor	
PPT skill	Perfectly ordered with suitable schemes	Perfectly ordered without schemes	Average structuring with suitable examples	No order	

Rubric for Assignment

Components	**Excellent (100 %)**	**Good (80 %)**	**Average (60 %)**	**Poor (50 %)**	**COs**
Content (40 %)	Complete information with suitable examples	Complete information without suitable examples	Partial information with examples	Partial information without examples	All

Structuring (30 %)	Perfectly ordered with suitable schemes	Perfectly ordered without suitable schemes	Average structuring with suitable examples	No order	
Drafting skill (30 %)	Good language &< 2 % Plagiarism	Good language &< 5 % Plagiarism	< 10 % Plagiarism	> 10 % Plagiarism	

Course Code	PY261
Course Title	**Advanced Physics Practicals**
Credits	
Hours/week	04
Category	Core Course (CC)-Practical
Semester	III & IV
Regulation	2020

Course Overview

1. This course highlights the importance of having hands-on experience to measure physical quantities and use practical methods to understand theoretical concepts.
2. It helps students to acquire experimental abilities, which are essential for physicists.
3. Students will be able to use various components and equipments.
4. Students will also be able to work efficiently and safely in a laboratory, both individually and in groups.

Course Objective

Demonstrate and understand various advanced physics experiments for acquiring fundamental concepts and analyze various experimental data.

Prerequisites	Fundamental Knowledge in Physics, Chemistry and Mathematics

SYLLABUS

Sl.No	Content	Hours	COs	Cognitive Level
01.	e/m of an electron-Thompson's method			
02.	Charge of an electron-Millikan's method			
03.	Determination of Fermi energy of Copper			
04.	Study of variation of resistance of a semiconductor with temperature and determination of band gap			
05.	Magnetic Susceptibility of a liquid using Quincke's method			
06.	Ferromagnetic studies using Guoy's method			
07.	Hall effect in a semiconductor			

08.	Rydberg constant determination using grating, spectrometer and discharge tubes.	02	CO1; CO2; CO3; CO4; CO5	CL1; CL2; CL3; CL4; CL5; CL6
09.	Thermo-emf of bulk samples like Al, Cu. Brass etc.			
10.	Zeeman effect using Fabry-Perot Interferometer.			
11.	Electrical characteristics of a solar cell			
12.	Studies using UV visible spectrophotometer			
13.	Refractive index of liquids and liquid mixtures using Abbe's refractometer			
14.	Optical activity studies using Polarimeters			
15.	Determination of temperature characteristics of a Flame (a) Candle flame using digital photography and image analysis (b) Sodium flame in comparison with incandescent lamp using a spectrometer			
16.	LDR and photodiode characteristics			
17.	Simple experiments using GM counter			
18.	Determination of dielectric constant of materials			
19.	Experimental determination of Avogadro's number using an electrochemical cell			
20.	Study of arc spectra and hydrogen spectra using an imager (CCD) and photoelectric/electronic recorder.			
21.	Analysis of the given band spectrum			
22.	Analysis of given rotation-vibration spectrum			
23.	Interpretation vibration spectra of simple molecules using Raman and IR spectra			
24.	Dissociation energy of diatomic molecules			
25.	Analysis of powder XRD data			
26.	Study of stellar spectral classification from low dispersion stellar spectra			
27.	Study of HR diagram of stars			
28.	Radioactive material counting statistics			
29	Interpretation of UV- visible spectra of materials			
30.	Weather and astronomy related image processing			
31.				

References

1. B.L. Worsnop and H.T. Flint - Advanced Practical Physics for students - Methusen & Co (1950)
2. E.V. Smith - Manual of experiments in applied Physics - Butterworth (1970)
3. R.A. Dunlap - Experimental Physics - Modern methods - Oxford University Press (1988)
4. D. Malacara (ed) - Methods of experimental Physics - series of volumes - Academic Press Inc (1988)
5. S.P. Singh –Advanced Practical Physics – Vol I & II – Pragati Prakasan, Meerut (2003) – 13th Edition
6. A.C. Melissinos and J.Napolitano, Experiments in Modern Physics, Academic Press, 2003
7. K.Muraleedhara Varier, A Practical Approach to Nuclear Physics, Narosa Publishing House (2018)

Books for Reference:

Web Resources

1. https://vlab.amrita.edu/?sub=1&brch=282&sim=1005&cnt=1
2. https://vlab.amrita.edu/?sub=1&brch=282&sim=1512&cnt=1
3. https://vlab.amrita.edu/?sub=3&brch=45&sim=539&cnt=900
4. https://vlab.amrita.edu/?sub=1&brch=282&sim=1507&cnt=1
5. https://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1
6. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAE/exp2/index.html

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To measure and analyze various physical quantities.	CL2, CL3
CO2	To calculate error in various advanced physics experiments.	CL2, CL4
CO3	To develop experimental skills by analyzing the problems	CL2, CL3, CL4
CO4	To analyze and point out results of experimental data.	CL4, CL5, CL6
CO5	To understand the fundamentals of physical concepts by scrutinizing the principles of an experiment	CL1,CL2,CL5

Note :

1. All the experiments should involve error analysis. Internal evaluation to be done in the respective semesters and grades to be intimated to the controller at the end of each semester itself. Practical observation book to be submitted to the examiners at the time of examination.
2. Total of 10 experiments to be done from 30
3. At least 5 experiments are to be done by a student from Sl.No 1 to 10
4. At least 2 experiments from Sl.No 11 to 20
5. At least 5 experiments are to be done by a student from Sl.No 21 to 30

Course Code	PY262E
Course Title	**Advanced Electronics Practicals**
Credits	
Hours/week	03
Category	Core Course (CC)-Practical
Semester	III & IV
Regulation	2020

Course Overview

5. This course highlights the importance of having hands-on experience to measure physical quantities and use practical methods to understand theoretical concepts.
6. It helps students to acquire experimental abilities, which are essential for physicists.
7. Students will be able to use various components and equipments.
8. Students will also be able to work efficiently and safely in a laboratory, both individually and in groups.

Course Objective

Design, construct and study various electronics circuits and programing using microprocessor.

Prerequisites	Fundamental Knowledge in Physics, Chemistry and Mathematics

SYLLABUS

Sl.No	Content	Hours	COs	Cognitive Level
01.	Study of active filters using OP amps (a) low pass (b) high pass (c) band pass for both first order and second order-gain/ roll off determination			
02.	Wave form generation using OP amp circuits: (a) astable and monostable multivibrators (b) square, triangular and saw-tooth wave generation			

03.	IC 555 timer experiments (a) monostable and astable multivibrators (b) VCO	02	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6
04.	D/A convertor circuits using OP Amp 741			
05.	Differential amplifier circuits using transistors			
06.	Design of series pass voltage regulators using (a) transistors with load and line regulation (b) OP Amp			
07.	Study of IF tuned amplifier and Amplitude modulation (generation and detection) using transistor, diode etc.			
08.	Frequency modulator and detector circuits.			
09.	Pulse modulation circuits using 555 timer (a) PAM (b) PWM			
10.	Digital modulation circuits (a) BFSK generation using 555 timer (b) BFSK detector using 555 timer and PLL (c) BPSK generation			
11.	Shift register and ring counter circuits using flip flops			
12.	Miscellaneous transistor applications (a) automatic night light with LDR (b) invertor circuit (transistors as a switch) (c) time delay circuit using SCR			
13.	BCD to decimal decoder and seven segment display using IC			
14.	Design of Electronic counters (up and down counters)			
15.	8085 /8086 program to find out largest from a group of 8bit/16 bit numbers			
16.	Square wave generation using 8255A interface using 8085/8086			
17.	8086 program for block additions			
18.	Interfacing LED display board with 8085/8086			
19.	8086 program to convert binary to ASCII and ASCII to BCD			
20.	8086 program to arrange a given data in ascending and descending order			
21.	8086-simple traffic light controller			
22.	8086 program for binary to BCD conversion and vice versa			
23.	Program of Fibonacci series using 8086			

References

1. Navas, K. A. (2009). Electronics Lab Manual Vol.2, Rajath Publishers, 4th ed
2. Navas, K. A. (2013). Electronics Lab Manual Vol.1, Rajath Publishers, 5th ed.
3. Zbar, Paul B, et al. (1994), Basic Electronics: a text – lab manual, Tata McGraw-Hill Publishing Co.7th ed.
4. Sunil Mathur, Microprocessor 8086-Architecture, Programming and Interfacing Pvt Ltd (2011)

5. B. Ram, Fundamentals of microprocessors and microcontrollers, Dhanpat Rai Publications, New Delhi (2016).

Books for Reference:

Web Resources

7. https://vlab.amrita.edu/?sub=1&brch=282&sim=1005&cnt=1
8. https://vlab.amrita.edu/?sub=1&brch=282&sim=1512&cnt=1
9. https://vlab.amrita.edu/?sub=3&brch=45&sim=539&cnt=900
10. https://vlab.amrita.edu/?sub=1&brch=282&sim=1507&cnt=1
11. https://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1
12. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAE/exp2/index.html

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	Design and construct various electronic circuits and its validation.	CL1; CL2; CL3; CL6
CO2	Analyse the errors in various electronics experiments.	CL4; CL5
CO3	Understand, develop and execute assembly language programs using microprocessors	CL2; CL3; CL6

Note :

1. All the experiments should involve error analysis. Internal evaluation to be done in the respective semesters and grades to be intimated to the controller at the end of each semester itself. Practical observation book to be submitted to the examiners at the time of examination.
2. Total of 12 experiments to be done from 23
3. At least 5 experiments are to be done by a student from Sl.No 1 to 06
4. At least 2 experiments from Sl.No 11 to 14
5. At least 5 experiments are to be done by a student from Sl.No 15 to 23

Course Outcome	Program Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Evaluation	Program Outcomes								Total
	CO1	CO2	CO3	CO4	CO5	CO6	CO7		
Internal									25
External									75
Total									100

Mapping course outcomes with Internal Assessment

Components	CO1	CO2	CO3	CO4	CO5	Total
Punctuality						5
Experiment skill						5
Performance in Lab						5
Maintenance of Observation Records						5
Attendance						5
Total						25

Mapping course outcomes with External Assessment

Components	CO1	CO2	CO3	CO4	CO5	Total
Theory and Formula						15
Viva-voce conducted during the exam						05
Observation and Tabulation						15
Skill in performance						10

Calculation/Graph						10
Error analysis						05
Result with correct unit						05
Total						75

Rubric for Internal Assessment

Components	Excellent (100 %)	Good (80 %)	Average (60 %)	Poor (50 %)	COs
Punctuality and measures	Punctual in coming to the lab and carrying essential things	Less punctual and missing any things	Ignorant in attending practical and missing 50 % things	Not attending and no things	All
Knowledge about the experiment	Exceptional knowledge about experiment	Considerable knowledge about the experiment	Minimal knowledge about the experiment	Not attended	
Handling of apparatus and recording of observation	Accurate handling of apparatus & Accurate, precise and appropriate reporting and recording the results in SI units	Less proper but careful handling of apparatus & Wrong but appropriate reporting and use of SI units	Proper But careless handling of apparatus & Incorrect way of recording observation	Not attended	
Maintenance of record book	Perfect presentation of record in terms of completeness, neatness, well maintenance and sticking to the dead line of submission	Completing and fine maintenance of record. Adhering to the dead line	Incomplete record	Not submitting	

Course Code	PH 201
Course Title	Project
Credits	
Hours/week	02
Category	Core Course (CC)-Theory
Semester	IV
Regulation	2020

Course Overview

1. This course provides an opportunity to students to carry out literature search thoroughly on a specific topic following the principles of scientific research methodology.
2. This course helps the students to write a project proposal relevant to the topic based on the literature review.
3. A systematic and scientific approach to synthesize compounds/complexes and to characterize them using sophisticated analytical techniques can be learnt in this course.
4. Analytical skills required to perform experiments, interpret the data and to present the report with a meaningful summary and conclusion can also be acquired in this course.
5. 5. This course trains the students to harness soft skill for presenting their research findings in front of a panel of subject experts.

Course Objective

1. To review literature on a specified topic using scientific research methodology.
2. To write the project proposal scientifically with the mention of its industrial and commercial relevance also.

3. To carry out the synthesis of compounds/complexes and characterize them using various analytical instruments for its applications.
4. To learn the scientific methodology to collect and interpret the experimental data for the presentation of the report.
5. 5. To handle sponsored research projects of social and environmental importance.

Prerequisites	Fundamental Knowledge in Physics, Chemistry and Mathematics

SYLLABUS

Expt	Content	Hours	COs	Cognitive Level
I	Performing experiments related to industrially and socially relevant projects.	**02**	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6
II		18	CO1; CO2; CO3; CO4; CO5; CO6	CL1; CL2; CL3; CL4; CL5; CL6
Books for Study:				
Books for Reference:				
Web Resources				

Project Report 50 Marks

Standard of the subject and plan Preparation and mastery Originality and logical development Summary, conclusions and references

Viva-voce 25 marks

Use of power point, teaching aids, blackboard etc. Language, Communication and diction Economy of time Answer to questions

Course Outcome (Cos) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO1	To recall and comprehend the concepts of scientific research methodology for literature survey.	CL1; CL2
CO2	To characterize the synthesized compounds/complexes and to interpret the experimental data systematically	CL3
CO3	To design a research-oriented project independently in a particular context.	CL4
CO4	To report and summarize the findings of their project with respect to its social and environmental importance	CL4; CL5

	To acquire the skill to write a dissertation, communication skills in a presentation	
	To demonstrate the utility of various software such as Chem Draw, Origin, MS-Office etc.	
CO5	To invent and adopt novel methodologies to solve interdisciplinary projects scientifically at national and international levels and to develop the skill of communication in presentation.	CL6

Course Outcome	Program Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Evaluation	Program Outcomes								Total
	CO1	CO2	CO3	CO4	CO5	CO6	CO7		
Internal									25
External									75
Total									100

Mapping course outcomes with Internal Assessment

Components	CO1	CO2	CO3	CO4	CO5	Total
Punctuality						5
Experiment skill						5
Performance in Lab						5
Maintenance of Observation Records						5
Attendance						5
Total						25

Mapping course outcomes with External Assessment

Components	CO1	CO2	CO3	CO4	CO5	Total
Viva-voce conducted during the exam						
Skill in performance						
Report						
Total						75

Rubric for Internal Assessment

Components	Excellent (100 %)	Good (80 %)	Average (60 %)	Poor (50 %)	COs
Punctuality and measures	Punctual in coming to the lab and carrying essential things	Less punctual and missing any things	Ignorant in attending practical and missing 50 % things	Not attending and no things	
Knowledge about the work	Exceptional knowledge about experiment	Considerable knowledge about the	Minimal knowledge about the	Not attended	All

		experiment	experiment		
Handling of apparatus and recording of observation	Accurate handling of apparatus & Accurate, precise and appropriate reporting and recording the results in SI units	Less proper but careful handling of apparatus & Wrong but appropriate reporting and use of SI units	Proper But careless handling of apparatus & Incorrect way of recording observation	Not attended	
Maintenance of record book	Perfect presentation of record in terms of completeness, neatness, well maintenance and sticking to the dead line of submission	Completing and fine maintenance of record. Adhering to the dead line	Incomplete record	Not submitting	

Learning Outcome (LOC) BASED Continuous Assessments Cognitive Level (CL) and Course Outcome (CO) Based CIA Question Paper Format (UG)

Section		Q. NO	Cognitive Level (CL)					
			CL1	CL2	CL3	CL4	CL5	CL6
A	(10 x 1 = 10) Answer All	1	+					
		2	+					
		3	+					
		4	+					
		5	+					
		6		+				
		7		+				
		8		+				
		9		+				
		10		+				
		11			+			
		12			+			
		13			+			
		14			+			
		15			+			

B	(8 x 2 = 16) Answer 8 out of 12	16			+			
		17			+			
		18				+		
		19				+		
		20				+		
		21				+		
		22				+		
C	(6 x 4 = 24) Answer 6 out of 9	23					+	
		24					+	
		25					+	
		26					+	
		27					+	
		28					+	
		29					+	
		30					+	
		31					+	
D	(2 x 15 = 30) Answer 2 out of 4	32						+
		33						+
		34						+
		35						+
No. of CL based Questions with Max. marks			5 (5)	5 (5)	4(2)	4(2)	6(4)	2(15)
No. of CO based Questions with Max. marks			CO1	CO2	CO3	CO4	CO5	CO6
			10(10)		8(16)		6(24)	2(30)

Bishop Moore College, Mavelikara
Department of Physics
First Semester M.Sc Degree Examination , June, 2022
First Continuous Assessment Examination
PH 211: CLASSICAL MECHANICS

TIME: 2 hrs Max: 50 marks

SECTION A

Learning Outcome (LOC) BASED End Semester Examination Cognitive Level (CL) and Course Outcome (CO) Based CIA Question Paper Format (UG)

Section		Q. NO	Cognitive Level (CL)					
			CL1	CL2	CL3	CL4	CL5	CL6
A	(5 x 3 = 15) Answer 5 out of 8	1	+					
		2	+					
		3	+					
		4	+					
		5	+					
		6		+				
		7		+				
		8		+				
B	(3 x 15 = 45) Answer 8 out of 12	11(a)			+			
		11(b)			+			
		12(a)			+			
		12(b)			+			
		13(a)			+			
		13(b)			+			
C	(3 x 5 = 15) Answer 3 out of 5	14					+	
		15					+	
		16					+	
		17					+	
		18					+	
No. of CL based Questions with Max. marks								
No. of CO based Questions with Max. marks			CO1	CO2	CO3	CO4	CO5	CO6
			3(5)		15(3)		5(3)	

Bishop Moore College, Mavelikara
Department of Physics
First Semester B.Sc Degree Examination , June, 2022
End Semester Examination
PH 211: CLASSICAL MECHANICS

TIME: 3 hrs Max: 75 marks

SECTION A

Learning Outcome (LOC) BASED Continuous Assessments Cognitive Level (CL) and Course Outcome (CO) Based LAB CIA Examination (UG)

Assessment	Criteria	Marks	Cognitive Level (CL)					
			CL1	CL2	CL3	CL4	CL5	CL6
Semester Practical Examination for 80 marks	Formula, circuit, graph, brief procedure	20	+					
	Setting and experimental skill	15		+				
	Observations and tabulations	15			+			
	Substitution, calculation, result with correct unit	20					+	+
	Certified record with 18 experiments	10				+		
No. of CL based Questions with Max. marks								
No. of CO based Questions with Max. marks								

Learning Outcome (LOC) BASED Continuous Assessments Cognitive Level (CL) and Course Outcome (CO) Based LAB End Semester Examination (UG)

Assessment	Criteria	Marks	Cognitive Level (CL)					
			CL1	CL2	CL3	CL4	CL5	CL6
Semester Practical Examination for 80 marks	Formula, circuit, graph, brief procedure	20	+					
	Setting and experimental skill	15		+				
	Observations and tabulations	15			+			
	Substitution, calculation, result with correct unit	20					+	+
	Certified record with 18 experiments	10				+		
No. of CL based Questions with Max. marks								
No. of CO based Questions with Max. marks								

Learning Outcome (LOC) BASED Continuous Assessments Cognitive Level (CL) and Course Outcome (CO) Based Project and Tour Report Examination (UG)

Assessment	Criteria	Marks	Cognitive Level (CL)					
			CL1	CL2	CL3	CL4	CL5	CL6
Semester Practical Examination for 80 marks	Originality of approach	20	+					
	Relevance of the topic	15		+				
	Involvement	15			+			
	Viva-voce	20					+	+
	Presentation of report	10				+		
	Research Institute/ Science museum visit and Report	30						
No. of CL based Questions with Max. marks								
No. of CO based Questions with Max. marks								