GOKUL GLOBAL UNIVERSITY
Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Master of Science

Physics

Faculty of Science
Gokul Science College
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Siddhpur - 384151, **Dist.** Patan, Gujarat, INDIA, **Mobile :** 9510973863
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Semester I

SR. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	MPHY111DSC	Mathematical Physics-I & Programming In C-I	4	0	0	4	4
2	MPHY112DSC	Classical Mechanics-I & Electrodynamics-I	4	0	0	4	4
3	MPHY113DSC	Quantum Mechanics-I & Solid State Physics-I	4	0	0	4	4
4	MPHY114DSC	Electronics-I	4	0	0	4	4
5	Subject Elective	Space Physics	2	0	0	2	2
6	Subject Elective	Energy Technology and Storage Systems					
PRACTICALS							
1	MPHY115PRA	Practical Module-01	0	0	6	3	3
2	MPHY116PRA	Practical Module-02	0	0	6	3	3
TOTAL			18	0	12	24	24

Semester-2

Sr. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	MPHY211DSC	Mathematical Physics-II & Programming In C-II	4	0	0	4	4
2	MPHY212DSC	Statistical Mechanics-II & Computer-II	4	0	0	4	4
3	MPHY213DSC	Quantum Mechanics-II & Solid State Physics-II	4	0	0	4	4
4	MPHY214DSC	Electronics-II	4	0	0	4	4
5	Subject Elective	Synthesis of Material	2	0	0	2	2
6	Subject Elective	Application of Computer in Physics					
PRACTICALS							
1	MPHY215PRA	Practical Module-01	0	0	6	3	3
2	MPHY216PRA	Practical Module-02	0	0	6	3	3
TOTAL			18	0	12	24	24

Semester-3

Sr. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	MPHY311DSC	NUCLEAR PHYSICS-I & INSTRUMENTS	4	0	0	4	4
2	MPHY312DSC	STATISTICAL MECHANICS-III & COMPUTER-III	4	0	0	4	4
3	MPHY313DSC	QUANTUM MECHANICS–III & SOLID STATE PHYSICS-III	4	0	0	4	4
4	MPHY314DSC	ELECTRONICS-III	4	0	0	4	4
5	Subject Elective	RESEARCH METHODOLOGY	2	0	0	2	2
6	Subject Elective	MICROCONTROLLER					
PRACTICALS							
1	MPHY315PRA	Practical Module-01	0	0	6	3	3
2	MPHY316PRA	Practical Module-02	0	0	6	3	3
TOTAL			18	0	12	24	24

Semester-4

Sr. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDIT	CONTACT HRS/WK
			L	T	P		
THEORY							
1	MPHY411DSC	NUCLEAR PHYSICS-II & BIO-PHYSICS	4	0	0	4	4
2	MPHY412DSC	CLASSICAL MECHANICS-II & ELECTRODYNAMICS-II	4	0	0	4	4
PRACTICALS							
1	MPHY413PRO	PROJECT WORK	0	0	16	16	16
TOTAL			08	0	16	24	24

Semester I

MPHY111DSC- CLASSICAL MECHANICS-I& ELECTRODYNAMICS-I

Objective: This course aims to introduce the fundamental surveying and geoinformatics theories, techniques and instruments that are used in civil engineering surveys besides providing practical skills that will be useful for the field work.

Credits: 04

Module No.	Contents	Teaching Hours
I	Introduction, Analytic functions, Contour Integrals, Laurent series, Residue Theorem, Methods of Finding Residues, Evaluation of Definite Integrals by use of the Residue theorem, the point of Infinity, residue at infinity, Mapping, Some Applications of conformal mapping.	15
II	**INTEGRAL TRANSFORMS:** Introduction, Laplace Transforms, Solution of Differential Equation by Laplace Transforms, Fourier Transforms, Convolution: Parseval's Theorem, Inverse Laplace Transform (Bromwich Integral), the Dirac delta function, Green functions, Integral transform solutions of partial differential equations.	15
III	**DECISION MAKING AND LOOPING:** Introduction, while statement, do statement, do while, for statement, jumps in loops – continue and break statements. **ARRAYS:** Introduction, One dimensional arrays, declaration and initialization of arrays one dimensional arrays,two dimensional arrays, initialization of two dimensional arrays, multidimensional arrays	15
IV	**CHARACTER ARRAYS AND STRINGS :** Declaring and initializing string variables, reading and writing strings, arithmetic operations oncharacters, Putting Strings together, comparison of two Strings, String handling functions, Table ofstrings, other features of strings. **FUNCTIONS:** Need for user defined functions, A multifunction program, Elements of	15

	user defined functions,Definition of functions, return values and their types, Function Calls, Function Declaration, categoryof functions,No argument and no return values, Arguments but no return values, Arguments withreturn values, No arguments but returns avalue,Functions that returns multiple values, nesting offunctions, recursion.	

Text Books:

- Mathematical methods in the physical sciences, M.L Boas., JohnWilley, 1966
- Mathematical Physics, P. K. Chattopadhyaya, Wiley Eastern Ltd.
- Mathematical methods for Physicists, G. Arfken, Academic Press, 1970
- Mathematical Physics, S. Satyaprakash, Sultan Chand & Sons, 1990
- Mathematical Physics, By H.K.DAS

Reference Books

- Programming in ANSI C (IIInd Ed.), Programming in ANSI C (IIInd Ed.), TMH Pub.
- C Programming language, Kernighan B.W. and Ritchie D.K. PHI Pub
- Programming in C, Kochan S.G. CBS Pub.
- Programming with C, By B.S. Gottfried
- Programming in C, P. Day and M.Ghosh, Oxford Univ. Press, 2007

- **Focus:** This course is employable under CO2 and CO3

Outcome:

- a) Solve differential equations like Legendre, Bessel and Hermite that are common in
- physical sciences.
- b) Solve the different partial differential equations encountered in physical problems and
- draw inferences from solutions.
- c) Solve transfer functions in Instrumentation using Laplace transforms.
- d) Apply Fourier transforms in Holography.
- e) Apply Matrices in the study of electrical circuits, Quantum Mechanics and Optics.
- f) Apply the knowledge of Tensors to understand phenomenon like stress and strain.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO1	The student will be able to understand about atmosphere nomenclature, hydrostatic equations scale height, geopotential height, chemical concept of atmosphere, thermodynamic consideration, chemistry of middle atmosphere and thermosphere, ionosphere, photochemical processes, chapman theory of photo ionization, production of ionospheric layers and its morphology
CO2	The student understands about night glow, dayglow, twilight glow, aurora, photometer for airglow measurement, applications, circulation in the magnetosphere, its electric fields, particle, plasma sphere and its dynamics, current system, magneto pause current tail current ring current and Birkland current

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**1**		**1**	**1**		**1**	**1**		
CO2	**3**	**2**	**1**		**1**			**1**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**2**
CO2													**3**	**1**

MPHY112DSC- CLASSICAL MECHANICS-I & ELECTRODYNAMICS-I

Objective: The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include molecular spectra and statistical mechanics of solid state physics. Some industry relevant topics are also covered under which basic concepts are taught.

Credits: 04

Module No.	Contents	Teaching Hours
I	**CANONICAL TRANSFORMATION :** Gauge transformations, Canonical transformation, Condition for transformation to be canonical, Illustration of canonical transformations, Poisson brackets, canonical equations in terms of Poisson brackets notation, Infinitesimal transformation, Relation between Infinitesimal transformation and Poisson brackets, The Hamilton Jacobi equations, separation of variables	15
II	**SMALL OSCILLATION AND ROTATING FRAME:** Stable and unstable equilibriums, Small Oscillation in a system with one degree of freedom, Small Oscillation in a system with more than one degree of freedom, Normal coordinates and Normal frequencies of vibration. Rotating Frame, Euler angles, Inertia tensor, Euler's equations of motion of a rigid body, Free motion of a rigid body, Motion of a symmetric top.	15
III	**ELECTOMAGNETIC WAVES:** Conductor and Dielectrics, Polarization, Reflection by a perfect conductor -normal incidence , Reflection by a perfect conductor -oblique incidence , Reflection by a perfect Dielectric –normal incidence , Reflection by a perfect Dielectric conductor -oblique incidence , surface impedance	15

IV	**POYNTING VECTOR AND THE FLOW OF POWER , GUIDEDWAVES:** Poynting theorem, Interpretation of Poynting vector, Instantaneous, average and complex Poynting vector, Power loss in plane conducto Waves between parallel planes, transverse electric waves (E_Z=0), Transverse Magnetic wave (B_Z=0), Characteristics of TE and TM waves. Transverse electromagnetic waves, Velocity of Propagation, Attenuation in Parallel plane guides, Wave impedance, Electric field and current flow within a conductor.	15

Text Books:

- Classical mechanics-A Text Book by Suresh Chandra, Narosa Publishing House New Delhi.
- Classical Mechanics (2nd Edition), Herbert Goldstein, Addison - Wesley Publishing Co.

Reference Books:

- Classical Mechanics, G. Aruldhas PHI Pvt. Ltd.
- Classical Mechanics, J. C. Upadhyaya Himalaya Publishing House.
- Introduction to Electrodynamics (2nd & 3rd Edition) J. Griffiths, Prentice Hall India Ltd.

Focus: This course is employable under CO2 and CO3

Outcome:

(i) The student will be able to relate different kind of molecular spectra and statistical. They will be able to explain various solid state physics.
(ii) Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
(iii) Apply the various procedures and techniques for the experiments
(iv) The students learn about different theories which help him/her to prove classical conditions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO1	The student will be able to relate different kind of molecular spectra and statistical. They will be able to explain various solid-state physics.
CO2	Develop basic communication skills through working in groups in performing the laboratory

	experiments and by interpreting the results
CO3	Apply the various procedures and techniques for the experiments
CO4	The students learn about different theories which help him/her to prove classical conditions.

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**2**		**2**				**1**		
CO2	**3**	**2**	**1**			**2**	**2**	**1**	**2**	**2**		
CO3	**3**	**2**	**1**		**2**	**1**		**1**				
CO4	**3**	**2**	**2**			**2**				**2**		

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**1**	**3**
CO2													**2**	**2**
CO3													**2**	**2**
CO4													**2**	**1**

MPHY113DSC- QUANTUM MECHANICS-I &SOLID STATE PHYSICS-I

Objective: The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include function of a complex variable, some exactly soluble three dimensional problem, representation of quantum states, quantum theory of angular momentum, energy bands, and semiconductor crystals. Some industry relevant topics are also covered under which basic concepts are taught.

Credits: 04

Module No.	Contents	Teaching Hours
I	**FUNCTIONOF A COMPLEX VARIABLE:** The equations of motion, The Schrödinger picture, The Heisenberg picture, The Interaction picture. [(4.1)QM by V K Thankappan] **Some exactly soluble Three-dimensional problem:** Anisotropic oscillator, The isotropic oscillator, Normal modes of a coupled system of particles. **REPRESENTATION OF QUANTUM STATES:** Quantum states, State vectors and wave functions, The Hilbert space of state vectors; Diracnotation. Dynamical variables and linear operators. Representations. Dynamical variables as matrix operators. Product of operators Self-adjointness and Hermiticity, diagonalization, Continuous basis, The Schrödinger representation. Degeneracy-Labeling by commuting observables. Change of Basis,-unitary transformations, unitary transformations induced by change of co-ordinate system: Translations. Unitary transformation induced by rotation of coordinate system, Algebra of rotation generators, Transformation of Dynamical variables, symmetries and conservation laws.	15

II	**ANGULAR MOMENTUM:** Quantum theory of angular momentum and its eigenvalue spectrum. Matrix representation ofangular momentum operators, spin angular momentum, Pauli matrices and their properties, totalwave function, non-relativistic Hamiltonian including spin. Addition of angular momenta, definitionof Clebsch-Gordan coefficients, Phase convention, spin-wave function for a system of two spin-1/2particles, Identical particles with spin, addition of spin and orbital angular momenta.	15
III	**ENERGY BANDS** Nearly Free Electron Model, Origin of the Energy gap, Magnitude of the Energy Gap, Bloch Functions, Kronig-Penney Model, Wave Education Of Electron in a Periodic Potential, Restatement of the BlochTheorem, Crystal Momentum of an Electron, Solution Of the Central Equation, Kronig- Penney Model in Reciprocal Space, Empty Lattice Approximation, Approximation Solution Near a Zone Boundary, Number of Orbitals in a Band, Metals and Insulators.	15
IV	**SEMICONDUCTOR CRYSTALS:** Band Gap, Equations of Motion, Physical derivation of ħk=F, Holes, Effective Mass, PhysicalInterpretation of the Effective Mass, Effective Masses in semiconductors, Silicon and GermaniumIntrinsic Carrier Concentration, Intrinsic Mobility, Impurity conductivity, Donor States, AcceptorStates, Thermal Ionization of Donors and Acceptors, Thermoelectric Effect, Semimetals, Superlattices, Bloch Oscillator, Zener Tunneling	15

Text Books:

- A textbook of quantum mechanics P M Mathews and K V Venkatesan McGrawhill Edu.
- Introduction to Solid State Physics. Charles Kittel 7th Edition.
- Introduction to Solid State Physics. J P Srivastava 4th Edition.

Quantum Mechanics by V.K. Thankappen, Wiely eastern Ltd

Reference Books:

- A textbook of quantum mechanics P M Mathews and K V Venkatesan McGrawhill Edu.

- Quantum Mechanics by L. I. Schiff, McGraw-Hill International student edition (1961).
- Introduction to Quantum Mechanics by Powell and Crasemann Addison-Wesley (1961).
- Quantum Mechanics by V.K. Thankappen, Wiely eastern Ltd.
- Quantum Mechanics : Theory and applications by A. Ghatak and S. Lokanathan.
- Introduction to Solid State Physics. Charles Kittel 7th Edition.

Focus: This course is employable under CO2 and CO3

Outcome:

(i) The student will learn aboutequation of motion, its Schrodinger picture, Heisenberg picture, interaction picture, anisotropic and isotropic oscillators, normal mode of couple system of particle, quantum states, its vector and wave functions, Hilbert space of state vector, Dirac notation, dynamic variable and linear operators, product of operators, Schrodinger representation, unitary transformation induced by rotation of coordinate system, and conservation laws.

(ii) The student learns about quantum theory of momentum its eigen value spectrum, matrix representation of angular momentum operators, spin angular momentum, Pauli matrices and their properties, total wave function, non-relativistic Hamiltonian including spins, clebsch- Gordan coefficients, phase convention, spin wave function for a system of two spin-1/2 particles, and addition of spin and orbital angular momenta.

(iii) In this section student will learn about nearly free electron model, origin of the energy gap, magnitude of the energy gap, Bloch functions, kroning penny model, wave education of electron in a periodic potential, crystal momentum of an electron, empty lattice approximation, its solution near zone boundary, and study about metals and insulators.

(iv) In this section student will learn about band gap, equation of motion its physical derivation, holes, effective mass its physical interpretation, silicon and germanium intrinsic carrier concentration, mobility, impurity conductivity, donor state thermal ionization, thermoelectric effect, semimetals, super lattice, Bloch oscillator and Zener tunneling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO1	The student will learn about equation of motion, its Schrodinger picture, Heisenberg picture, interaction picture, anisotropic and isotropic oscillators, normal mode of couple system of particle, quantum states, its vector and wave functions, Hilbert space of state vector, Dirac notation, dynamic variable and linear operators, product of operators, Schrodinger representation, unitary transformation induced by rotation of coordinate system, and conservation laws
CO2	The student learns about quantum theory of momentum its eigen value spectrum, matrix representation of angular momentum operators, spin angular momentum, Pauli matrices and their properties, total wave function, non-relativistic Hamiltonian including spins, clebsch-Gordan coefficients, phase convention, spin wave function for a system of two spin-1/2 particles, and addition of spin and orbital angular momenta
CO3	In this section student will learn about nearly free electron model, origin of the energy gap, magnitude of the energy gap, Bloch functions, kroning penny model, wave education of electron in a periodic potential, crystal momentum of an electron, empty lattice approximation, its solution near zone boundary, and study about metals and insulators
CO4	In this section student will learn about band gap, equation of motion its physical derivation, holes, effective mass its physical interpretation, silicon and germanium intrinsic carrier concentration, mobility, impurity conductivity, donor state thermal ionization, thermoelectric effect, semimetals, super lattice, Bloch oscillator and Zener tunneling

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**1**				**1**				
CO2	**3**	**2**	**2**		**1**	**1**						
CO3	**3**	**2**	**2**				**2**			**1**		
CO4	**3**	**2**	**2**	**1**				**2**	**1**			

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**2**
CO2													**2**	**2**
CO3													**2**	**1**
CO4													**2**	**2**

MPHY114DSC- ELECTRONICS-I

Objective: The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Different types of FET amplifier. What is the power amplifier and Detail discussion on Class A,B,C types amplifier. Introduction of Different types of Multivibrators and its working methods, linear and non linear circuits, clamping circuits. Methodology of IC , Basic Process used in monolithic technology. How 555 timer IC Work as Monostable and astable multivibrator.

Credits: 04

Module No.	Contents	Teaching Hours
I	**FET AMPLIFIERS:** FET parameters, biasing the FET , basic FET amplifier, FET small signal, common source a. c. amplifier, Thecommon drain or source follower, common gateamplifier, general treatment of low frequency common source and common drainamplifier common source amplifier at high frequency, common drain amplifier at highfrequencies, MOSFET: Depletion MOSFET, Enhancement MOSFET, Differences between JFET andMOSFET, Handling precaution for MOSFET **MULTIVIBRATORS:** Switching Characteristics of transistor, Multivibrators, AstableMultivibrator, MonostableMultivibrator, Bi-stable Multivibrator	15
II	**POWER AMPLIFIER:** Introduction, Difference between Voltage and Power amplifiers, Performance quantities of poweramplifiers, Class-A power amplifier, and power distribution, Transformer coupled class –A amplifier,Power consideration and dissipation, Class-B power amplifier, Class-A Push-Pull power amplifier,Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier,Double tuned transistor amplifier.	15

III	**WAVE SHAPING CIRCUIT:** linear wave shaping, the high pass RC circuit, High pass RC circuit as differentiator, the Low pass RCcircuit, Low pass circuit as an integrator, Non Linear wave shaping, PN junction diode switchingtimes, Diode clipper circuits, comparison of shunt and series diode clippers, Double ended PNjunction clippers, Double ended clippers using Zener diodes **Clamping circuits**: Zero Level Clamping circuits, Clamping at a given reference D.C. voltage, Design consideration of clamping circuit, A clamping circuit theorem, Voltage Controlled Oscillator, Circuit to produce sharp pulses.	15
IV	IC Technology, Advantages and limitations of ICs, Basic monolithic IC technology, Basic processesused in monolithic technology, Monolithic integrated components, Transistors of monolithic ICs,Monolithic diodes. **Timer 555 IC:** Circuit of the 555 Timer, The 555 IC Timer-as a Monostable and Astable multivibrator.	15

Text Books:

- Hand book of Electronics by Gupta & Kumar 30th Revised Edition,2002 PragatiPrakashan
- Electronics and Radio Engineering by M.L. Gupta (9th Edition-2002) D Raj & Sons
- Electricity and Magnetism by Maharajan and Rangwala, THM
- Electronic Devices and Circuits by A.Mottershead Prentice – Hall of India.

Reference Books:

- Hand Book of Electronics by Gupta and Kumar, Pragati Prakashan, Meerut (Basic)
- Integrated Electronics by Milmann and Halkias
- Electronics and radio engineering by M.L.Gupta

OP-AMP and linear Integrated circuits by R.A.Gayakwad,PHI Pub

Focus: This course is employable under CO2 and CO3

Outcome:

(i) The student will be able to understand FET Parameters,basing, Sources and MOSFET amplifier. Differences between JFET and MOSFET. Also learn the different types of Multivibrators like Astable,Monostable& Bi-stable. They introduce with Voltage – Power amplifer, Performance quantities of Different types of Class A,B,C power amplifier. Get knowledge of Low-High Pass RC Circuit which is use in Different types of Wave shaping circuits. Learn the IC technology and circuit of 555 Timer and its work as astable& Monostable circuit.

(ii) They Develop their skills through working in groups in performing the laboratory experiments and by interpreting the results

(iii) They also develops their working circuit knowledge with experiment skill and active to solve the Different query regarding any circuit or Instruments.

(iv) They learn how to fabricate the IC and basics about IC- 555.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO1	The student will be able to understand FET Parameters, basing, Sources and MOSFET amplifier. Differences between JFET and MOSFET. Also learn the different types of Multivibrators like A stable, Monostable& Bi-stable. They introduce with Voltage –Power amplifier, Performance quantities of Different types of Class A,B,C power amplifier. Get knowledge of Low-High Pass RC Circuit which is use in Different types of Waves shaping circuits. Learn the IC technology and circuit of 555 Timer and its work as a stable& Monostable circuit
CO2	They Develop their skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	They also develop their working circuit knowledge with experiment skill and active to solve the Different query regarding any circuit or Instruments
CO4	They learn how to fabricate the IC and basics about IC- 555

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**1**								
CO2	**3**	**3**	**3**		**1**	**1**			**2**	**1**		
CO3	**3**	**3**	**3**				**1**					
CO4	**3**	**3**	**3**	**2**		**2**		**1**	**1**	**2**		

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**3**
CO2													**3**	**3**
CO3													**2**	**3**
CO4													**3**	**3**

MPHY117SE- SPACE PHYSICS

Objective: The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics basic concepts of earth's atmosphere, structure and variability of earth's ionosphere, aurora and airglow and magnetosphere. Some industry relevant topics are also covered under which basic concepts are taught

Credits: 02

Module No.	Contents	Teaching Hours
I	**Basic Concepts of Earth's Atmosphere:** Atmosphere nomenclature, Hydrostatic equations scale height, Geopotential height, Chemical concepts of atmosphere Thermodynamic considerations, elementary chemical kinetics composition and chemistry of middle atmosphere and thermosphere **Structure and Variability of Earth's Ionosphere** Night glow, Dayglow, Twilight glow, Aurora, Photometer for airglow measurement, applications of Airglow measurement for ionospheric dynamics and composition.	15
II	**Aurora and Airglow:** Night glow, Dayglow, Twilight glow, Aurora, Photometer for airglow measurement, applications of Airglow measurement for ionospheric dynamics and composition **Magnetosphere:** particles in the magnetosphere, plasma sphere and its dynamics, magnetospheric current system, magneto pause current tail current ring current and Birlkeland current.	15

Text Books:

- Introduction to Ionosphere and Magnetosphere, J.A. Ratcliff Ratcliff CUP
- The Solar-Terrestrial Environment, JK. Hargreaves CUP
- Introduction Space Physics, M.J. Kievelson CUP
- Chemistry Sensing and Image Interpretation, M. Lillesand and R.L. Kiefer 4th Edition JohnWiley& Sons

Reference Books:

- The solar terrestrial environment, J K Hargreaves CUP

- Space Plasma Physics, A C Das Narosa Pub

Focus: This course is employable under CO2 and CO3

Outcome:

(i) The student will be able to understandabout atmosphere nomenclature, hydrostatic equations scale height, geopotential height, chemical concept of atmosphere, thermodynamic consideration, chemistry of middle atmosphere and thermosphere, ionosphere, photochemical processes, chapman theory of photo ionization, production of ionospheric layers and its morphology.

(ii) The student understands about night glow, dayglow, twilight glow, aurora, photometer for airglow measurement, applications, circulation in the magnetosphere, its electric fields, particle, plasma sphere and its dynamics, current system, magneto pause current tail current ring current and Birkland current.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO1	The student will be able to understand about atmosphere nomenclature, hydrostatic equations scale height, geopotential height, chemical concept of atmosphere, thermodynamic consideration, chemistry of middle atmosphere and thermosphere, ionosphere, photochemical processes, chapman theory of photo ionization, production of ionospheric layers and its morphology
CO2	The student understands about night glow, dayglow, twilight glow, aurora, photometer for airglow measurement, applications, circulation in the magnetosphere, its electric fields, particle, plasma sphere and its dynamics, current system, magneto pause current tail current ring current and Birkland current

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**1**		**1**	**1**		**1**	**1**		
CO2	**3**	**2**	**1**		**1**			**1**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**2**
CO2													**3**	**1**

MPHY115PRA PRACTICAL MODULE-01

CRADIT-3

LIST OF EXPERIMENTS

1. e/m by Magnetron Valve.

2. Temperature Co-efficient of Platinum resistance Thermometer by Carry Foster or C.G.

Bridge.

3. Study of Hall Effect.

4. Study of hysteresis of Anchor ring / transformer using C.R.O.

5. E.B.Plate (Determination of unknown wavelength and air gap).

6. F.P. Interferometer.

7. L by Rayleigh's method

8. An optical method for determining dielectric constant, dipole moment andpolarizability of a

polar liquid by Hollow Prism.

9. Computer

10. Computer

MPHY116PRA PRACTICAL MODULE-02

CRADIT-3

1. Transistorized R.C. Phase shift Oscillator.
2. UJT as a Relaxation Oscillator.
3. Astable Multivibrator.
4. Study of Power Amplifier.
5. FET amplifier.
6. Inverting OP-AMP.
7. Differential Amplifier.
8. Regulated Power Supply (78xx & 79xx).
9. MOSFET Characteristics.
10. Schmitt trigger using transistor**.**

Semester II

MPHY211DSC- MATHEMATICAL PHYSICS-II & PROGRAMMING IN C-II

Objective: A comprehensive, high-quality education in the physical sciences.

A flexible curriculum with multiple concentrations that allows students to tailor their education according to their specific interests.

The opportunity to experience the excitement of scientific discovery through direct participation in faculty research.

Credits: 04

Module No.	Contents	Teaching Hours
I	**TENSOR ANALYSIS :** Introduction , Definition, Contravariant vector, Covariant vector, Definition of Tensors of rank two, addition & subtraction of tensor, summation convention, symmetry - anti symmetry of second rank tensor, Contraction, Direct product, Quotient rule, Pseudo tensors Dual tensor Levi-civet symbol, irreducible tensor, Non Cartesian tensors, Metric tensor, Christoffel symbols, christoffel symbols as derivatives of metric tensor, covariant derivative, Tensor derivative operators.	15
II	**GROUP THEORY**: Groups, subgroups and classes, Invariant, subgroups and factor groups, Homomorphism & Isomorphism, Group representation, Reducible & Irreducible representations, Schur's lemma, Orthogonality theorem, Character of representation, character table, Decomposing a reducible representation into Irreducible ones, Construction of representations, Lie groups & Lie algebra, The Three dimensional rotation groups SO(3) ,The special unitary groups SU(2) and SU(3), The homomorphism between SU(2) & SU(3), Some application of group theory in physics, (application- 4 classification of elementary particles)	15

III	**STRUCTURES AND UNIONS** Introduction, Defining a structure, Declaring structure variables, Accessing structure members, Structure initialization, copying and comparing structure variables, Operation on individual members, Arrays of structure, Arrays within structure, Structures within structures, Structures and functions, Unions, Size of structures, Bit fields. **POINTERS :** Concept, accessing the address of variables, declaring and initializing pointers, accessing variables through pointers, pointer expressions, pointer increments and scale factor, pointers and arrays, pointer and character strings, pointers and functions, pointers and structures	15
IV	**FILE MANAGEMENT IN C** Defining and Opening a File, Closing a File, I/O operations on Files, Error handling during I/O operations, Random Access to Files, Command Line Arguments. **DEVELOPING A C PROGRAM:** Program Design, Program Coding, Common Programming Errors, Program Testing and Debugging, Program Efficiency.	15

Text Books:

- Mathematical methods in the physical sciences, M.L Boas., John Willey, 1966
- Mathematical Physics, P. K. Chattopadhyaya, Wiley Eastern Ltd.
- Mathematical methods for Physicists, G. Arfken, Academic Press, 1970
- Mathematical Physics, S. Satyaprakash, Sultan Chand & Sons, 1990

Mathematical Physics, By H.K.DAS

Reference Books

- Programming in ANSI C (IInd Ed.), Balagurusamy E.TMH Pub.
- C Programming language, Kernighan B.W. and Ritchie D.K. PHI Pub
- Programming in C, Kochan S.G. CBS Pub.
- Programming with C, By B.S. Gottfried

Focus: This course is employable under CO2 and CO3

Outcome:

- Apply the knowledge and skill in the design and development of Electronics circuits to fulfill the needs of Electronic Industry.

- Become professionally trained in the area of electronics, optical communication, nonlinear circuits, materials characterization and lasers.
- Pursue research related to Physics and Materials characterization.
- Demonstrate highest standards of Actuarial ethical conduct and Professional Actuarial behavior, critical, interpersonal and communication skills as well as a commitment to life-long learning.
- e) Apply Matrices in the study of electrical circuits, Quantum Mechanics and Optics.
- f) Apply the knowledge of Tensors to understand phenomenon like stress and strain.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO1	Apply the knowledge and skill in the design and development of Electronics circuits to fulfill the needs of Electronic Industry
CO2	Become professionally trained in the area of electronics, optical communication, nonlinear circuits, materials characterization and lasers
CO3	Pursue research related to Physics and Materials characterization
CO4	Demonstrate highest standards of Actuarial ethical conduct and Professional Actuarial behavior, critical, interpersonal and communication skills as well as a commitment to life-long learning

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**1**				**2**	**2**	**2**		
CO2	**3**	**2**	**2**		**2**		**2**					
CO3	**3**	**2**	**2**			**2**			**1**	**1**		
CO4	**3**	**2**	**2**	**1**		**1**		**1**				

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**2**
CO2													**2**	**1**
CO3													**2**	**1**

CO4													**3**	**2**

MPHY212DSC- STATISTICAL MECHANICS-II & COMPUTER-II

Objective: The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include statistical mechanics and quantum statistics of statistical mechanics. Some industry relevant topics are also covered under which basic concepts are taught.

Credits: 04

Module No.	Contents	Teaching Hours
I	**BASIC CONCEPT IN STATISTICAL MECHANICS AND QUANTUM STATISTICS** Ergodic Hypothesis, Density distribution in phase space, The Liouville Theorem, Principle of conservation of density in phase space and principle of conservation of extension in phase space, Condition for statistical equilibrium, Density matrix, Liouville Theorem in quantum statistical mechanics, Condition for statistical equilibrium (in quantum statistics), Ensembles in quantum mechanics.	15
II	**IDEAL BOSE AND FERMI SYSTEM** Photon gas, Einstein derivation of Planck's law, Bose-Einstein condensation, Fermi energy, An alternate derivation of Fermi energy, Mean energy of fermions at absolute zero, Fermi gas in metals, Fermi energy as a function of temperature, White dwarfs, Compressibility of a Fermi gas	15
III	**WINDOWS AND POWER POINT Free Electron Theory of Metal :** Thermal conductivity of metals(6.1.2), The F.D. distribution function(6.3), The Sommerfield Model(6.4), Density of states(6.4.1), The free electron gas at 0◦ K(6.4.2), Energy of electron at 0◦ K(6.4.2), The electron heat capacity(6.5), The Sommerfield Theory of conduction in metals(6.6), The Hall coefficient(6.6.1). **Application to Plasmons, Polaritons and Polarons** : (Note: Qualitative description of dielectric constant should be given equation 10.45 to 10.49)Application to Plasma(10.7), Plasma oscillations(10.7.1), Transverse optical mode in plasma(10.7.2), Application to optical phonon modes in ionic crystals(10.8), The longitudinal optical mode(10.8.1),	15

	Transverse optical mode(10.8.2), The interaction of electromagnetic waves with optical modes(10.9).	
IV	**MICRO-SOFT WORD** Starting word, Word processor basics, word wrapping, adding or deleting tools, Selecting blocks of text, Copying text, Moving text, search and replace, editing a document, character formatting and style, Margin settings and columns, Justification of text, Line spacing, Setting tabs, Automatic tasks,Creating letters in readymade formats, Change case, Borders and Shading, Bullets and Numbering, Spelling and Grammar checking, Clip Art, Creating Drawing (with Toolbar), Auto correct, Auto Text, Printing a document, Short Keys, Help. Menus in Microsoft word: Menus, Menu bar, Toolbar, Table etc.	15

Text Books:

- Statistical Mechanics by R.K. Patharia, Pergamon Press
- Funadamentals of Statistical Mechanics by F. Reif, Mc Graw Hill Companies
- Microsoft Office 2000 Complete by Sybex, BPB Publication.

Reference Books:

- Fundamentals of statistical mechanics by B. B. Laud, 1998, New age international (P) LTD, Publishers, New Delhi. basic reference
- Statistical Mechanics and Properties of Matter by E.S. Raja Gopal, Mc Millan Company of India Limited.
- IT Tools and Applications by R.K. Taxali.

Focus: This course is employable under CO2 and CO3

Outcome:

(v) The student will be able to relate different kind of statistical mechanics and quantum statistics. They will be able to explain various computer uses.

(vi) Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

(vii) Apply the various procedures and techniques for the experiments

(viii) Students can able to learn Microsoft word and its usages.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO1	The student will be able to relate different kind of statistical mechanics and quantum statistics. They will be able to explain various computer uses
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	Apply the various procedures and techniques for the experiments
CO4	Students can able to learn Microsoft word and its usages

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**2**						**1**		
CO2	**3**	**3**	**3**		**1**	**1**	**1**		**2**			
CO3	**3**	**3**	**3**					**1**		**2**		
CO4	**3**	**3**	**3**	**1**		**2**			**1**			

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**3**
CO2													**2**	**2**
CO3													**2**	**1**
CO4													**3**	**3**

MPHY213DSC: -QUANTUM MECHANICS-II &SOLID-STATE PHYSICS-II

Objective: The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include function of a approximation methods for stationary states, the variational method, WKB approximation, evolution with time, fermi surfaces and metals, diamagnetism and paramagnetism. Some industry relevant topics are also covered under which basic concepts are taught.

Credits: - 04

Unit	Content	Credit	Weightage
I	**APPROXIMATION METHODS FOR STATIONARY STATES:** PERTURBATION THEORY FOR DISCRETE LEVELS; Equation in various orders of perturbation, theory, Non degenerate case, The Degenerate Case – Removal of degeneracy, The effect of electric field on energy level of an atom (Stark effect), Two electron atoms. **THE VARIATION METHOD:** Upper bound on ground state energy, Applications to excited state, Trial function Linear in variation parameters, Hydrogen molecule, Exchange interaction **WKB APPROXIMATION** The one dimensional Schrödinger equation (inclusive all cases & discussion relevant to perturbation theory/WKB method, The Bohr-Somerfield quantum condition, The WKB solution of radial wave equation	1	25 %
II	**EVOLUTION WITH TIME:** Exact Formal Solutions: The Schrödinger equation: General Solution, Propagators, Alteration of Hamiltonian: Transitions; Sudden Approximation. Perturbation theory for Time Evolution Problems: Perturbative Solution for Transition Amplitude, Selection rules, First Order Transitions: Constant Perturbation, Transitions in the Second Order: Constant Perturbation. Harmonic Perturbations, Interaction of an atom with electromagnetic radiation, The dipole approximation	1	25 %
III	**FERMI SURFACES AND METALS:** Reduced Zone Scheme, Periodic Zone Scheme, Construction of Fermi Surfaces, Nearly Free Electrons, Electron Orbits, Hole Orbits, and Open Orbits, Calculation of Energy Bands, Tight	1	25 %

	Binding Method of Energy Bands, Wigner – Seitz Method, Cohesive Energy, Pseudo potential Methods, Experimental Method in Fermi surface Studies, Quantization of orbits in a Magnetic Field, De Hass- van Alphen Effect, Extremal Orbits, Fermi Surface of Copper, Magnetic Breakdown.		
IV	**DIAMAGNETISM AND PARAMAGNETISM** Langevin Diamagnetism Education, Quantum Theory of Diamagnetism of Mononuclear System, Quantum Theory of Para magnetism, Rare Earth Ions, Hund Rules, Irons group Irons , Crystal Field splitting, Quenching of the Orbital Angular Momentum, Spectroscopic Splitting Factor, Van Vleck Temperature – Independent Para magnetism, Cooling by Isentropic Demagnetization, Nuclear Demagnetization, Paramagnetic Susceptibility Conduction Electrons.	1	25%

Reference Books:

- A textbook of quantum mechanics P M Mathews and K V Venkatesan McGrawhill Education
- Quantum Mechanics by L. I. Schiff, McGraw-Hill International student edition (1961).
- Introduction to Quantum Mechanics by Powell and Crasemann Addison-Wesley (1961).
- Quantum Mechanics by V.K. Thankappen, Wiely eastern Ltd.
- Quantum Mechanics : Theory and applications by A. Ghatak and S. Lokanathan.
- Quantum Mechanics by K.K. Chopra &G.C.Agarwal,KrishnaPrakashan Media,(P)LTD.MEERUT
- Introduction to Solid State Physics. Charles Kittel 7th Edition.
- Introduction to Solid State Physics. J P Srivastava 4th Edition.
- Solid State Physics by S.O.Pillai, New age international publishers
- Fundamental of Solid State Physics by Saxena, Gupta and Kumar Pragati Prakashan

Suggested Readings:

- A textbook of quantum mechanics P M Mathews and K V Venkatesan McGrawhill Edu.
- Introduction to Solid State Physics. Charles Kittel 7th Edition.
- Introduction to Solid State Physics. J P Srivastava 4th Edition.
- Quantum Mechanics by V.K. Thankappen, Wiely eastern Ltd.

Online Resources:

1. https://uomustansiriyah.edu.iq/media/lectures/6/6_2021_09_21!05_27_57_PM.pdf
2. http://www.tcm.phy.cam.ac.uk/~bds10/aqp/handout_approx.pdf
3. https://en.wikipedia.org/wiki/Variational_method_(quantum_mechanics)#:~:text=In%20quantum%20mechanics%2C%20the%20variational,method%20is%20the%20variational%20principle.
4. https://www.sciencedirect.com/topics/chemistry/variational-method
5. https://en.wikipedia.org/wiki/WKB_approximation
6. https://www.thphys.uni-heidelberg.de/~wolschin/qms17_7s.pdf
7. http://yclept.ucdavis.edu/course/215b.W17/wkb3.pdf
8. https://en.wikipedia.org/wiki/Time_evolution#:~:text=Time%20evolution%20is%20the%20change,be%20discrete%20or%20even%20finite.
9. http://physics.mq.edu.au/~jcresser/Phys301/Chapters/Chapter15.pdf
10. https://phy.ntnu.edu.tw/~changmc/Teach/SS/SS_note/chap09.pdf
11. http://www-personal.umich.edu/~sunkai/teaching/Winter_2015/chapter08.pdf
12. https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/diamagnetism-and-paramagnetism#:~:text=Paramagnetic%20materials%20characteristically%20align%20with,its%20lines%20of%20magnetic%20force.
13. https://www.vedantu.com/physics/diamagnetism-ferromagnetism-and-paramagnetism
14. https://www.nde-ed.org/Physics/Magnetism/MagneticMatls.xhtml

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will learn about perturbation theory for discrete levels, equation in various orders of perturbation, non-degenerate case, removal of degeneracy, the effect of electric field on energy level of an atom(stark effect), two electron atoms, variation method for upper bound on ground state energy, application to exited state, trial function linear in variational parameters, hydrogen molecule, exchange interaction, the one dimensional Schrodinger

	equation, the Bohr-Somerfield quantum condition, the WKB solution of radial wave equation
CO2	The student learns about exact formal solution of the Schrodinger equation, general solution, propagators, alteration of Hamiltonian, transitions, sudden approximation, perturbation theory for time evaluation, perturbative solution for transition amplitude, selection rules, first order transitions, constant perturbation, harmonic perturbation, interaction of an atom with electromagnetic, radiation, and dipole approximation
CO3	In this section student will learn about reduced zone scheme, periodic zone scheme, construction of fermi surfaces, nearly free electrons, electron orbits, hole orbits and open orbits, calculation of energy bands, tight binding method of energy bands, Wigner-Seitz method, cohesive energy, pseudo potential methods, experimental method in fermi surface studies, quantization of orbits in a magnetic field, De Hass- Van alphen effect, external orbits, fermi surface of copper, and magnetic breakdown
CO4	In this section student will learn about Langevin diamagnetism education, quantum theory of diamagnetism of mononuclear system, para magnetism, rare earth ions, Hund rules, irons group irons, crystal field splitting, quenching of the orbital angular momentum, spectroscopic splitting factor, van vleck temperature-independent para magnetism, cooling by isentropic demagnetization, nuclear demagnetization, paramagnetic susceptibility conduction electrons

CO - PO Competency and Program Indicators (PI)

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**3**	**2**				**1**	**2**			
CO2	**2**	**3**	**2**		**1**					**2**		
CO3	**2**	**2**	**1**			**1**	**1**					
CO4	**2**	**1**	**1**	**1**					**1**			

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**2**	**1**
CO2													**2**	**1**
CO3													**1**	**2**
CO4													**1**	**3**

MPHY214DSC: -ELECTRONICS-II

Course Objective:

The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Different types of Operational amplifier and its configuration , feedback, and its some applications, the different types of Flip flop, converter and counter, some objective of Microprocessor and get architecture and its operational**.**

CREDIT: - 04

Unit	Content	Credit	Weightage
1	**OPERATIONAL AMPLIFIER:** Differential amplifier, The operational amplifier, A general purpose IC operational amplifier, open loop OP-AMP configuration, OP-AMP with negative feedback, Non Inverting and Inverting OP-AMP, Some Op-AMP Parameters, Effects of offset, Frequency Response and Stability, Applications of OP-AMP: As a Scale Changing-Phase Shifting and Summing amplifier, Voltage Follower, Integrator, Differentiator, Logarithmic and Antilogarithmic amplifier, Bridge amplifier, Schmitt Trigger, Saw-tooth wave generator. Bootstrap Sweep generator,	1	25 %
2	**DIGITAL ELECTRONICS** FLIP FLOP: RS FLIP-FLOPs, D FLIP-FLOPs, JK FLIP-FLOPs, Master Slave FLIP-FLOPs. Shift Registers: Types of registers, serial in - serial out, serial in parallel out, parallel in - serial out, parallel in - parallel out, Universal Shift Register. Counters: Asynchronous Counters, Synchronous Counters, Decade Counters, Presettable Counters, Digital Clock. Conversion: Binary Ladder, D/A Converters, A/D Converter-Simultaneous Conversion, A/D Converter-Counter Method.	1	25 %
3	**3.1. MICROPROCESSOR – I** Microprocessors: Advances in semiconductor technology, Organization of Microprocessor based system, Microprocessors instruction set and computer Languages: Machine language, 8085-Machine language, 8085-Assembly Language, Writing and executing an assembly language program, High level language, Operating systems. **3.2. Microprocessors architecture and its operational:**	1	25 %

	M.I.O. and 8085 Bus organization, Internal data operations and the 8085 registers, Peripheral or externally initiated operations, Memory, Flip –Flop or latch as a storage element, Memory Map and addresses, Memory address range of a 1K memory chip, Memory classification.		
	3.3. Logic devices for interfacing:		
	Tristate devices, Buffer, Decoder and Encoder		
	3.4. The 8085 MPU:		
	The 8085 microprocessors (Pinout), Demultiplexing the bus AD7- - ADo , Generating control signals.		
4	**4.1. MICROPROCESSOR – II**	1	25 %
	Introduction to 8085 Assembly Language Programming: The 8085 Programming Model, Instruction classifications, Instruction Format, How to write assemble and execute simple program, Overview of 8085 Instruction Set.		
	4.2. Introduction to 8085 Instruction:		
	Data Transfer Operations, Arithmetic Operations. Logical operations, Branch Operations. Debugging a program static and dynamic debugging.		
	4.3. Programming Techniques with Additional Instructions:		
	Programming Techniques; Looping, Counting and Indexing, Additional Data transfer and 16-bit Arithmetic instructions, Arithmetic Operation related to Memory, Logical Operation: Rotate, Logical Operation: Compare. Common sources of errors.		

Reference Books:

- Hand Book of Electronics (Basic) Gupta and Kumar, Pragati Prakashan, Meerut
- Electronic Devices and Components, by J. Seymore (Longmann Scientific & Technical).
- Integrated Electronics, by K. R. Botkar, (Khanna Publishers.)
- Microprocessor Architecture, Programming and Applications with 8085 by Ramesh S. Gaonkar PIP Pub.

Suggested Readings:

- Introduction to microprocessor by R. Zalls B. P. B. Publication Delhi.
- An introduction to microprocessor and applications by Krishna Kant,Macmillan.
- Basic Electronics and Linear Circuits by N.N.Bhargava, D.C.Kulshreshtha, S.C.Gupta McGraw

Online Resources:

- https://www.electronics-tutorials.ws/
- www.youtube.com
- https://www.tutorialspoint.com/microprocessor/index.htm
- https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand the Differential amplifier, operational amplifier, its feedback & parameters, frequency Response, its applications; they develop the thoughts about different type of flip flop & types of Registers. They will be learning the Organization of Microprocessor based system, Microprocessors instruction set and computer Languages, Microprocessors architecture and its operation, Introduction of 8085 and its Instruction, Programming Techniques with Additional Instructions of 8085
CO2	They Develop their skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	They also develop their working circuit knowledge with experiment skill and active to solve the Different query regarding any circuit or Instruments
CO4	Students can able to learn about microprocessor 8085 and its programming techniques

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**2**			**1**			**2**		
CO2	**3**	**3**	**2**		**2**				**2**			
CO3	**3**	**3**	**2**			**2**		**2**				
CO4	**3**	**3**	**2**	**1**			**2**		**1**			

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**2**	**3**
CO2													**2**	**3**
CO3													**3**	**3**
CO4													**3**	**3**

MPHY215PRA: - Group – I

Credit: - 03

Practical / Activities:

LIST OF EXPERIMENTS

1. Hysterisis by Magnatometer Method.
2. Ultrasonic Interferometer-Determination of Velocity of Ultrasonic waves in a liquid/solid
3. ‘e’ by Milicon’s method
4. Fiberless optical communication using Laser
5. G.M. counter.
6. Determination of Band gap energy of given Thermister.
7. Biprism
8. Fiber Optics
9. Microproccessor-arithmetic operations. ADDITION, SUBTRACTION, 1’s and 2’scompliment

10. C Programming.

MPHY216PRA: - Group – II

Credit: - 03

Practical / Activities:

LIST OF EXPERIMENTS

1. Class-B Push-Pull Amplifier.
2. Amplitude modulation and demodulation.
3. Non-Inverting OP-AMP.
4. Voltage follower.
5. IC-723 Regulated Power Supply.
6. OP-AMP Parameters.
7. IC-555 Timer.
8. R-S FLIP-FLOP
9. Study of Differentiator
10. Square wave generator

MPHY217SE: - SYNTHESIS OF MATERIAL

Course Objective:

(i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics Physical methods, thin film synthesis, Chemical routes, and Different crystal growth techniques. Some industry relevant topics are also covered under which basic concepts are taught.

Credit: - 02

Unit	Content	Credit	Weightage
I	**PHYSICAL METHODS** Solid State Reaction (Ceramic) Method: General Principles,	1	50 %

	Experimental Procedure: Reagents, Mixing, Container Material, Heat Treatment, Analysis, Kinetics of Solid-State Reaction, Disadvantages.		
	THIN FILM SYNTHESIS:		
	Vacuum Evaporation, Sputtering, Spin Coating, Dip Coating, Pulsed Laser Deposition (PLD), Spray Pyrolysis, Chemical Vapour Deposition (CVD).		
II	**CHEMICAL ROUTES:**	1	50 %
	Sol-gel Method: Principle, Lithium Niobate (LiNbO3), Doped Tin Dioxide, Silica for Optical Fiber		
	GROWTH OF SINGLE CRYSTALS:		
	Czochralski Method, Bridgman and Stockbarger Methods, Zone Melting, Precipitation from Solution or Melt; Flux Method, Epitaxial Growth of Thin Layers. Vapour Phase Transport Methods.		

Reference Books:

- Solid State Chemistry and its Applications, Anthony R. West (John Wiley & Sons)
- Solid State Chemistry – An Introduction, Lesley Smart and Elaine Moore (Viva Books Pvt (Limited)
- Hand Book of Thin Film Technology, K. L. Chopra (MacGrow Hill)
- Thin Film Fundamentals, Goswami A. (New Age International)
- Hand Book of Thin-Film Deposition Processes and Techniques, Krishna Seshan (Noyes Pub.)
- Crystal Growth – A Tutorial Approach,Eds. W. Bradsley, D.T.J. Hurle& J. B. Mullin (NorthHolland)

Suggested Readings:

- Solid State Chemistry and its Applications, Anthony R. West (John Wiley & Sons)
- Solid State Chemistry – An Introduction, Lesley Smart and Elaine Moore (Viva Books Pvt (Limited)

Online Resources:

1. https://www.nanoshel.com/physical-methods
2. https://www.cliffsnotes.com/study-guides/biology/microbiology/control-of-microbial-growth/physical-methods-of-control
3. https://openstax.org/books/microbiology/pages/13-2-using-physical-methods-to-control-microorganisms
4. https://www.intechopen.com/chapters/52684
5. https://www.sciencedirect.com/topics/materials-science/thin-film-processing-method
6. https://www.sciencedirect.com/topics/chemistry/thin-film-processing-method
7. https://en.wikipedia.org/wiki/Thin_film
8. http://webdoc.sub.gwdg.de/ebook/diss/2003/fu-berlin/2000/145/Chapter4.pdf
9. https://openaccesspub.org/j3dpa/article/1804
10. https://www.dentonvacuum.com/resources/what-is-thin-film-deposition/
11. https://pubs.rsc.org/en/content/articlehtml/2021/ma/d0ma00807a
12. https://www.researchgate.net/publication/6230186_Chemical_Routes_in_the_Synthesis_of_Nanomaterials_Using_the_Sol-Gel_Process
13. https://www.researchgate.net/publication/347751943_Routes_of_Synthesis_and_Characterizations_of_Nanoparticles
14. https://www.intechopen.com/chapters/71103
15. https://courseware.cutm.ac.in/wp-content/uploads/2020/06/synthesis-of-nanomaterials-by-different-routes.pdf
16. https://courseware.cutm.ac.in/courses/synthesis-routes-of-nanomaterials-2/
17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8705396/
18. https://www.frontiersin.org/articles/10.3389/fchem.2020.00357/full
19. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/note_1519281517.pdf
20. https://innovareacademics.in/journals/index.php/ijcpr/article/view/41556/24630
21. https://bmcmaterials.biomedcentral.com/articles/10.1186/s42833-020-0008-0#:~:text=The%20growth%20of%20single%20crystals,(PVT)%20%5B16%5D.
22. https://www.sciencedirect.com/topics/chemistry/single-crystal-growth
23. https://www.sciencedirect.com/topics/engineering/single-crystal-growth
24. https://en.wikipedia.org/wiki/Single_crystal
25. https://acadpubl.eu/hub/2018-119-12/articles/2/489.pdf

26. https://pubs.acs.org/doi/10.1021/acsomega.0c01769
27. https://www.nature.com/articles/s41598-021-04235-2

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand about solid state reaction method its principles, experimental procedure, reagents, mixing container material, heat treatment, analysis, kinetics of solid-state reaction, disadvantages, in thin film synthesis method learn about different techniques of it as like vacuum evaporation, sputtering, spin coating, dip coating, pulsed laser deposition, spray pyrolysis, chemical Vapour deposition
CO2	The student understands about sol-gel method principle, lithium niobate, doped tin dioxide, silica for optical fiber, Czochralski Method, Bridgman and Stockbarger Methods, Zone Melting, Precipitation from Solution or Melt Flux Method, Epitaxial Growth of Thin Layers. Vapour Phase Transport Methods

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**2**		**1**		**1**	**1**	**1**		
CO2	**3**	**3**	**3**		**1**		**1**					

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**3**
CO2													**3**	**3**

MPHY311DSC: - NUCLEAR PHYSICS-I & INSTRUMENTS

Course Objective:

Students completing this module should be able to **describe the structure of the atom, the constituents of the nucleus, and different types of radiation**. The student should be able to give definitions of basic nuclear physics terms and units of measure.

Credit: 04

Unit	Content	Credit	Weightage
I	**NUCLEAR PROPERTIES** Nuclear spin, electric moments, magnetic moments, a brief description of hyperfine structure of atomic spectra, effect of an external magnetic field on the hyperfine structure, determination of *I* from molecular band spectra, molecular beam resonance method – experiments on hydrogen and deuteron.	**15**	**25%**
II	**TWO-BODY FORCES** Deuteron, Excited states of the deuteron, neutron proton scattering at low energies, scattering length, spin dependence of neutron proton scattering, singlet state in n-p system, effective range theory in n-p scattering, tensor forces, magnetic moment and electric quadrupole moment of the deuteron,proton-protonscatteringatlowenergy,exchangeforces,mesontheoryofnuclearforces.	**15**	**25%**
	NUCLEAR REACTIONS Nuclear reactions and cross sections, Resonance: Breit Wigner dispersion formula for $l = 0$, The compound nucleus, Continuum theory of nuclear reaction, Direct reactions, Theory of stripping reactions - semi classical description and wave mechanical description.	**15**	**25%**
III	**MICROSCOPY** **Scanning Electron Microscopy (SEM)** PhysicalBasisandPrimaryModesofOperation,Instrumentation,SampleRequirements, FESEM, Advantages over conventional SEM,Applications Transmission Electron Microscopy (TEM) BasicPrinciple,Resolution,Sensitivity,TEMOperation,ImageMode,Specimen Preparation Scanning Tunnelling Microscopy (STM) and Scanning Force Microscopy (SFM) Introduction, Instrumentation, Topography, Profilometry, Sample Requirements	**15**	**25%**
	UV-VIS		**25%**

IV	Introduction, principle of UV-vis spectroscopy, Beer-Lambert's law, molar absorbility, absorbing species, containing π, σ and η electrons, charge transfer absorption, Instrumentation of UV-vis spectroscopy: Radiation Sources, Wavelength Selectors, Monochromators, Sample Handling, Detectors, Signal Processing and Output Devices, Types of UV-Visible Spectrometers: Single Beam Spectrometers, Double Beam Spectrometers, Photodiode Array Spectrometer, applications.	**15**	

Reference Books :

a) IntroductiontoNuclearphysicsTheoryandExperimentbyR.R.ROYandB.P.Nigam
b) Introduction to Nuclear physics, H.A.Enge
c) Nuclear physics byD.C.Tayal
d) Nuclear physics by IRVINGKAPLAN

Suggested Readings :

a) Elementary Organic Spectroscopy, Y R Sharma S.Chand.
b) Molecular Structure and Spectroscopy, G Aruldhas PHIpublisher.

Online Resources :

a) https://youtu.be/5jM6ST-VDX0
b) https://youtu.be/FOuAIUgfehc

Course Outcomes: At the end of the course, students shall be able to

CO1	express the basic concepts of nuclear physics
CO2	can tell a chronology of some of the major events in nuclear physics

CO3	can identify some introductory terminology, can use the units and dimensions
CO4	can express the radioactive decays,

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**3**	**1**	**2**		**1**	**2**	**1**			
CO2	**2**	**3**	**2**						**1**	**2**		
CO3	**2**	**3**	**2**	**2**		**1**	**1**					
CO4	**2**	**3**	**2**		**1**			**1**		**1**		

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**1**	**2**
CO2													**1**	**2**
CO3													**2**	**1**
CO4													**1**	**1**

MPHY312DSC: - STATISTICAL MECHANICS - II & COMPUTER-II

Course Objective:

To understand the properties of macroscopic systems using the knowledge of the properties of individual particles. The Statistical Basis of Thermodynamics: The macroscopic and microscopic states, contact between statistics and thermodynamics, classical ideal gas, Gibbs paradox and its solution

Credit: - 04

Content

Unit	Description in detail	Credit	Weightage
I	**PHASE EQUILIBRIA** Equilibrium conditions, classification of phase transitions, phase diagram, Clausious-Clapeyron equation, Critical exponents, Vander Waal equations, second order phase transitions, Ginzburg- Landau	1	33 %

	theory, phase transition in ferromagnetic materials, liquid helium, Curie - Weiss theory of Magnetic transition, Ising Model, Ising Model in zeroth approximation, Exact solution of one dimensional Ising Model, Order parameters		
II	**TRANSPORT PHENOMENA** Mean collision time, Thermionic emission, Photoelectric effect, Molecular collisions, Effusion, Einstein relation for mobility, Distribution function, Boltzmann transport equation, Relaxation approximation, Boltzmann H-theorem, Maxwell-Boltzmann distribution from Boltzmann equation. Boltzmann H- theorem in Q.M.	1	33 %
III	**MICRO-SOFT EXCEL** Introduction to spreadsheets, Use of spreadsheets, spreadsheets basics, Labels, Values and Functions, Formula, Functions, What-if analysis, Automatic recalculation, formatting spreadsheet, graphs. **Introduction to Excel :**Functions of Microsoft Excel, starting ms-excel, Excel work environment, changing the size of work book and excel window, Cell and Cell address, Standard toolbar, Formatting toolbar, the formula bar, status bar, Components of an excel workbook, quitting ms-excel **Working in Excel :**Moving inside a workbook, Moving the cell pointer quickly, Selecting a command, types of data, Entering data at cell address, Making changes to an entry, saving your workbook, closing the workbook, quitting ms-excel **Mathematical Calculations:** Formulas using numbers, Formulas using cell address, Openingms-excel and entering data, Defining functions, writing a function, Common excel functions **Manipulating data:** Moving data, Copying data, Relative cell addressing, absolute cell addressing, Copying values, not formula or function, deleting rows and columns, Deleting contents of a row, Inserting rows, inserting columns, Automatic filling of entries, quitting ms-excel **Changing the layout:** Aligning data, Increasing or decreasing the column width, Increasing or decreasing the height of rows, Erasing the contents of a sheet, Deleting data from the cell address, Setting column width to zero, Values formatting, Points to remember, Closing workbook and quitting excel **Simple Graphs:** Drawing a graph, Naming the sheet, saving the workbook, printing and closing a graphic sheet, opening the saved graphic sheet, quitting ms-excel **Manipulating Sheets:** Adding sheet to a workbook, Adding many sheet to a workbook, renaming a sheet and entering data in it, Moving sheet, Copying data between sheets, Protecting the workbook, Deleting a sheet from a workbook, Saving the workbook automatically, Closing the workbook, recovering the deleted workbook, quitting ms-excel.	1	34 %

IV	**COMPUTER NETWORK, INTERNET AND VIRUS** Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN), Routing, Network topology. Use of Internet, Web Browser, Search Engine, Surfing, Mail(Draft,Send, Receive, Delete), TCP/IP, Uniform resource locator (URL), Internet service provider, Internet security, surfing. Introduction to computer viruses, What is virus?, Classification of viruses, Latest known viruses, virus prevention, Antivirus.	1	33%

Reference Books:

- Fundamentals of statistical mechanics by B. B. Laud, 1998, New age international(P) LTD, Publishers, New Delhi. basic reference
- Statistical Mechanics - Theory and Applications by S.K. Sinha, Narosa Publishing House,New Delhi.
- IT Tools and Applications by R.K. Taxali.
- Comdex Computer Course Kit by Vikas Gupta, Publisher: Dreamtechl.

Suggested Readings:

- Statistical Mechanics - An Introduction by Evelyn Guha, Narosa Publishing House
- Statistical Mechanics by R.K. Patharia, Pergamon Press
- Funadamentals of Statistical Mechanics by F. Reif, Mc Graw Hill Companies
- Statistical Mechanics - Theory and Applications by S.K. Sinha, Narosa
- Peter NortonComplete Guide to Microsoft Office 2000 by Wayne S. Freeze, BPB Publication.
- Fundamental of Information technology by: Deepak Bharihoke

Online Resources:

1. https://sites.google.com/a/phys.buruniv.ac.in/statmech2/my-reading-list
2. https://www.coursera.org/learn/statistical-mechanics
3. www.wikipedia.com
4. Swayam portal

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of properties of macroscopic systems. They will be able to explain various properties of individual particles

CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	Apply the various procedures and techniques for the experiments
CO4	Students can able to learn about computer internet, virus and lots of things

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**2**	**1**	**2**	**1**		**1**		**1**		
CO2	**2**	**3**	**3**				**2**		**2**			
CO3	**2**	**3**	**2**		**1**					**2**		
CO4	**2**	**2**	**2**	**2**			**1**		**1**			

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**2**	**1**
CO2													**1**	**2**
CO3													**1**	**1**
CO4													**1**	**1**

MPHY313DSC: - QUANTUM MECHANICS-III &SOLID-STATE PHYSICS-III

Course Objective:

(i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include function of a scattering theory, partial wave analysis, ferromagnetism and anti-ferromagnetism, and magnetic resonance. Some industry relevant topics are also covered under which basic concepts are taught.

Credit: - 04

Content

Unit	Description in detail	Credit	Weightage
I	**SCATTERING THEORY** The scattering cross-section. General considerations : Kinematics of scattering process; Differential and Total cross-sections, Wave mechanical picture of scattering: The scattering amplitude, Green functions : Formal expression for scattering Amplitude, The Born and Eikonal Approximations : The Born Approximation, The validity of the Born Approximation, The Born series, The Eikonal Approximation.	1	25 %
II	**PARTIAL WAVE ANALYSIS** Asymptotic Behaviorof partial waves : phase shift, The scattering Amplitude in terms of phase shifts, The Differential and Total cross-sections, Optical Theorem , Phase shift: relation to the potentials, Potentials of finite range, Low energy scattering, Exact soluble problems, Scattering by a square well, scattering by a hard sphere, scattering by a coulomb potential mutual scattering of two particles , Reduction of the two body problem:Thecenterofmassframe,Transformationfromcentreofmasstolaboratoryframeofreference, collisions between identicalparticles.	1	25 %
III	**FERROMAGNETISM & ANTI FERROMAGNETISM** Ferromagnetic Order, Curie Point and the Exchange Integral, Temperature Dependence of the Saturation, Magnetization, Saturation Magnetization at Absolute Zero, Magnons, Quantization of Spin Wave, Thermal Excitation of Magnons, Neutron Magnetic Scattering, Ferrimagnetic Order, Currie Temperature and Susceptibility of Ferrimagnets, Iron Garnets, Anti ferromagnetic Order, Susceptibility Below the Neel Temperature, Anti ferromagnetic Magnons, Ferromagnetic Domains, Anisotropy Energy, Transition Region between Domains, Origin of Domains, Coercivity and Hysteresis, Single Domain Particles, Geomagnetism and Biomagnetism, Magnetic Force Microscopy	1	25 %
IV	**MAGNETIC RESONANCE** Nuclear Magnetic Resonance, Equation of Motion, Line Width, Motional Narrowing, Hyperfine Splitting,Examples:ParamagneticPointDefects,FCentersinAlkaliHalides,DonorAtomsinSilicon, KnightShift,NuclearQuadrupoleResonance,FerromagneticRe	1	25%

	sonance,ShapeEffectsinFMR,Spin Wave Resonance, Antiferromagnetic Resonance, Electron Paramagnetic Resonance, Exchange Narrowing,Zero-FiledSplitting,PrincipleofMaserAction,Three-LevelMaser,Lasers		

Reference Books:

- AtextbookofquantummechanicsPMMathewsandKVVenkatesanMcGrawhillEducation
- QuantumMechanicsbyL.I.Schiff,McGraw-HillInternationalstudentedition(1961).
- IntroductiontoQuantumMechanicsbyPowellandCrasemannAddison-Wesley(1961).
- QuantumMechanicsbyV.K.Thankappen,WielyeasternLtd.
- QuantumMechanics:TheoryandapplicationsbyA.GhatakandS.Lokanathan.
- Quantum Mechanics byH.C.Verma
- QuantumMechanicsbyK.K.Chopra&G.C.Agarwal,KrishnaPrakashanMedia,(P)LTD. MEERUT
- IntroductiontoSolidStatePhysics.CharlesKittel7thEdition.
- IntroductiontoSolidStatePhysics.JPSrivastava4thEdition.
- Solid State Physics by S.O.Pillai, New age internationalpublishers
- FundamentalofSolidStatePhysicsbySaxena,GuptaandKumarPragatiPrakashan

Suggested Readings:

- A textbook of quantum mechanics P M Mathews and K V Venkatesan McGrawhill Edu.
- Introduction to Solid State Physics. Charles Kittel 7th Edition.
- Introduction to Solid State Physics. J P Srivastava 4th Edition.
- Quantum Mechanics by V.K. Thankappen, Wiely eastern Ltd.

Online Resources:

1. http://www.tcm.phy.cam.ac.uk/~bds10/aqp/lec20-21_compressed.pdf

2. https://amsler.web.cern.ch/NPIOP/Scattering.pdf
3. http://atlas.physics.arizona.edu/~shupe/Indep_Studies_2015/Notes_Goethe_Univ/L6_Scattering_PartialWaves.pdf
4. https://phy.ntnu.edu.tw/~changmc/Teach/SS/SS_note/chap12.pdf
5. http://www.uptti.ac.in/classroom-content/data/UNIT_4_LECTURE_3_AS.pdf
6. https://www.infoplease.com/encyclopedia/science/physics/concepts/magnetic-resonance#:~:text=magnetic%20resonance%2C%20in%20physics%20and,produce%20absorption%20of%20the%20radiation.
7. https://www.britannica.com/science/magnetic-resonance
8. https://kids.frontiersin.org/articles/10.3389/frym.2019.00023

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will learn about scattering cross section, general consideration, kinematics of scattering, differential and total cross sections, wave mechanical picture of scattering, its amplitude, green functions, formal expression, born approximation, its validity, born series and eikonal approximation
CO2	The student learns about asymptomatic behavior of partial waves, phase shift, scattering amplitude in terms of phase shifts, differential and total cross section, optical theorem, potentials of finite range, low energy scattering, scattering by square well, hard sphere, coulomb potential, reduction of two body problem, the center of mass frame, transformation from center of mass frame to laboratory frame of reference and collision between identical particle
CO3	In this section student will learn about ferromagnetic order, curie temperature and exchange integral, temperature depends on saturation, magnetization, saturation magnetization at absolute zero value, magnons, quantization of spin wave, thermal excitation of magnons, magnetic scattering, ferrimagnetic order, curie temperature and susceptibility of ferrimagnets, iron garnets, Neel temperature, anti-ferromagnetic order, magnons, ferromagnetic domains, anisotropy energy, coercitivity and hysteresis, geomagnetism and biomagnetism and force microscopy
CO4	In this section student will learn about nuclear magnetic resonance, equation of motion, motional narrowing, hyperfine splitting its examples, F centers in alkali halides, donor atoms in silicon, knight shift, nuclear quadrupole resonance, ferromagnetic resonance, shape effect in FMR, spin wave resonance, antiferromagnetic resonance, electron paramagnetic resonance, zero field splitting, principle of MASER action and three-level MASER, LASERS

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**1**	**2**					**1**		
CO2	**3**	**2**	**2**			**1**		**1**				
CO3	**3**	**2**	**2**				**2**					
CO4	**3**	**2**	**2**		**1**				**2**	**2**		

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														

MPHY314DSC: - ELECTRONICS-III

Course Objective:

(i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics include Different types of Plus modulation like Pulse amplitude, Pulse code, Pulse time, Pulse position, Pulse width modulation. Digital carrier systems like ASK, FSK & PSK. Principal of A.M Detection and classification of A.M. Detector. How remote sensing system works and which sensor and plate form use this systems. Introduction of GIS and its Architecture & work flow. Importance of power electronics and daily uses Electrical machines and some Phase converters.

Credit: - 04

Content

Unit	Description in detail	Credit	Weightage
1	**POWER ELECTRONICS**	1	25 %

	Pulse Modulation Pulse amplitude modulation, Pulse code modulation, PCM Receiver, Pulse time modulation, Pulse position modulation, Pulse width modulation. Synchronization, Probability of bit error in base band transmission, matched filter, Bit-timing recovery, carrier recovery systems. **Digital carrier systems** Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), FSK Transmitter, FSK Receiver, Phase Shift Keying(PSK).		
2	**DEMODULATION** Principle of A.M. detection and classification ofA.M. detectors, Envelope diode detector, op-amp envelope detector, automatic volume control, frequency demodulation, slope detector, Balanced slope detector, Foster-seeley discriminator, limiter, Radio detector, Quadrature detector, phase locked loop.	1	25 %
3	**REMOTE SENSING** **Remote Sensing Principles:** Electromagnetic remote sensing process, Radiation laws, Atmospheric interaction with electromagnetic radiation, Interaction with earth surface and spectral signatures, **Remote Sensing Platforms and Sensor:** Satellite system parameters – instrumental parameters, viewing parameters, Sensor parameters – spatial resolution, spectral resolution, radiometric resolution, Imaging sensor systems. Fundamental of GIS: GIS Definitions and Terminology, GIS Architecture, Components of a GIS, GIS Work Flow.	1	25 %
4	**POWER ELECTRONICS** **Fundamental of Power Electronics:** Important rules for finding Fourier Series. Expression for Voltage, Current and Power factor. Laplace Transform, Inverse Laplace Transform. Performance parameter of Rectifiers. Introduction to Discrete Fourier transform. **Basic of Electrical Machines:** D.C. motors, Types of D.C. motors, torque speed characteristics. Induction motors, Types of Induction motors. Synchronous machines and stepper	1	25 %

	motors. **Convertes:** Single phase and three phase converters, Series converters, Dual converters.Effect of source and leakage inductance on the performance, Power factor improvement. Single phase dual converter, three phase dual converter, three phase AC voltage controllers		

Reference Books:

- Hand Book of Electronics (Basic) Gupta and Kumar, Pragati Prakashan, Meerut
- Remote sensing and Geographical Information systems, Anji Reddy, B.S. Publications, (3rd edition), 2006
- Electronic communications, Roddy D. and CoolIn J., PHI, 2006
- Power Electronics P.C. Sen
- Power Electronics R.M. Jalnekar& N.B. Pasalkar
- Thyristor power Controllers. C.K Dubey, S.R. Doradla, A. Joshi & R.M. Sinha
- Power Electronics – By M. Rashid
- Electronic Devices and Components, by J. Seymore (Longmann Scientific & Technical).
- Integrated Electronics, by K. R. Botkar, (Khanna Publishers.)
- Solid State Pulse Circuits, by David A. Bell (Prentice Hall of India Pvt. Ltd).
- Energy Technology (Non conventional, Renewable and conventional), by S. Rao and Dr. P. B.Parrulkar (Khanna Publishers.)

Suggested Readings:

- Power Electronics –J. S. Katre Techn over Publication
- Basic Electronics and Linear Circuits by N.N.Bhargava, D.C.Kulshreshtha, S.C.Gupta McGraw
- Integrated Electronics: Analog and Digital Circuits Systems, by J. Millman and C. C. Halkias (Tata McGraw -Hill Publishing Company Ltd.).

Online Resources:

- https://www.electronics-tutorials.ws/
- www.youtube.com
- https://www.tutorialspoint.com/

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand the different pulse modulation, digital carrier systems, A.M Detector, Remote sensing systems, GIS, and Different types of Electrical Machine-like D.C motor & it's types, Induction motors and its types, Synchronous machines and stepper motors and some Phase converter like Single phase and three phase converters, Series converters, Dual converters
CO2	They Develop their skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	They also develop their working circuit knowledge with experiment skill and active to solve the Different query regarding any circuit or Instruments
CO4	Students can able to learn about basics of power electronics, their design, working, and detectors

CO - PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**3**	**2**			**1**		**1**			
CO2	**3**	**3**	**2**			**1**		**2**		**2**		
CO3	**3**	**2**	**2**		**1**							
CO4	**3**	**2**	**2**	**2**				**1**		**1**		

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**2**	**2**
CO2													**2**	**2**
CO3													**2**	**2**
CO4													**2**	**2**

MPHY315PRA: -Group – I

Credit: -03

Practical / Activities:

LIST OF PRACTICALS

1. e/m by Magnetron Valve.
2. Temperature Co-efficient of Platinum resistance Thermometer by Carry Foster or C.G. Bridge.
3. Study of Hall Effect.
4. Study of hysteresis of Anchor ring / transformer using C.R.O.
5. E.B. Plate (Determination of unknown wavelength and air gap).
6. F.P. Interferometer.
7. L by Rayleigh's method
8. An optical method for determining dielectric constant, dipole moment and polarizability of a polar liquid by Hollow Prism.
9. Computer
10. Computer

MPHY315PRA: -Group – II

Credit: -03

Practical / Activities:

LIST OF PRACTICALS

1. Transistorized R.C. Phase shift Oscillator.

2. UJT as a Relaxation Oscillator.
3. Astable Multivibrator.
4. Study of Power Amplifier.
5. FET amplifier.
6. Inverting OP-AMP.
7. Differential Amplifier.
8. Regulated Power Supply (78xx & 79xx).
9. MOSFET Characteristics.
10. Schmitt trigger using transistor.

MPHY317SE: - RESEARCH METHODOLOGY

Course Objective:

(i) The objective of the course to impart fundamental knowledge about some selected aspects of physics. The topics basic concepts of research, structure and variability of Physics,some industry relevant topics are also covered under which basic concepts are taught.

Content

Unit	Description in detail	Credit	Weightage
I	**What is research?** What is research? Science and research, Basic and applied research, Essential steps in Research. Literature Collection: Needforreviewofliterature,Reviewprocess,Researchreading, Referencecards,Literaturecitation, Differentsystems.	1	50 %
II	**Components of Research Report/Thesis** Field work and laboratory work, photography, Preparation of tables, Preparation of figures. Research Report/Thesis –Formatting and Typing (Computing): Titlepage,certificate,declaration,acknowledgement,listoftable	1	50 %

	,figures,abbreviationsand symbols,chapterquotations,table,figures,summary,appendices,referencesetc		

Reference Books:

- ResearchMethodologywithstatisticalpakageforsocialsciencesDr.A.SafeevanRao &Dr.Dipak, Tyagi, Shree Nivas Pub.-Jaypur
- Research Methodology G.R Basotia and K.K. Sharma, Mangal DeepJaypur

Suggested Readings:

- Research Methodology Modern methods and New techniques M.N. Borse, Shree Nivas Jaipur
- Research Methodology Modern methods and techniques, Anil Tandon, Annol NewDelhi

Online Resources:

1. https://education.nationalgeographic.org/resource/resource-library- research methodology
2. https://byjus.com/physics/research/
3. https://new.bhu.ac.in/Content/Syllabus/Syllabus_300620200413105019.pdf
4. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019JA027497
5. https://www.realclearscience.com/articles/2016/11/05/whats_the_difference_between_an_airglow_and_an_aurora_110077.html
6. https://www.nasa.gov/mission_pages/sunearth/multimedia/magnetosphere.html
7. https://en.wikipedia.org/wiki/Magnetosphere
8. https://science.nasa.gov/heliophysics/focus-areas/magnetosphere-ionosphere
9. https://www.swpc.noaa.gov/phenomena/earths-magnetosphere

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to understand about fundamental knowledge of research
CO2	The student understands about literature collection, Components of Research Report/Thesis & Formatting and Typing

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**2**		**2**	**1**	**1**				
CO2	**3**	**3**	**3**		**2**				**1**	**1**		

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**3**	**2**
CO2													**3**	**3**

MPHY411DSC: -Nuclear Physics-II & Bio-Physics

Course Objective:

a) The course gives an overview of modern nuclear and particle physics, stressing fundamental concepts and processes.
b) Methods of measurement and applications within other sciences and technology will be reviewed.
c) Nuclear and nucleon properties and models to describe them. Strong and weak interaction.

Credit: - 04

Content

Unit	Description in detail	Credit	Weightage
I	**NUCLEAR MODEL** Singleparticleshellmodel,spin-orbitpotential,analysisofshellmodelpredictions–spin sandparities of nuclear ground states, magnetic moments, electric quadrupole moment, nuclear isomerism, stripping reactions and shell model, Collective nuclear model – rotational states and vibrational states, a brief description of Nilsonmodel.	**15**	**25%**
	ELEMENTARY PARTICLES	**15**	**25%**

II	Classification of elementary particles, type of interaction, Baryon number, lepton number, parity, charge conjugation and time reversal, CPT theorem, charge independence nuclear forces, Isospinm consequences of Isospin, G-Parity, Strange particles, associated prediction, Gell-mann Nishijima scheme, Neutral K-meson, strangeneSs, hypercharge, CP-violation in K- decay, Ispin and SU(2) and SU(3),Baryonandmesonmultiplates,Gell-mannOkubomassformula.Quarkmodelflavorandcolor		
III	**Separation Techniques** Introduction, Chromatography, Column chromatography, Thin layer chromatography, Paper chromatography, Adsorption chromatography, Partition chromatography, Gas liquid chromatography (GLC) , Ion exchange chromatography, Molecular exclusion chromatography, Affinity chromatography Electrophoresis: Moving boundary electrophoresis, Zone electrophoresis, Low voltage electrophoresis, High voltage electrophoresis, Gel electrophoresis, Sodium dodecyl sulphate poly acrylarnide gel electrophoresis (SDS-PAGE), Iso electric focusing, and Continuous flow electrophoresis.	**15**	**25%**
IV	**BIOMECHANICS** Striated Muscles, Contractile proteins, Mechanical Properties of Muscles, Contraction mechanism, Biomechanics of the Cardiovascular System, Blood pressure, Electrical activity during the heartbeat, Electrocardiography. **NEUROBIOPHYSICS** Introduction, The Nervous System, Synapse, Physics of membrane potentials, Membrane potential due to diffusion, Voltage Clamp, Sensory mechanism-The Eye, the visual receptors, Electrical activity and visual generator potentials, Optical defects of the eye, Neural aspects of vision, Visual communications, bioluminescence, Physical Aspects of Hearing, The Ear, Elementary acoustics, Theories of hearing, Signal Transduction, Mode of transport, Signal transduction in the cell.	**15**	**25%**

Reference Books:

- IntroductiontoNuclearphysicsTheoryandExperimentbyR.R.ROYandB.P.Nigam
- Introduction to Nuclear physics, H.A.Enge
- Nuclear physics byD.C.Tayal
- Nuclear physics by IrvingKaplan
- IntroductiontonuclearphysicsanintroductionbyS.B.Patel,NewAgeInter national Publishers

Suggested Readings:

- Khanna M. P., Introduction to particle physics,PHI
- Leon M., Particle Physics - anintroduction
- Perkins D. H., Introduction to High EnergyPhysics
- BiophysicsbyVasanthaPattabhiandN.Gautham,NarosaPub.

Online Resources:

a) https://youtu.be/sOT5ODu236Y
b) https://youtu.be/BSTRJjElDI

Course Outcomes: At the end of the course, students shall be able to

CO1	Explain the ground state properties of the nucleus for study of the nuclear structure behavior
CO2	Explain the deuteron behavior at ground and excited states
CO3	Apply deuteron physics and the Nucleon-Nucleon scattering for explaining the nuclear forces, Demonstration of the shell model and collective model descriptions, Apply various aspects of nuclear reactions in view of compound nuclear dynamics
CO4	Students can able to learn about our bodies biomecheniques and Nuro physics

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**1**			**1**			**1**		
CO2	**3**	**2**	**1**									

CO3	**3**	**2**	**1**		**1**	**2**			**1**			
CO4	**3**	**2**	**1**	**2**				**2**		**2**		

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**2**	**2**
CO2													**2**	**2**
CO3													**2**	**3**
CO4													**2**	**3**

MPHY412DSC: - CLASSICAL MECHANICS-II & ELECTRODYNAMICS-II

Course Objective:

To understand the properties of classical mechanics-ii & electrodynamics-ii systems using the knowledge of the properties of electrodynamics.

Credit: - 04

Content

Unit	**Description in detail**	**Credit**	**Weightage**
I	**Non Linear Oscillations and Chaos** Introduction, Singular Points of Trajectories, Nonlinear Oscillations, Volter's Problem, Limit cycle,Chaos, Logistic Map, Poincare System, Strange attractors	1	33 %
II	**Relativistic electrodynamics** Relativistic Mechnics, Proper Time and Proper velocity, Relativistic energy and momentum Relativistickinematics,Relativisticdynamics,Relativisticelectrodynamics,Howfieldtransform,The field tensor, Electro-dynamics in tensor notation, Relativisticpotentials.	1	33 %
III	**WAVEGUIDE** Rectangular guides, Transverse magnetic waves in rectangular guides, Transverse electric waves in rectangular guides, Impossibility of TEM waves in wave guides, cylindrical coordinates, TM and TE waves in circular guide, Wave Impedance and Characteristic impedance	1	34 %

IV	**RADIATION** Potential functions and the EM fields, potential functions for sinusoidal oscillations, oscillating electricdipole,powerradiatedbyacurrentelement,applicationto shortantenna,assumedcurrent distributions, radiations from a quarter wave monopole or half wave dipole, electromagnetic field close to an antenna, solution of the potential equations, far field approximation. Radiation- from moving charges and dipoles and retardedpotentials	1	33%

Reference Books:

- Classical mechanics-A Text Book by Suresh Chandra, Narosa Publishing House NewDelhi.
- ClassicalMechanics(2nd Edition),HerbertGoldstein,Addison-WesleyPublishingCo.
- Handbook of Electronics by Kumar and GuptaPragatiPrakashan
- Introduction to Electrodynamics (2nd & 3rd Edition) J. Griffiths, Prentice Hall IndiaLtd.

Suggested Readings:

- Statistical Mechanics - An Introduction by Evelyn Guha, Narosa Publishing House
- Classical Mechanics, V. B. Bhatia, Narosa Publishinghouse.
- Classical Mechanics, G. Aruldhas PHI Pvt.Ltd.
- Classical Mechanics, J. C. Upadhyaya Himalaya PublishingHouse.

- Handbook of Electronics by Kumar and GuptaPragatiPrakashan
- Introduction to Electrodynamics (2nd & 3rd Edition) J. Griffiths, Prentice Hall IndiaLtd.

Online Resources:

1. https://sites.google.com/a/phys.buruniv.ac.in/statmech2/my-reading-list
2. https://www.coursera.org/learn/statistical-mechanics

3. www.wikipedia.com
4. Swayam portal

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of properties of classical mechanics. They will be able to explain various properties of electrodynamics
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results
CO3	Apply the various procedures and techniques for the experiments
CO4	Students can able to learn about the radiation and its effects and approximation methods of it

CO-PO Competency and Program Indicators (PI)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**2**	**1**		**1**		**1**		**1**		
CO2	**2**	**1**	**1**		**2**				**1**			
CO3	**2**	**1**	**2**				**1**			**1**		
CO4	**2**	**2**	**2**	**2**	**1**				**1**			

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													**2**	**1**
CO2													**2**	**1**
CO3													**1**	**2**
CO4													**1**	**1**

MPHY413PRO: - PROJECT WORK

Credit: -16

- PROJECT REPORT
- PROJECT PRESENTATION
- VIVA