SHSB1102	GENERAL ENGLISH - I	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide opportunities for students to read and respond to representations of current issues
- To prepare the students to effectively communicate by applying reflective thinking practices
- To provide an opportunity to the students to improve their vocabulary

UNIT 1 **9 Hrs.**

Listening to identify vocabularies- Self Introduction - Developing dialogue between characters -Talking about neighbours, family members, likes and dislikes, Reading Comprehension strategies- Parts of Speech- Kinds of Sentences Connectives and Discourse markers - Rearranging the Jumbled sentences, EMail Writing.

UNIT 2 **9 Hrs.**

Listening for Inference- Just a Minute speech- Types of words- Compound words, abbreviations and acronyms, Word Association- Tenses and its Types- Voice- Impersonal Passive- Rules of Passive voice formation - Transcoding - Encoding and Decoding- Bar chart, Pie Chart

UNIT 3 **9 Hrs.**

Listening to telephonic talk to fill blanks- Giving information- travel, hotel booking, making enquiries about availability of seats for admission, asking about courses - Question Tags – Open ended and Close ended questions, Concord, Single - Line Definition - Note Making - Preparing checklists

UNIT 4 **9 Hrs.**

Listening to summarise the information- Reading and identifying the topic sentence, - Editing - PunctuationError Corrections, „If „Conditionals, Idioms & Phrases, Instructions & Recommendations – Drafting a brochure/Advertisement.

UNIT 5 **9 Hrs.**

Listening to Movie reviews and book reviews, Listening and summarizing- Giving impromptu talks - Reading and Summarizing -Types of words- Homonyms, Homophones, eponyms, acronyms- Writing a Paragraph, Descriptive Essay, Dialogue Writing.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember knowledge of linking words related to both spoken and written discourse.
CO2 - Understand collocations, words to express one‟s point of view in both writing and speaking.
CO3 - Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given,
CO4 - Analyse critical thinking skills by framing questions related to elements of reasoning.
CO5 - Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation
CO6 - Equip the students with the required Professional Skills.

TEXT / REFERENCE BOOKS

1. Sen S, Mahendra etal. (2015) Communication and Language Skills. Foundation books. Chennai
2. Strunk, William Jr., and E.B. White. The Elements of Style. Allyn and Bacon, 2000.
3. Murphy, Raymond. English Grammar in Use. Cambridge University Press, 2012.
4. Thomson, A.J., and A.V. Martinet. A Practical English Grammar. Oxford University Press, 1986.
5. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
6. O'Conner, Patricia T. Woe is I: The Grammarphobe's Guide to Better English in Plain English. Riverhead Books, 2019.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB1102	PROPERTIES OF MATTER	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- It gives a brief idea of the physical parameters and their relevance in our day to day life.
- To impart a thorough knowledge about liquid motion and various relevant theoretical facts. It creates a platform for in depth understanding in low temperature Physics
- It gives a brief idea of the crystalline materials and their structural determination using various methods.

UNIT 1 ELASTICITY 9 Hrs.

Modulus of elasticity- Poisson's ratio- Relation between elastic constants and Poisson's ratio-Energy stored- Twisting couple on a cylinder- Torsional pendulum (with and without weights)- Bending of beams- Bending moment- Cantilever loading- Transverse vibrations of cantilever-Non- uniform and uniform bending of a beam-Koenig's method – Determination of Y and n for the material of the spring.

UNIT 2 VISCOSITY AND LOW PRESSURE 9 Hrs.

Newton's law- Poiseuilles flow- Stoke's fall- Rotation viscometer- Ostwald viscometer- Meyer's formula for viscosity of gas-Rankine's method- Effect of temperature and pressure on viscosity- Air pump-Rotary oil pump-Mercury diffusion pump- McLeod gauge-Pirani gauge- Knudsen Gauge.

UNIT 3 SURFACE TENSION 9 Hrs.

Molecular interpretation- surface energy- Pressure difference across a curved surface- Excess pressure in liquid drops and air bubbles-Molecular forces- Shape of liquid meniscus in capillary tube-Angle of contact- Capillary rise and energy consideration- Jaeger's method- Quincke's drop- Vapour pressure over flat and curved surfaces.

UNIT 4 GRAVITATION 9 Hrs.

Classical theory of gravitation : Kepler's laws, Newton's law of gravitation – G and measurement – Earth – moon system – weightlessness – earth satellites – parking orbit – earth density – mass of the Sun – gravitational potential – velocity of escape – satellite potential and kinetic energy. Einstein's theory of gravitation **:** Introduction – the principle of equivalence – experimental tests of general theory of relativity – gravitational red shift – bending of light – perihelion of mercury.

UNIT 5 CRYSTAL PHYSICS 9 Hrs.

Crystal structures: Introduction – periodic array of atoms – crystal lattice – unit cell – basis – symmetry considerations – classification of crystals – Bravais lattices in three dimensions – crystal planes and Miller indices – simple crystal structures. Crystal diffraction: Bragg's law – experimental X-ray diffraction methods :- Laue method – rotating crystal method – powder method – neutron diffraction.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire in depth knowledge about our modulus of elasticity.
CO2 - Apply the Concepts to several relevant fields like Material Science, Civil and Mechanical streams.
CO3 - Develop the theoretical and practical skills towards industrial applications,
CO4 - Choose the optional subjects of interest for further study and research.
CO5 - Relate the advanced topics easily later for higher studies.
CO6 - Correlate with growth of single crystals

TEXT / REFERENCE BOOKS

1. Properties of matter – Brijlal and Subramanian, S.Chand Co., Ltd (2001).
2. Properties of matter and acoustics –R.Murugesan, KiruthigaSivaprasad, S.Chand Co., Ltd (2013).
3. Elements of Properties of matter – D.S. Mathur.S.Chand, Ltd (1968).
4. Properties of matter – Subramanian Iyer and Jeyaraman.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SMTB1110	ANCILLARY MATHEMATICS-I	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVES

- The ability to identify, reflect upon, evaluate and apply different types of information
- To enhance the knowledge to form independent judgments. Analytical, logical thinking
- To educate the conclusions based on quantitative information will be the main objective of learning this subject.

UNIT 1 **9 Hrs.**

Polynomial equations – Imaginary and Irrational roots – relation between roots and coefficients of equations Symmetric functions of roots interms of coefficients of third degree equation -problems.

UNIT 2 **9 Hrs.**

Characteristic Equation of a square matrix - Eigen values, Eigen vectors of a real matrix, Properties of Eigen values and Eigen vectors. Cayley Hamilton Theorem (without proof) Verification - Finding inverse and power of a matrix.

UNIT 3 **9 Hrs.**

Differentiation of all standard functions (without proof): Product rule, quotient rule, functions of a function rule, logarithmic differentiation, differentiation of implicit function. Applications of differentiation: maxima, minima of a curve.

UNIT 4 **9 Hrs.**

Methods of Integration - Integration by parts-Bernoulli‟s formula- Definite Integrals - Properties of Definite Integrals-Simple problems..

UNIT 5 **9 Hrs.**

Formation of ODE - Solving higher order linear differential equations with constant coefficients: Particular integral for.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify using Cayley Hamilton theorem, the power and the inverse of the matrix..
CO2 - Understand the concept of derivatives to find maxima and minima of a curve..
CO3 - Solve problems involving the various methods of integration
CO4 - Point out the complementary function and particular integral of ODE..
CO5 - Apply the concept of probability to solve the problems.
CO6 - Produce the conditional probability problems using Baye‟s theorem.

TEXT / REFERENCE BOOKS

1. T.K.Manickavachagam Pillai, Matrices, S.Viswanathan Printers & Publishers, 2012.
2. Dipak Chatterjee, Integral Calculus and differential equations, TATA McGraw S Hill Publishing Company Ltd.,2000.
3. Narayanan, T.K. Manichavasagam Pillai, Calculus, Vol. I, S. Viswanathan Printers Pvt. Limited, 2007.
4. P. R. Vittal, Mathematical Statistics, Margham Publications, Chennai, 2002..

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB2102	PROPERTIES OF MATTER LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To explain the laws of orbit and the gravitational phenomenon surrounding us.
- To impart basic understanding of the various physical techniques practically. It caters the needs for engineering applications.
- To give details about physical properties of materials and inculcates interest to observe facts Experimentally

LIST OF EXPERIMENTS

1. Rigidity modulus of a wire using Torsional Pendulum
2. Wavelength of Laser source using Diffraction grating
3. Young‟s modulus of a bar - non uniform bending - Pin and Microscope
4. Refractive index of the given liquid- Spectrometer - Hollow Prism
5. Surface tension of a liquid by Capillary raise method
6. Viscosity of highly viscous liquid using Stokes method
7. Young‟s modulus of a bar - uniform bending - Pin and Microscope
8. Coefficient of viscosity – Burette method.
9. Coefficient of thermal conductivity of a bad conductor – Lee disc method
10. Magnetic susceptibility of Liquid – Quinke‟s method

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire in depth knowledge about our modulus of elasticit
CO2 - Apply the Concepts to several relevant fields like Material Science, Civil and Mechanical streams.
CO3 - CO3 - Develop the theoretical and practical skills towards industrial applications,
CO4 - Choose the optional subjects of interest for further study and research.
CO5 - Relate the advanced topics easily later for higher studies.
CO6 - Produce the conditional probability problems using Thermal methods.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB2103	MODERN PHYSICS LAB- I	L	T	P	EL	C	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To understand about the paramagnetic solution and find the susceptibility of a materials.
- To study about the energy loss of material by hysteresis loop.
- To measure the young's modulus of a material

LIST OF EXPERIMENTS

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
3. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
4. To study IV characteristics of PN diode, Zener and Light emitting diode.
5. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
6. To study Lissajous Figures
7. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
8. To determine the modulus of a material by searl's method.
9. Determine the resistance of a wire by potentio meter
10. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire in depth knowledge about our ferromagnetism
CO2 - Apply the Concepts to several relevant fields like Material Science,
CO3 - Develop the theoretical and practical skills towards industrial applications,
CO4 - Choose the optional subjects of interest for further study and research.
CO5 - Relate the Zener diode and PN junction diode.
CO6 - Acquire knowledge of Lissajous figure

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SHSB1201	GENERAL ENGLISH- II	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide opportunities for students to read and respond to representations of current issues through texts that present themes and topics that are familiar, insightful and informative.
- To provide an opportunity to the students to improve their vocabulary
- To develop skills relating to creative writing

UNIT 1 **9 Hrs.**

Listening for details, Speaking - making a presentation, reading for details and Global Comprehension Vocabulary Binomials, Types of Words- Synonyms, Antonyms that describe people, things and their actions - Paired Expressions -Letter Writing - Informal Letters- Letter to a Friend / Family Members - Creating blogs to post written materials

UNIT 2 **9 Hrs.**

Listening for details - Speaking: Giving Interview, Public Speech based on specific topics given. Reading for Comprehension and for overall idea - Vocabulary: phrases - Sentence Pattern – Contextual guessing of words– Singular, Plural– Letter writing- Formal letters- Inviting dignitary for a function, Application for job with resume.

UNIT 3 **9 Hrs.**

Listening for details - Telephonic conversation – Speaking: Narrating a Story - Vocabulary: positive and negative connotations - Language Focus: Adjective- Degrees of Comparison, Direct and Indirect Speech -Types of Sentences (simple, compound, complex) - Collocations -Letter to the Editor (Social Issues) –Hints Development.

UNIT 4 **9 Hrs.**

Listening for Overall information - Making requests and suggestions - Speaking: Group Discussion - Vocabulary: Homonyms and Homophones - Language Focus: Transitive and Intransitive verbs - Writing:
Precis writing, Story Writing - Process description (Flow chart)

UNIT 5 **9 Hrs.**

Listening for specific details - Speaking using imagination. Reading to identify facts – Language Focus : Modal Auxiliary Verbs Writing: Imaginative writing by predicting, Argumentative Essay, Writing a Book or Film review. Vocabulary: Countable and Uncountable Nouns, foreign nouns and framing of plurals.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Remember knowledge of linking words related to both spoken and written discourse
CO2 - Understand collocations, words to express one"s point of view in both writing and speaking
CO3 - Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given
CO4 - Analyse critical thinking skills by framing questions related to elements of reasoning
CO5 - Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation
CO6 - Equip the students with the required Professional Skills

TEXT / REFERENCE BOOKS

1. Strunk Jr., William, and E.B. White. The Elements of Style. Allyn and Bacon, 2000.
2. Murphy, Raymond. English Grammar in Use. Cambridge University Press, 2019.
3. Thomson, A.J., and A.V. Martinet. A Practical English Grammar. Oxford University Press, 2013.
4. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
5. Swan, Michael. Practical English Usage. Oxford University Press, 2016.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB2101	MECHANICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study the rotational and vibrational motion of rigid body.
- To determine the Centre of gravity, Centre of pressure, Centre of mass.
- To acquire the details of the Relative motion.

UNIT 1 DYNAMICS 9 Hrs.

Rigid body - moment of inertia - radius of gyration - moment of inertia of a solid cylinder, hollow sphere with external and internal radii. Compound pendulum - theory - equivalent simple pendulum - reversibility of centers of suspension and oscillation - determination of g and k - Kater's pendulum.

UNIT 2 STATICS AND HYDROSTATICS 9 Hrs.

Centre of gravity - Centre of gravity of a solid and hollow tetrahedron, solid and hollow hemisphere, solid cone. Centre of pressure - Centre of pressure of a vertical rectangular lamina. Laws of floatation - meta centre - meta centric height of a ship.

UNIT 3 FRAME OF REFERENCE 9 Hrs.

Laws of Mechanics, Inertial frames of reference and three type of co-ordinate system (qualitative), Galilean transformations, conservation of momentum. Non-Inertial Systems: Non-inertial frames and fictitious forces - Rotating frames of reference Centrifugal force - Coriolis force and its applications.

UNIT 4 SPECIAL THEORY OF RELATIVITY 9 Hrs.

Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity – Consequences of special relativity- Time Dilation – Length Contraction - Relativistic Doppler effect – Lorentz Transformation - Lorentz Velocity Transformation - Relativistic Kinematics - Transformation of Energy and Momentum.

UNIT 5 OSCILLATIONS 9 Hrs.

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Resonance, sharpness of resonance; power dissipation and Quality Factor.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Study about the Relative motion, Inertial and non- inertial reference frames.
CO2 - Calculate Centre of mass and inertia tensor of mechanical systems.
CO3 - Students can learn about the Newton's laws of motion and conservation principles.
CO4- Establish the knowledge about Michelson-Morley experiments with interferometer, Lorentz Transformation
CO5 - Learn Constant relative motion of different bodies.
CO6 - Understand the concept of oscillations and its solutions

TEXT / REFERENCE BOOKS

1. An introduction to Mechanics, Daniel Kleppner and Robert Kolenkow, Cambridge, Second Edition, March 2021
2. Mechanics by J.C. Upadhyaya, Ram Prakash Publications, January 2017.
3. Fundamentals Of Mechanics by Mohit Kumar Sharma|Suresh Chandra, Wiley India, January 2021.
4. Introduction To Mechanics, Chittaranjan Ghosh, TECHNO WORLD PUBLICATION, March 2021
5. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2016
6. Mechanics -J.C. Slater and N. H. Frank (McGraw-Hill)
7. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A.Serway, 2010
8. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2017, Tata McGraw-Hill.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SMTB1208	ANCILLARY MATHEMATICS-II	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVES

- To study the rotational and vibrational motion of rigid body.
- To determine the Centre of gravity, Centre of pressure, Centre of mass.
- To acquire the details of the Relative motion.

UNIT 1 TRIGONOMETRY 9 Hrs.

DeMoivre"s Theorem-Expansion of sinn, cosn, sinn, cosn, sin, cos- Hyperbolic functions, Inverse Hyperbolic functions, Relation between Circular and Hyperbolic Functions - Separating into Real and Imaginary parts.

UNIT 2 PARTIAL DIFFERENTIAL EQUATIONS 9 Hrs.

Formation of PDE by eliminating constants and functions - Solution of linear homogeneous PDE of higher order with constant coefficients.

UNIT 3 NUMERICAL METHODS FOR SOLVING EQUATIONS 9 Hrs.

Solution of algebraic equation and transcendental equation: Regula Falsi Method, Newton Raphson Method– Solution of simultaneous linear algebraic equations: Gauss Elimination Method, Gauss Jacobi and Gauss Seidel Method

UNIT 4 NUMERICAL INTERPOLATION 9 Hrs.

Difference operators-Relation between the operators-Interpolation: Newton"s forward and backward difference interpolation formula (equal interval) - Lagrange"s interpolation formula (unequal interval).

UNIT 5 INTRODUCTION TO PROBABILITY 9 Hrs.

Definitions: Sample Space, Events – Addition Law of probability – Multiplication law of probability Conditional probability – Baye"s theorem (without proof) – problems on Baye"s theorem.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the trigonometric functions and the relation between circular and hyperbolic functions
CO2 - Understand the concept of formation of PDE and solving them.
CO3 - Use Gauss method to solve system of linear equations.
CO4 - Discuss the problems on the numerical interpolation methods.
CO5 - Apply the concept of probability to solve the problems.
CO6 - Produce the conditional probability problems using Baye"s theorem.

TEXT / REFERENCE BOOKS

1. 1. Narayanan. S, Manicavachagom Pillay. T.K, Trigonometry, S.Viswanathan Printers & Publishers 1980.
2. S. Arumugam& Others, Trigonometry, New Gamma Publications, Revised Edition, 1985.
3. Kandasamy P, Thilagavathy. K and G. Gunawathy, Numerical Methods, S.Chand & Sons,3rd Revised Edition, 2013.30
4. Balagurusamy. E, Numerical Methods, Tata Mcgraw Hill Publishing Company, 3rd Edition, 2000.
5. Narayanan, T.K. Manichavasagam Pillai, Calculus, Vol. I, S. Viswanathan Printers Pvt. Limited, 2007.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice **20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

SPHB2201	MECHANICS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To understand about the paramagnetic solution and find the susceptibility of a materials
- To study about the energy loss of material by hysteresis loop
- To measure voltage and frequency by CRO

LIST OF EXPERIMENTS

1. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c)Modulus of rigidity
2. To investigate SHM using an oscillating spring
3. To determine the Moment of Inertia of a Flywheel
4. To determine the elastic Constants of a wire by Searle's method
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle
6. To determine the meta centric height of ship model
7. To determine the value of g using Kater's Pendulum
8. To determine the value of g and K using Compound Bar Pendulum
9. To determine of g using simple pendulum
10. Verification of Law of floatation

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - To determine the simple harmonic oscillation for spring.
CO2 - To determine the moment of Inertia of a flywheel
CO3 - To determine the elastic constants of a wire
CO4 - To determine of g using simple pendulum
CO5 - To determine g using Kater's pendulum
CO6 - To determine SHG of a oscillating spring

TEXT/REFERENCE BOOKS

1. An introduction to Mechanics, Daniel Kleppner and Robert Kolenkow, Cambridge, Second Edition, March 2021
2. Mechanics by J.C. Upadhyaya, Ram Prakash Publications, January 2017.
3. Fundamentals Of Mechanics by Mohit Kumar Sharma|Suresh Chandra, Wiley India, January 2021.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB2202	BASIC COMPUTER LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- Develop programs using C Programming Language
- Understand problem statements and identify appropriate solutions
- To understand the usage of pointers

LIST OF EXPERIMENTS

1. Write a Program to calculate and display the volume of a CUBE having its height (h=10cm), width (w=12cm) and depth (8cm).
2. Write a program to take input of name, roll no. and marks obtained by a student in 4 subjects of 100 marks each and display the name, roll no. with percentage score secured.
3. Write a program to print whether a given number is even or odd.
4. Write a program to print positive integers from 1 to 10.
5. Write a program to insert 5 elements into an array and print the elements of the array.
6. Write a program to calculate factorial of a number using recursion.
7. Write a program to find biggest among three numbers using pointer.
8. Write a program to find smallest among three numbers using pointer.
9. Write a C program to create, declare and initialize structure.
10. Write a program to create a file called emp. rec and store information about a person, in terms of his name, age and salary

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explore the basic knowledge of C programs.
CO1 - Apply the concept of control structures to solve any given problem.
CO3 - Apply concept of structures to write programs.
CO4 - Apply the knowledge in solving problems
CO5 - Apply the usage of pointers for programs
CO6 - Apply the knowledge in solving numerical problems using C

TEXT / REFERENCE BOOKS

1. Dr. Guruprasad Nagraj, “C Programming for Problem Solving”, Himalaya Publishing House. ISBN-978-93-5299-361
2. 1. Pradip Dey, Manas Ghosh, “Programming in C”, 2nd Edition, 2018, Oxford University Press, ISBN: 978-01-9949-147-6. 3.
3. Kernighan B.W and Dennis M. Ritchie, “The C Programming Language”, 2nd Edition, 2015, Pearson Education India, ISBN: 978-93-3254-944-9.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB1301	THERMAL AND STATISTICAL PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To make the student familiar with measurement techniques of force, torque and speed
- To make the student familiar with pressure and temperature measurement techniques
- To Provide basic concepts of thermal and statistical physics in interdisciplinary importance

UNIT 1 BASIC CONCEPT OF INSTRUMENTATION 9 Hrs.

Basic concepts of Instrumentation: Methods of measurement-direct method, indirect method, mechanical, electrical and electronic instruments; Measurement systems: static characteristics-accuracy, sensitivity, linearity, precision, resolution, threshold, range, hysteresis, drift; dynamic characteristics -measuring lag fidelity, speed of response, dynamic error; Definition and type of errors-systematic errors, instrumental errors, environmental errors, random errors; propagation of error; Error calculation.

UNIT 2 MEASUREMENT OF FORCE, TORQUE, SPEED, ACCELERATION 9 Hrs.

Force and torque measurement: Load cell, Different types of load cells: Hydraulic, Pneumatic, Magneto-elastic and Piezoelectric load cells (concept); Strain gauge- concept and required mathematical expression for measurement of force and torque; Speed measurement- capacitive tachometer, DC and AC tacho generators; Acceleration measurement – LDVT accelerometer and its mathematics, particle accelerometer.

UNIT 3 TEMPERATURE AND PRESSURE MEASUREMENT 9 Hrs.

Definition, standards and different temperature scales; Bimetallic thermometer, Resistance thermometers; Thermistors- types and their mathematical expression for R-T variation; Thermocouples-types, laws of thermocouple, cold junction compensation; Thermopiles in series and parallel connection; Pyrometer- radiation type; IC temperature sensors. Pressure -Definition and unit, Direct and indirect pressure gauges; Manometer types, U-tube manometer with derivation of pressure; Elastic type pressure transducer (concept); Electric pressure transducer – capacitive, resistive; Vacuum gauges- Mc Leod gauge with derivation of unknown pressure; Thermocouple gauge; hot and cold cathode ionization gauge.

UNIT 4 MEASUREMENT OF FLOW, LEVEL, DENSITY, VISCOSITY, HUMIDITY 9 Hrs.

Types of flowmeter, Bernoulli's principle in flow measurement; Differential flowmeter- orifice plate, venturi tube; Electromagnetic flowmeter with mathematical expression of flow rate; Ultrasonic flowmeter; Level measurement- float gauge, resistive type level indicator, ultrasonic level gauging; Density measurement- hydrometer, Radioactive densitometer, gas densitometer; Viscosity measurement- Saybolt viscometer, rotameter type; Humidity measurement- Hygrometer (resistive and capacitive type); Electrolytic hygrometer.

UNIT 5 DIGITAL MEASUREMENT AND DISPLAYS 9 Hrs.

Digital Instruments: Block diagram, principle of operation and accuracy of measurement of -Digital Multimeter, Kilowatt Hour meter, Digital Tachometer, Ultrasonic Distance meter, Digital Thermometer, Frequency meter. Seven segment digital display devices- construction and operation.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Applying the concept of measurement, error calculation while performing experiments practically.

CO2 - Acquire a detailed knowledge of industrial measurement

CO3 - An exposure to various available techniques of temperature and pressure measurement

CO4 - A detailed knowledge of fluid property measurement will be obtained

CO5 - An idea of newly evolving digital measurement techniques is gained.

CO6 - An idea on seven segment display and constructions is acknowledged

TEXT BOOKS / REFERENCE

1. Patranabis D., "Principles of Industrial Instrumentation", Tata McGraw Hill, II Edition, New Delhi, Reprint 2009
2. Singh. S.K., "Industrial Instrumentation &Control" 3rd Edition, Tata McGraw Hill, Reprint 2009
3. Krishnaswamy. K &Vijayachitra. S, "Industrial Instrumentation" New age International, Reprint 2008.
4. Ernest O. Doebelin, Dhanish. N. Manik, "Measurement Systems Application & Design", TMH, 5th Edition, 2004
5. Jain R.K, "Mechanical & Industrial Measurements", Khanna Publishers, 11th Edition, 2004
6. T. S. Rathore, "Digital Measurement Techniques" CRC Press, 2003

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration **3 Hrs**

PART A: 10 Questions of 2 mark each - No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks. **80 Marks**

SCYB1303	ANCILLARY CHEMISTRY – I	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To know about the water quality parameters and the methods to estimate the hardness of water.
- To understand the charging and discharging characteristics in batteries.
- To understand the various synthesis of nanomaterials, organic materials and their applications.

UNIT 1 WATER TECHNOLOGY 9 Hrs.

Introduction: Water quality parameters - Contamination of water by arsenic, lead, fluoride, mercury and their removal. Hardness: Types - Expression - Units. Estimation of hardness of water by EDTA method - Problems. Estimation of iron, calcium and magnesium: AAS method. Water softening: Zeolite process – Demineralization process. Desalination: Reverse osmosis - Electrodialysis.

UNIT 2 ELECTROCHEMICAL POWER SOURCES 9 Hrs.

Electrochemistry: Galvanic cell - Electrochemical cell representation - EMF series and its significance. Batteries: Terminology - Lead-acid accumulator - Nickel-cadmium batteries. Lithium batteries: Li/SOCl2 cell- Lithium ion batteries. Fuel Cells: Hydrogen-oxygen fuel cells - Solid oxide fuel cell (SOFC).

UNIT 3 PHASE EQUILIBRIA 9 Hrs.

Introduction: Definition of phase rule - Terms involved in phase rule with examples. One component system: Water system. Two component alloy systems: Classification - Reduced phase rule - Thermal analysis. Simple eutectic system: Lead-silver system. Congruent system: Zinc-magnesium system. Incongruent system: Sodium potassium system.

UNIT 4 SYNTHESIS OF NANOMATERIALS 9 Hrs.

Introduction: Nanomaterials: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by chemical reduction method. Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and multi walled nanotubes - Applications of CNTs - Synthesis of CNTs by electric arc discharge method and laser ablation method.

UNIT 5 POLYMER CHEMISTRY 9 Hrs.

Introduction to polymers: Nomenclature - Functionality. Types of polymerization. Mechanism of polymerization: Free radical mechanism - Cationic mechanism - Anionic mechanism. Plastics: Types - Thermoplastics and thermosetting plastics. Properties: Strength - Crystalline and amorphous state – Average molecular weight - Polydispersity. Compounding of plastics. Moulding of plastics: Compression moulding – Injection moulding - Extrusion moulding. Introduction to conducting polymers.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Outline the water quality parameters of domestic and industrial water.
CO2 - Evaluate the charging and discharging characteristics of batteries and fuel cells.
CO3 - Construct the phase diagram to alloy systems for optimizing their mechanical and thermal properties
CO4 - Understand the synthesis of nanomaterials and their applications.
CO5 - Interpret various properties of polymeric materials and its industrial applications.
CO6 - Evaluate the chemistry materials for real world applications.

TEXT / REFERENCE BOOKS

1. Jain P.C. and Monica Jain, Engineering Chemistry, 15th Edition Dhanpat Rai Publishing Co., 2009.
2. Dara S.S., Text Book of Engineering Chemistry, S. Chand & Co, 2008.
3. Sheik Mideen A., Engineering Chemistry (I & II),13th Edition, Shruthi Publishers, 2010.
4. Kuriakose J.C. and Rajaram J., Chemistry in Engineering and Technology". Vol.1 & 2, 5th reprint, Tata McGraw Hill,Publishing Company (P) Ltd., 2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB1304	ELECTRICITY AND MAGNETISM	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To understand the basic concepts in static electric field and such as Coulomb's law and electric potential.
- To know about the basic concepts of magnetism and basic laws.
- To Provide basic concepts of Electricity and Magnetism in interdisciplinary importance

UNIT 1 ELECTROSTATICS 9 Hrs.

Coulomb's Law – Gauss's Law and its applications (Electric Field due to a uniformly charged sphere, hollow cylinder & solid cylinder)– Electric Potential – Potential at a point due to a uniformly charged conducting sphere – Principle of a capacitor–Capacity of a spherical and cylindrical capacitors – Energy stored in a charged capacitor–Loss of energy on sharing of charges between two capacitors.

UNIT 2 CURRENT ELECTRICITY 9 Hrs.

Ampere's circuital law and its applications -Field along the axis of a circular coil and Solenoid–Theory of Ballistic Galvanometer –Figure of merit– Damping Correction– Ki rchhoff 's Laws of Electricity – Wheatstone's Bridge–Carey Foster's Bridge–Potentiometer– Calibration of Ammeter – Calibration of Voltmeter (Low range and High range) – Comparison of Resistances.

UNIT 3 ELECTROMAGNETIC INDUCTION 9 Hrs.

Laws of electromagnetic induction– Self and mutual induction– Self-inductance of a solenoid– Mutual inductance of a pair of solenoids–Coefficient of coupling–Experimental determination of self (Rayleigh's method) and mutual inductance–Growth and decay of current in a circuit containing L and R–Growth and decay of charge in a circuit containing C and R– Measurement of High resistance by leakage.

UNIT 4 AC CIRCUITS 9 Hrs.

Alternating EMF applied to series circuits containing LC, LR and CR– Alternating EMF applied to circuits containing L, C and R–Series and Parallel resonance circuits– Sharpness of resonance–Q factor– Comparison between Series and Parallel resonant circuits –Power in AC circuits (R, L-R, L-C-R only) – Power factor–Wattless current – Choke Coil – Transformer – Uses of Transformers – Skin Effect.

UNIT 5 MAGNETISM 9 Hrs.

Intensity of Magnetization– Magnetic Susceptibility– Magnetic Permeability –Types of magnetic materials– Properties of para, dia and ferromagnetic materials–Langevin's theory of dia and para magnetism– Weiss's theory of ferromagnetism –B-H curve–Energy loss due to magnetic hysteresis – Ballistic Galvanometer method for plotting B-H curve - Magnetic properties of iron and steel.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Use of Coulomb's law and Gauss' law for the electrostatic force
CO2 - Relationship between electrostatic field and electrostatic potential
CO3 - Use of the Lorentz force law for the magnetic force
CO4 - Use of Ampere's law to calculate magnetic fields
CO5 - Knowledge of electricity and magnetism to explain natural physical processes and related technological advances.
CO6 - An idea on Ballistic Galvanometer method for plotting B-H curve and its importance

TEXT BOOKS / REFERENCE

1. BrijLal and N. Subrahmanyam, A Text Book of Electricity and Magnetism, Ratan Prakasan Mandir Educational & University Publishers, New Deihi,2000.
2. R. Murugeshan, Electricity and Magnetism, S. Chand & Company Pvt. Ltd., New Delhi – 2015
3. D. L. Sehgal, K. L. Chopra and N. K. Sehgal, Electricity and Magnetism, S.Chand & Sons. New Delhi. 1996

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SCYB2302	ANCILLARY CHEMISTRY LAB – I	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To understand the basics of chemistry laboratory
- To understand and correlate the theory with laboratory
- To understand the basic concepts of real sample results interpretation.

LIST OF EXPERIMENTS

1. Estimation of Total hardness of water sample by EDTA method.
2. Estimation of glycine by Sorenson method
3. Estimation of Ferrous ion by potentiometric method.
4. Determination of pH of a strong acid using pH meter
5. Estimation of mixture of acids by conductometric method.
6. Determination of molecular weight of unknown solute
7. Estimation of Fe by photocolorimeter
8. Estimation of Nickel in a Nickel-Steel alloy

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Estimate ionic conductance (∧c) in samples.
CO2 - Evaluate the amino acid content in samples.
CO3 - Construct the redox cell and measure emf (E cell) of the cell
CO4 - Analyse the hardness in water samples.
CO5 - Relate viscosity (η) in determining molecular weight of a polymer.
CO6 - Assess the iron content in samples by photocolorimetry.

TEXT / REFERENCE BOOKS

1. Vogel"s Text Book of Inorganic Qualitative Analysis, 4th ed., ELBS, London, 1974.
2. Inorganic lab manual by S.Mumazuddin, Shailendra Kumar Sinha. 2009.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB2301	THERMAL, ELECTRICITY AND MAGNETISM LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

- To understand the calibration of multimeter, ammeter, Voltmeter and Wattmeter
- To know the calibration techniques of thermocouple, calorimeter, carey foster bridge
- To understand the basic concepts of Thermal, Electricity and Magnetism in physical applications

LIST OF EXPERIMENTS

1. Study and checking of electrical components using multimeter
2. Verification of Kirchhoff's Law.
3. Series and Parallel A.C circuits
4. Series and Parallel Resonance
5. Measurement of self-inductance by Maxwell's inductance bridge
6. Calibration of Ammeter, Voltmeter and Wattmeter
7. EMF of thermocouple using potentiometer
8. Specific resistance using Carey Foster bridge
9. To study the characteristics of a thermistor and to measure temperature of the process.
10. Newton's law of cooling
11. Determination of emissivity of a surface of a spherical calorimeter.
12. To determine the coefficient of thermal conductivity of a rubber.
13. Measurement of Planck's constant using black body radiation.
14. Series and Parallel A.C circuits
15. Series and Parallel Resonance
16. Measurement of self-inductance by Maxwell's inductance bridge
17. Calibration of Ammeter, Voltmeter and Wattmeter
18. EMF of thermocouple using potentiometer
19. Specific resistance using Carey Foster bridge
20. To study the characteristics of a thermistor and to measure temperature of the process.
21. Newton's law of cooling
22. Determination of emissivity of a surface of a spherical calorimeter.
23. To determine the coefficient of thermal conductivity of a rubber.
24. Measurement of Planck's constant using black body radiation.
25. To study the variation of thermo emf across two junctions of a thermocouple with temperature
26. capacity of water
27. Joule's calorimeter – Specific heat

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explore the physical principle involved in the several instruments.
CO2 - Analyze the physical principle involved in all related fundamental principles.
CO3 - Think inventively and progress the innovative skills that are essential for science.
CO4 - Apply for new application.
CO5 - Explore new thermal an magnetic techniques
CO6 - Explore ideas about calorimeter

TEXT BOOKS/ REFERENCE

1. BrijLal and N. Subrahmanyam, *A Text Book of Electricity and Magnetism*, RatanPrakasanMandir Educational & University Publishers, New Deihi,2000.
2. R. Murugeshan, *Electricity and Magnetism*, S. Chand & Company Pvt. Ltd.,New Delhi – 2015
3. D. L. Sehgal, K. L. Chopra and N. K. Sehgal, *Electricity and Magnetism*, S.Chand& Sons. New Delhi. 1996

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam	**50 Marks**
ESE University Practical Exam	**50 Marks**

SPHB1401	OPTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To learn the fundamental principles of optics.
- To be able to make approximate judgements about optical and other wave phenomena when necessary.
- To provide basic concepts of optics with interdisciplinary importanc

UNIT 1 GEOMETRICAL OPTICS 9hrs

Propagation of light - Reflection, Refraction, Snell's Law (Basic definitions) - Thin lens equation - compound thin lenses - Thick lens formula - Power of a thick lens – Lens combination - Spherical aperture and stops - Single lens magnifier – Single lens camera – Two lens optical systems –The Microscope – The Telescope – Telephoto Lens.

UNIT 2 LENS ABERRATIONS 9hrs

Optical Aberration - Spherical aberration and lenses - Methods of minimizing spherical aberration - Condition for minimum spherical aberration in the case of two lenses separated by a distance - Chromatic aberration in lenses - Condition for achromatism of two thin lenses (in contact and out of contact) - coma - astigmatism - Curvature of the field.

UNIT 3 LIGHT WAVES 9hrs

Electromagnetic waves and characteristics - Maxwell"s equation – The wave equation-plane wave solution- spherical and cylindrical wave solutions –– energy density and Poynting vector - Dispersion produced by a thin prism - Angular dispersion - Dispersive power - Cauchy's formula

UNIT 4 INTERFERENCE 9hrs

Coherent sources and their production; Conditions for observing interference (mention); Conditions for constructive and destructive interference (mention) - Air wedge - Determination of diameter of a thin wire by air wedge - Test for optical flatness - Haidinger's fringes - Michelson's Interferometer - Theory - Applications - thickness of thin transparent material and resolution of spectral lines - Brewster's fringes - Jamin's & Rayleigh's Interferometers - Stationary waves in light - Colour photography (principle only), Holography (principle only).

UNIT 5 POLARIZATION AND DIFFRACTION 9hrs

Newton’s corpuscular theory - Double refraction - Nicol prism - polarizer and analyzer - Huygen's explanation of double refraction in uniaxial crystals - Dichroism - Polaroids and their uses - Double image polarizing prisms - Fresnel diffraction - Diffraction at Circular aperture, Straight edge and Narrow wire – Fraunh offer diffraction - single slit - Double slit - Plane diffraction grating - theory and experiment to determine wave length.

Max. 45 Hrs

Course Outcomes

On completion of the course, student will be able to

CO1 - Understand the physical significance of Maxwell‟s equations and hence estimate the speed of light.

CO2 - To understand the various types of optical aberration.

CO3 - To know about the basics of electromagnetic waves and their characteristics.

CO4 - To know the principle of air wedge and Jamin's & Rayleigh's interferometers.

CO5 - To understand the basics of polarization and applications of polarization.

CO6 - To understand the basics of diffraction and applications of diffraction.

TEXT BOOK / REFERENCES

1. Optics by Subramaniam, N.BrijLal, S.Chand& Co. Pvt. Ltd., New Delhi.
2. Optics by Khanna D.R. & Gulati H.R., R.Chand&Co. Pvt. Ltd., New Delhi.
3. Optics by K.K.Sharma, Elsevier, New Delhi,2006.
4. Optics by Eugene Hecht, Tata Mcgraw Hill, New Delhi, 2011.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SCYB1403	ANCILLARY CHEMISTRY – II	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To know about the types and properties of solutions and their laws.
- To expose various separation techniques for the purification of compounds.
- To provide an idea about the chemical kinetics in terms of order, molecularity and catalytic properties.

UNIT 1 SOLUTIONS 9Hrs.

Introduction: Solid solution - Hume Rothery's rule. Types of solid solutions: Liquid solutions: Solubility of partially miscible liquids - Phenol-water system. Colligative properties: Lowering of vapour pressure. Raoult's law: Derivation - Osmotic pressure - Isotonic solution - Relationship between osmotic pressure and vapour pressure. Depression in freezing point - Derivation. Elevation in boiling point - Derivation - Problems.

UNIT 2 INTRODUCTION TO SPECTROSCOPY 9Hrs.

Electromagnetic spectrum, Absorption of radiation, electronic transition – Vibrational transition – Rotational transition – Intensities of spectral lines – Beer- Lambers law – Colorimetric analysis – Estimation of concentration of a solution by colorimetry – Flame photometry – Theory, Instrumentation(block diagram only) and application – UV-Visible spectroscopy – principles, instrumentation(block diagram only) and IR spectroscopy – simple application only.

UNIT 3 CHEMICAL KINETICS 9 Hrs.

Introduction, Basic Concepts, Factors affecting reaction rates, rate equations for different orders – Derivation of Zero order, First order, Second order (A+A and A+B) reactions, Half life, problem based on First order and second order kinetics. Methods for the determination of the order of a reaction, Steady state hypothesis, Arrhenius Equation, Energy of activation, complex reactions – kinetics of opposing, parallel and consecutive reactions, Theories of reaction rates – Collision theory, Absoulte reaction rate theory.

UNIT 4 SURFACE CHEMISTRY AND CATALYSIS 9Hrs.

Adsorption – types of adsorption – Adsorption of gases on solids – adsorption isotherm – Freundlich, Langmuir isotherms – Adsorption of solutes from solutions – applications – Role of adsorption in catalytic reactions – Ion exchange adsorption – basic principles in adsorption chromatography – catalysis – classification – characteristic of catalysts – Auto catalysis – Enzyme catalysis – Michaelis – Menten equation – Acid – base catalysis.

UNIT 5 SEPARATION TECHNIQUES 9 Hrs.

Distillation techniques: Fractional distillation - Steam distillation - Vacuum distillation. Chromatography: Elution analysis - Paper chromatography - Thin layer chromatography - Liquid chromatography - High performance liquid chromatography (HPLC) - Gas chromatography (GC).

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 - Examine the types of solutions and the colligative properties.
CO2 - Interpret the spectral transition of simple molecules and its applications.
CO3 - Determine the sequence of elementary reactions that comprise complex reactions.
CO4 - Analyze the surface phenomenon and study the types of catalyst reactions
CO5 - Evaluate various separation techniques and its uses.
CO6 - Evaluate the materials for real world applications.

TEXT / REFERENCE BOOKS

1. B. R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Vishal Publishing Co, 48th edition, 2020.
2. Keith J. Laidler, Chemical Kinetics, Third Edition, Pearson education limited, 2004.
3. Atkins P. W., Physical Chemistry, 6 edition, Oxford University press, 1998.
4. Barrow G. M., Physical Chemistry, 5th edition, McGraw-Hill, 1988.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB2401	OPTICS , WAVES AND OSCILLATIONS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To acquire skills allowing the student to organize from theory, simpler laboratory course experiments are associated.
- Hand-in exercises are assigned over various determination methods of wavelength.
- Handling the Sonometer for wave analysis

COURSE CONTENTS

1. To determine the focal length and radius of curvature of double lens by uv method
2. To determine the focal length and radius of curvatures of a convex lens.
3. To draw i-d curve and to determine the angle of minimum deviation and the angle of the prism from it and hence to calculate the refractive index of the material of the prism.
4. To determine the focal length and radius of curvatures of a concave lens by displacement method.
5. To standardize the diffraction grating and hence to determine the wavelength of mercury spectral lines by normal incidence method using spectrometer.
6. To determine the radius of curvature of a lens by Newton‟s rings method.
7. Sonometer-frequency of the tuning fork.
8. Sonometer-AC frequency determination.
9. Display of acoustic beats/ ultrasonic waves on CRO
10. Melde’s apparatus- Relative density of solid

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the physical principle involved in the various instruments.
CO2 - Analyze the physical principle involved in all related fundamental principles.
CO3 - Nurture the students in all branches of science.
CO4 - Think innovatively and also improve the creative skills that are essential for science.
CO5 - Apply for new application
CO6 - To identify and analyze the wave theory

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SCYB2402	ANCILLARY CHEMISTRY LAB – II	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To understand the basics of chemistry laboratory
- To understand and correlate the theory with laboratory
- To enable the students to understand better the concepts of organic analysis and appreciate better the applications of organic chemistry towards biological systems.

ORGANIC ANALYSIS

a) Identification of acidic, basic, phenolic and neutral organic substances
b) Detection of N, S and halogens
c) Test for aliphatic and aromatic nature of substances.
d) Test for saturation and unsaturation.
e) Identification of functional groups i) Carboxylic acid ii) Phenols iii) Aldehydes iv) Ketones v) Esters

COURSE OUTCOME

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

CO1 - Understand the systematic identification of mixtures containing two compounds
CO2 - Separation and identification simple binary mixtures having acidic, basic and neutral components by chemical methods
CO3 - Preparation of the identified compound derivatives
CO4 - Recognize the chemical reactions in identifying the chemical compounds
CO5 - Identify the compounds containing one or more functional groups
CO6 - Execute practical knowledge in real world application

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB1501	QUANTUM MECHANICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To enable the students to understand the basic concepts of quantum mechanics.
- To introduce the key elements of quantum mechanics, including the statistical interpretation of wave functions, the role of operators and their connection with observables, and uncertainty.
- To learn about the different mathematical approaches of quantum mechanics

UNIT 1 INTRODUCTION TO QUANTUM MECHANICS 9 Hrs.

Limitations of Classical Physics- Black – Body Radiation Curve- Optical Spectra- Photoelectric Effect- Specific Heat of Solids – Planck's Quantum Hypothesis - Compton Effect- Quantum Theory of Specific Heat-Bohr Atom Model of Hydrogen Atom- Franck and Hertz Experiment .

UNIT 2 SCHROEDINGER WAVE EQUATION 9 Hrs.

Time independent Schrodinger equation –derivation- General solution of the time dependent Schrodinger equation; Eigenvalues and Eigenfunctions; Hamiltonian, stationary states and energy eigenvalues-applications.

UNIT 3 GENERAL DISCUSSION OF BOUND STATES IN AN ARBITRARY POTENTIAL 9Hrs

Continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- Wave Function of a Free Particle in one dimension - particle in a box-square well potential; Quantum mechanics of simple harmonic oscillator.

UNIT 4 QUANTUM THEORY OF HYDROGEN-LIKE ATOMS 9 Hrs.

Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; solution of radial wave equation- Radial wave functions; shapes of the probability densities for ground and first excited states; angular momentum operator & quantum numbers.

UNIT 5 FORMALISM OF QUANTUM MECHANICS 9 Hrs.

Linear Vector Space –Orthogonal Functions –Linear Operator -Eigen Functions and Eigenvalues-Hermitian Operator- Postulates of Quantum Mechanics – Simultaneous Measurability of Observables-Eigen Values of Angular Momentum Operators-Ladder Operators

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - To understand the idea of wave function, normalization and uncertainty.

UNIT 2 To derive Schrodinger wave equation.

CO3 - To apply Schrodinger equation to one-dimensional problem, Free Particle in one dimension, particle in a box and square well potential;

CO4 - To derive Time independent Schrodinger equation in spherical polar coordinates, radial wave equation.

CO5 - To understand the basics of Atoms in Electric & Magnetic Fields, Zeeman effect.

CO6 - To learn mathematical concepts of quantum mechanics

TEXT/REFERENCE BOOKS

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill
4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
6. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
7. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press
8. Quantum Mechanics, EugenMerzbacher, 2004, John Wiley and Sons, Inc.
9. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
10. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
11. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam

Duration: 3 Hrs.

PART A: 10 Questions of 2 Marks each-No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 Marks. **80 Marks**

SPHB1503	ATOMIC PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE:

- To understand the basics of atomic physics terminology, Atomic physics**,** the scientific study of the structure of the atom, its energy states and its interactions with other particles and with electric and magnetic fields.
- Atomic physics has proved to be a spectacularly successful application of quantum mechanics, which is one of the cornerstones of modern Physics
- To learn about X-rays, photoelectric effect

UNIT I – DISCHARGE PHENOMENON THROUGH GASES

9 Hrs.

Moving of a charge in transverse electric and magnetic fields - specific charge of an electron - Dunnington's method - positive rays – Aston's , Dempster's mass spectrographs.

UNIT 2 : PHOTOELECTRIC EFFECT

9 Hrs.

Richardson and Compton experiment - Laws of photoelectric emission - Einstein photo electric equation - Millikan's experiment - verification of photoelectric equation - photo electric cells - photo emissive cells - photovoltaic cell - photo conducting cell - photomultiplier.

UNIT 2 I: ATOMIC STRUCTURE

9 Hrs.

Bohr and Sommerfield atom models - Vector atom model - Pauli's exclusion principle - explanation of periodic table - various quantum numbers - angular momentum and magnetic moment - coupling schemes - LS and JJ coupling - special quantisation - Bohr magnetron - Stern and Gerlach experiments.

UNIT 4 :ATOM WITH ONE ELECTRON-HYDROGEN ATOM

9 Hrs.

Electron Spin - Normal and anomalous Zeeman Effect; The Stern–Gerlach Experiment; fine structure - Lamb Shift; Hyperfine Structure- Magnetic Dipole-Dipole Interaction; Zeeman Effect of Hyperfine Structure.

UNIT 5:X-RAYS

9 Hrs.

Bragg's law - X-ray spectroscopy - characteristic X-ray spectra - satellite and Auger effect - continuous X-ray spectra - X-ray absorption and fluorescence - Moseley's law - uses of X-rays - Compton effect - experimental verification of Compton effect.

Max. 45 Hrs

COURSE OUTCOMES

By the end of this course students will be able to

CO1 - Understand the quantum numbers, including their physical significance, and quantum mechanical states of the hydrogen atom.

CO2 - Understand time independent perturbation theory including its derivation and be able to apply it to simple systems, including the Stark-Effect and Zeeman Effect.
CO3 - Know about the origins of fine structure in atomic spectra and understand the exchange degeneracy and how this affects the excited states of helium.
CO4 - Understand the Periodic table from the viewpoint of the electronic structure and understand and be able to apply to simple cases time dependent perturbation theory.
CO5 - Understand the derivation of and be able to apply the selection rules for the interaction of electric dipole radiation and atoms.
CO6 - Fine details of atomic physics will be understood

TEXT/REFERENCE BOOKS

1. Laser Principles and Applications – A. K. Ghatak and K. Tyagrajan (Tata – McGraw Hill).
2. Optics and Atomic Physics – B. P. Khandelwal (SiblalAgarwala).
3. Physics of Atoms and Molecules – B. H. Bransden and C. J. Joachain(Pearson Education)
4. Atomic and Nuclear Physics – S. K. Sharma (Pearson Education).

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam

Duration: 3 Hrs.

PART A: 10 Questions of 2 Marks each-No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 Marks. **80 Marks**

SPHB1504	MATHEMATICAL PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE:

- To familiarize students with essential mathematical methods for solving advanced problems in theoretical physics.
- To learn about vector algebra
- To learn about vector calculus and integration

UNIT I – CALCULUS I **9 Hrs.**

Plotting of functions, Intuitive ideas of continuous, differentiable functions and plotting of curves, Approximation: Taylor and binomial series (statements only), First Order Differential Equations and Integrating Factor, Second Order Differential equations: Homogeneous Equations with constant coefficients.

UNIT 2 : VECTOR ALGEBRA

9 Hrs.

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations, Vector product, Scalar triple product and their interpretation interms of area and volume respectively, Scalar and Vector fields.

UNIT 2 I: VECTOR CALCULUS

9Hrs

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation.Divergence and curl of a vector field.Del and Laplacian operators. Vector identities.

UNIT 4 :VECTOR INTEGRATION

9 Hrs.

Ordinary Integrals of Vectors. Double and Triple integrals, change of order of integration, Jacobian.Notion of infinitesimal line, surface and volume elements.Line, surface and volume integrals of Vector fields- Green's and Stokes Theorems and their verification (no rigorous proofs).

UNIT 5:COMPLEX ANALYSIS

9 Hrs.

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables.

Max. 45 Hrs

COURSE OUTCOMES

By the end of this course students will be able to

CO1 - To use advanced mathematical methods and theories on various mathematical and physics problems
CO2 - To develop the skill of problem-solving ability.
CO3 - Use Matrices to solve simultaneous equations
CO4 - Solve quantum mechanical problems using special functions and polynomials.
CO5 - Apply Fourier series to simple circuits.
CO6 - To understand electromagnetic theory with Vector Calculus

TEXT / REFERENCE BOOKS

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier. •
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill. •
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole. • An Introduction to Ordinary Differential Equations, E.A Coddington, 1961, PHI Learning • Differential Equations, George F.
4. Simmons, 2006, Tata McGraw-HillQuantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB2501	QUANTUM MECHANICS AND MATHEMATICAL PHYSICS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

- To familiarize students with essential mathematical methods for solving advanced problems in theoretical physics.
- To learn about applications of quantum mechanics
- To learn about softwares

LIST OF EXPERIMENTS (USING MATLAB)

1. Predict and sketch the nature of stationary waves in a string which is clamped at x=0 and x=L for n=0, 1, 2. String is not allowed to vibrate at x=0 and x=L.
2. Represent the vector A(x,Y) of length r in an x-y plane under clockwise and anticlockwise rotation through an angle .
3. Draw the first four eigen functions for a particle in a box whose length is L and origin (x=0) of the coordinate system is in the middle.
4. Draw the probability curves of a particle in a box for n=1, 2, 3 where L is the length of the box.
5. Draw the waveforms of eigen functions for n=1 and n=2 for a particle in a one dimensional box with one finite potential barrier at x=L and one infinite potential barrier at x=0.
6. Calculate the first two wave functions and sketch them that obtained by solving the Schrodinger equation for a simple harmonic oscillator

LIST OF EXPERIMENTS (USING MATLAB)

1. Matrix operations
2. Plotting curve
3. Differentiation of the given function
4. Integration of the given function
5. First order differential equation
6. Contour plotting
7. Fourier plot
8. Fourier series
9. Linear equation
10. Eigen values and eigen vector

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - To use advanced mathematical methods and theories on various mathematical and physics problems

CO2 - To develop the skill of problem-solving ability.

CO3 - Use Matrices to solve simultaneous equations

CO4 - Solve quantum mechanical problems using special functions and polynomials.

CO5 - Apply Fourier series to simple circuits.

CO6 - To understand electromagnetic theory with Vector Calculus

TEXT / REFERENCE BOOKS

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill
4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
5. .Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
6. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
7. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole. F.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB2502	DIGITAL AND MICROPROCESSOR LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVE

- It introduces to the fundamental and broad range of digital and analog experiments related to amplifiers, oscillators, timers, logic gates, multiplexers and demultiplexers.
- To expose students to the operation of typical microprocessor (8085) trainer kit.
- To have hands on experience in electronic gadgets

LIST OF EXPERIMENTS

1. Inverting and Non inverting Amplifier
2. Summing and Differential Amplifier
3. Linear Op amp circuits such as Instrumentation amplifier, Integrator and Differentiator
4. RC Phase Shift Oscillator
5. Wien Bridge Oscillator
6. Study of IC 555 Timer
7. Study of Logic Gates
8. Study of Flip Flops using Gates
9. Multiplexers and Demultiplexers
10. Encoders and Decoders

LIST OF EXPERIMENTS

1) Simple arithmetic operations: BCD Addition - 8-bit & 16 bit
2) Simple arithmetic operations: BCD Subtraction - 8-bit & 16 bit
3) Simple arithmetic operations: BCD multiplication
4) Simple arithmetic operations: BCD division.
5) Programming with control instructions: Ascending / Descending order
6) Programming with control instructions: Maximum / Minimum of numbers
7) Programming with control instructions: Programs using Rotate instructions
8) Programming with control instructions: Hex / ASCII / BCD code conversions.
9) Interface Experiments: with 8085 : A/D Interfacing. & D/A Interfacing.
10) Interface Experiments: with 8085 : Traffic light controller

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - To use advanced electronic equipments
CO2 - To develop the skill of electrical circuits
CO3 - Use different electronic kits
CO4 - To learn encoders, decoders
CO5 - To use operational amplifiers
CO6 - To understand IC technology

TEXT / REFERENCE BOOKS

1. A Text book of Electronics, B. Ghosh.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB1601	SOLID STATE PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the importance of the crystalline order in solids.
- To understand the importance of Magnetic and dielectric materials
- To understand the nature of superconducting materials

UNIT 1 CRYSTAL STRUCTURE 9 Hrs.

Introduction – Types of solids – amorphous and crystalline solid - space lattice – The basis and the crystal structure unit cell – primitive lattice cell – Lattice parameter - classification of Bravais lattice- Definition of reciprocal lattice - construction of a reciprocal lattice–– point groups - seven crystal systems – co-ordination number for SC, BCC and FCC - Miller indices–features of miller indices - Bragg's law –- Rotating crystal method–Powder method.

UNIT 2 MAGNETIC AND DIELECTRIC MATERIALS 9 Hrs.

Magnetic materials: Magnetic moment – dia and Para magnetism – Ferromagnetism – Domain theory of ferromagnetism – Antiferromagnetic – Ferrites -; applications – *floppy, Compact Disk, Hard drive.*
Dielectric materials: Polarization - Local Electric Field at an Atom - Depolarization Field - Electric Susceptibility – Polarizability: Electronic, ionic, oriental and space charge polarization – Internal field – Determination of Clausius – Mosotti relation – dielectric loss – dielectric breakdown - Classical Theory of Electric Polarizability

UNIT 3 SUPERCONDUCTIVITY 9 Hrs.

Introduction – Occurrence of Superconductivity - properties of superconductors – Meissner effect – London Equation - Coherence Length - Flux Quantization in a Superconducting Ring – Isotope Effect - High and low temperatures superconductors – Type I and Type II superconductivity. BCS theory - Levitation –- Applications of superconducting materials – MAGLEV, Cryotron, Quantum Computers and Supercomputers.

UNIT 4 SEMICONDUCTING MATERIALS 9 Hrs.

Introduction - Conductors, Semiconductors - and Insulators – Band structure of semiconductors - expressions for the carrier concentration in intrinsic and extrinsic semiconductors – Fermi level and its variation with temperature – Determination of band gap energy – Hall effect – Determination of Hall coefficient.

UNIT 5 OPTICAL MATERIALS 9 Hrs.

Introduction- Ionic conduction – Optical absorption in metals, Insulators and semiconductors – colour Centres – Excitons – Luminescence – Maser and Laser – applications of lasers. Introduction to Display device- Photo Luminescence, LED, Liquid Crystal Displays.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Have a basic knowledge of crystal systems and spatial symmetries.
CO2 - Understanding classification of magnetic material and how Dielectric materials are studied including concepts like polarizability, electric susceptibility.
CO3 - Know the principles of superconductivity and its wide range of applications.
CO4 - Understand the role of carrier concentration in semiconductor materials.
CO5 - Know the significance of Optical instruments
CO6 - Understand about superconducting materials

TEXT BOOK / REFERENCES

1. An Introduction to Solid State Physics (5thedition), Kittel. C
2. Solid State Physics, Dekker A.N. MacMillan
3 Fundamentals of Electricity and Magnetism, Mandiratta, Sawhey
4. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
5. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
6. Solid-state Physics, H.Ibach and H Luth, 2009, Springer
7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB1602	NUCLEAR & PARTICLE PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide an in-depth Knowledge of Nucleus, Nuclear radiations detectors, Radioactivity and Elementary particle towards their higher education.
- Introduce students to the fundamental principles and concepts governing nuclear and particle physics and have a working knowledge of their application to real-life problems
- To Understand the Working of Accelerators

UNIT 1 PROPERTIES OF NUCLEI 9 Hrs.

Introduction, Classification of Nuclei, Properties of Nuclei - Nuclear size, charge, mass, density, spin, magnetic dipomoment, electric quadrupole moment, binding energy, packing fraction, Nuclear Stability. Nuclear models - Liquid Drop Model (Weizacker Semi Empirical mass formula), Shell Model and magic numbers.

UNIT 2 DETECTORS OF NUCLEAR RADIATIONS 9 Hrs.

Introduction, Interaction between energetic particles and matter, Ionization Chamber and Geiger-Muller Counter - estimation of electric field, mobility of particle, Solid-State Detectors, Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT)

UNIT 3 PARTICLE ACCELERATORS 9 Hrs.

Introduction, Van de Graaff Generato (Tandem acceleratorr, Linear Accelerator, Cyclotron, Synchrocyclotron Betatron, Electron Synchrotron, Proton Synchrotron (Bevatron).

UNIT 4 RADIOACTIVITY 9 Hrs.

Introduction, Natural radioactivity, Alpha Particle – Properties, Radioactive decay - Geiger-Nuttal law. Measurement of Range of Alpha particle by Bragg - Kleeman method, Geiger - Nuttal method. Beta Particle – Properties, e/m ratio, Pauli's Neutrino Hypothesis, Neutrino theory of Beta decay, Detection of Neutrino. Gamma Particle – Origin, determination of wavelength by Du – half Curved Crystal Spectrometer, Nuclear Isomerism, Internal Conversion, Mossbauer effect with experiment.

UNIT 5 ELEMENTARY PARTICLES 9 Hrs.

Introduction, Classification of elementary particles (Baryon and Leptons), Particles and Anti-Particles, Antimatter, Fundamental Interactions, Elementary Particle Quantum numbers – Baryon, Leptons, strangeness, Hypercharge and Isospin. Conservation Laws – Parity, Charge Conjugation Symmetry and Time Reversal Symmetry. Basic ideas about Quark, Quark Model, Types of Quarks –Super symmetry and neutrino oscillation.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamental principles and concepts governing classical nuclear and particle physics.

CO2 - Demonstrate knowledge and understanding of detectors of Nuclear Radiations. Ionization chamber, solid state detectors.

CO3 - Demonstrate knowledge and understanding of Particle accelerators. Van de Graaff generator, Linear accelerator, Cyclotron.

CO4 - Acquire relevant information of Radioactivity. Properties, e/m ratio, charge and range of Alpha, Beta and Gamma particles.

CO5 - Acquire relevant information of Elementary Particles. Classification, fundamental interactions, quantum numbers. Basic ideas about Quarks.

CO6 - Analyze the quantum numbers

TEXT / REFERENCE BOOKS

1. Nuclear and Particle Physics, Kanwar Shefali
2. Nuclear Physics, Andrea Giodani
3 Nuclear and Particle Physics an Introduction, Satadal Bhattacharya

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB1604	ASTRONOMY AND ASTROPHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To explore the composition of the universe better.
- To reveal the truths and dispel the myths related to the universe.
- To develop new techniques of observation for a better understanding of the solar system

UNIT 1 SUN AND SOLAR SYSTEM 9 Hrs.

Basic structure of the Sun - The solar constant - Solar energy for Earth - Origin of the solar system -The planets and their origins - The Moon -The planets Mercury, Venus and Mars - The planets Jupiter, Saturn, Uranus, Neptune - Comets, Meteors and Asteroids- Astronomy in the Era of Copernicus, Tycho, Kepler, and Galileo; Kepler's Laws of Planetary Motion

UNIT 2 OPTICAL TECHNIQUES 9 Hrs.

Optical telescopes - Light gathering power - Observing in different spectral regions - Magnifying power - Resolving power - Limiting magnitude - Measurement of stellar distances - Stellar magnitudes - Stellar parallaxes - Stellar photography - Stellar photometry - CCD and its uses - Multicolor photometry - Spectrophotometry - Radio telescopes- detection of flux density and brightness

UNIT 3 EVOLUTION FORMATION AND STRUCTURE OF STARS 9 Hrs.

Novae and Supernovae - Black holes - Stars formation - Interstellar medium - Stellar prime of life - Stellar structure - Dying stars - Nebulae and supernovae remnants - Pulsars, neutron stars and black holes - The Big Bang theory - The Steady State theory - The Hubble's law

UNIT 4 THE CONSTELLATIONS AND THEIR IDENTIFICATION 9 Hrs.

Earth's rotation and other motions - Eclipses - Contents of the Universe: - The constellations and their identification - Geometry of the celestial sphere - The alt-azimuth coordinate system - The equatorial coordinate system - The ecliptic coordinate system -The galactic coordinate system

UNIT 5 SPACE ASTRONOMY 9 Hrs.

Effects of the Earth's atmosphere on incident electromagnetic radiation - Galaxies-The Milky way Galaxy - distribution of matter, differential rotation, formation of the spiral arms-Elliptical and Spiral Galaxies-Evidence for dark matter-Active Galaxies - Active Galactic Nuclei, Seyfert Galaxies, Quasars, Blazers- IR, UV, X-ray and Gamma ray satellites

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Know about and understand the observed properties of physical systems that comprise the known universe, on various scales.
CO2 - Analyze the physical principle involved in optical instruments used in astronomy.
CO3 - Appreciate the role of astronomy in the evolution and star formation.
CO4 - Determine the different coordinate systems to understand the geometry of celestial sphere.
CO5 - Explore the galaxy its types and space astronomy.
CO6 - Understand the concept of Satellites

TEXT / REFERENCE BOOKS

1. Fundamental Astronomy by Hannu Karttunen, Pekka Kroger, Heikki Oja, Markku Poutanen, Karl Johan Donner, Cham, Switzerland: Springer-Verlag Berlin, 2016
2. An Introduction to Astronomy and Astrophysics, Pankaj Jain
3. A Text book of astronomy and astrophysics, Mohit Kumar Sharma & Suresh Chandra,2019
4. New Perspectives in Astrophysical Cosmology by Martin Rees, New York: Cambridge University Press, 2000
5. Astrophysics: Stars and Galaxies, K.D. Abhyankar,2001

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice	**20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks	**80 Marks**

SPHB5101	CONDENSED MATTER PHYSICS	L	T	P	EL	Credits	Total Marks
		4	0	0	0	4	100

COURSE OBJECTIVES

- To acquire basic concept of crystalline lattices and the techniques.
- To understand the importance of the quantum behaviour of electrons in metals.
- To apply band theory to various classes of solids.

UNIT 1 CRYSTALLOGRAPHY 9 Hrs.

Elementary concepts of space group and its relevance to crystal structure. Principal of powder diffractometer, Interpretation of powder-photographs, Application of powder method. Interpretation of oscillation photograph, X-ray method of orienting crystals about a crystallographic direction. Bernal chart, Indexing of reflection. Fourier representation of electron density, the phase problem, Patterson function.

UNIT 2 IMPERFECTION OF CRYSTALS 9 Hrs.

Mechanism of plastic deformation in solids, stress and strain fields of screw and edge dislocations, elastic energy of dislocation, Elementary idea of topological defects, Partial dislocations and stacking faults in close-packed structures.

UNIT 3 LATTICE ENERGIES AND LATTICE VIBRATIONS 9 Hrs.

Origin of chemical binding in ionic and van der Waals crystals – Elastic properties – Stress and strain – Elastic moduli - Lattice energy calculations for ionic and van der Waals crystals – Lattice vibrations: Mono and diatomic one dimensional infinitely long lattices.

UNIT 4 FREE ELECTRON FERMI GAS 9 Hrs.

Energy levels and density of orbitals in one dimension, Free electron gas in 3 dimensions, Heat capacity of the electron gas, Experimental heat capacity of metals, Motion in Magnetic Fields- Hall effect, Ratio of thermal to electrical conductivity., Fermi surfaces of metals: Reduced zone scheme, Periodic Zone schemes, Construction of Fermi surfaces, Electron orbits, hole orbits and open orbits.

UNIT 5 THE BAND THEORY OF SOLIDS 9 Hrs.

Nearly free electron model, Origin of the energy gap, The Block Theorem, Kronig-Penny Model, wave equation of electron in a periodic potential. The distinction between metals, insulators and semiconductors.

Max. 45 Hrs

COURSE OUTCOMES

By the end of this course students will be able to:

CO1 - Have a basic knowledge of crystal systems and spatial symmetries.
CO2 - Be able to account for how crystalline materials are studied using diffraction, including concepts like form factor, structure factor, and scattering amplitude.
CO3 - Know the principles of structure determination by diffraction.
CO4 - Understand the concept of reciprocal space and be able to use it as a tool.
CO5 - Know the significance of Brillouin zones.
CO6 - Comprehend the band theory applied to classes of solids.

TEXT / REFERENCES BOOKS

1. Modern Physics by R.MurugesanS.KiruthigaSivaprasad. S.Chand Publishers (2012).
2. Modern Physics by Sehgal Chopra SehgalS.Chand Publishers.
4. Solid state physics by Gupta Kumar. Vikas Publishing Pvt., Ltd., (2001).
5. Solid State Physics – R- L Singhal. Wiley Eastern Ltd.
6. An Introduction to Solid State Physics (5thedition), Kittel. C
7. Solid State Physics, Dekker A.N. MacMillan.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5102	CLASSICAL MECHANICS	L	T	P	EL	Credits	Total Marks
		4	0	0	0	4	100

COURSE OBJECTIVES

- To enable students to understand the description of equations of motion of a system.
- To find the linear approximation to any dynamical system near equilibrium and also know how to derive and solve the wave equation for small oscillations.
- To comprehend the Hamilton's formulation applied to various systems.

UNIT 1 LAGRANGIAN FORMULATION 9 Hrs.

Constraints, Classification of Constraints, Principal of Virtual Work, D'Alembert's principal and Lagrangian equation and its applications.- simple pendulum, compound pendulum and Atwoods machine - Hamilton's Principle, Langrange's equations of motion from Hamilton's principle, extention to non-holonomic systems, conservation theorem and symmetry properties. Problems.

UNIT 2 MOTION UNDER CENTRAL FORCE: TWO BODY PROBLEM 9 Hrs.

Equivalent one body problem - equation of motion and first integral - Two body central force -Kepler's Problem : Inverse square law of force, Motion in time in Kepler's problem, orbits of artificial satellites: scattering in central field force-angle of scattering - differential scattering cross section - Rutherford scattering. Problems.

UNIT 3 MECHANICS OF RIGID BODY 9 Hrs.

Angular momentum and kinetic energy – moment of inertia tensor – principle axes – Euler's angle Euler's equations of motion – Force free motion of a symmetrical top – Heavy symmetric top with one point fixed. Problems.

UNIT 4 HAMILTON'S FORMULATION 9 Hrs.

Phase space, Hamilton's equation of motion, cyclic coordinates and conservation theorems, Routh's procedure, Derivation of Hamilton's equation from variational principle, principle of least action and its Jacobi's form.

UNIT 5 RELATIVISTIC MECHANICS 9 Hrs.

Relativistic mechanics: Four-dimensional formulation- four-vectors, four-velocity and four-acceleration. Lerentz co-variant form of equation of motion.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Derivation of Lagrange equation from D'Alembert principle.
CO2 - Apply the Lagrange equation to study the motion under central force problems.
CO3 - Apply the Lagrange equation to study the motion of rigid bodies.
CO4 - Derivation of Hamilton equation of motion and apply the same for systems such as relativistic particles and light rays.
CO5 - Use canonical transformation to find the constants of motion according to Hamilton-Jacobi theory.
CO6 - Acquire the knowledge of four-dimensional formulation.

TEXT / REFERENCES BOOKS

1. P.V.Panat, Classical Mechanics, Narosa Publishing Home, New Delhi.
2. H.Goldstein, Classical Mechanics, 3rd Edn, Pearson Education Asia, 2000.
3. T. W. B. Kibble, Classical Mechanics, 5th Edn, Imperial College press, 2004.
4. J. L. Synge and B. A. Griffith, Principles of Classical Mechanics, 2nd Edn, TMH, 1949.
5. C. R. Mondal, Classical Mechanics, 7th Edn, AsokeK.Ghosh, 2011.
6. S.L.Gupta ,V.Kumar, H.V.Sharma, Classical Mechanics, 21st Edn, pragatiprakshan, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5103	LASER AND NON-LINEAR OPTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	3	4	100

COURSE OBJECTIVES

- To know about the properties of laser radiation and how laser beams propagate through optical materials and components.
- To be familiar with how second-order nonlinear response in crystals can be used to convert laser radiation from one wavelength to another.
- To know about the range of non-linear materials and techniques.

UNIT 1 INTRODUCTION TO LASERS 9 Hrs.

Interaction of radiation with matter – induced absorption, spontaneous emission, stimulated emission. Einstein's co-efficient (derivation). Properties of LASERS :Gain mechanism, threshold condition for PI (derivation), Types of Laser: Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS.

UNIT 2 INDUSTRIAL APPLICATIONS 9 Hrs.

Data storage: Mention of previous data storage devices, optical storage/holographic data storage. Explanation of optical storage using low power laser beam. Advantages of optical storage ii. Laser printing: Construction and working of laser printer along with either ray diagram or with actual 3-d diagram. Advantages.

UNIT 3 RESEARCH AND DEVELOPMENT APPLICATIONS 9 Hrs.

Lithography: Definition of lithography. Photolithography, Qualitative explanation of Deep UV Lithography using Excimer laser with block diagram. Laser cooling: Principle of laser cooling. Working of laser cooling (Doppler cooling) iii. Laser fusion: Brief explanation of condition for fusion. Explanation of Laser Inertial Fusion Energy (LIFE). Mention of 2 laser fusion devices namely SHIVA and NOVA.

UNIT 4 INTRODUCTION TO NON-LINEAR OPTICS 9 Hrs.

Optics & Wave propagation in anisotropic medium, Electromagnetic Waves in Nonlinear Media, Phenomenological theory of nonlinearities, Nonlinear polarization. Second Order Nonlinear Optics: Electro-Optic and Acousto-optic effects.

UNIT 5 NON-LINEAR OPTICAL TECHNIQUES & MATERIALS 9 Hrs.

Z-Scan, Four-Wave Mixing, Third Harmonic Generation, Non-Linear Optics of Organics, Semiconductors, Glasses, Polymers, Fiber and Nanostructures.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Solve absorption and spontaneous and stimulated emission in two level system, the effects of homogeneous and inhomogeneous line broadening, and the conditions forlaser amplification.

CO2 - Fabry-Perot cavity including mode separation and line-widths, laser gain conditions, gain clamping in both homogeneous and inhomogeneous line broadened media.

CO3 - Understand the four-level laser system, the simple homogeneous laser and its output behaviour and optimal operating conditions.

CO4 - Comprehend the spectral properties of a single longitudinal mode, mode locked laser operation, schemes for active and passive mode locking in real laser system.

CO5 - Understand the operations and basic properties of the most common laser types, He-Ne, Argon-ion, and carbon-dioxide, ruby, titanium sapphire, neodymium YAG and glass, knowledge of other main laser types.

CO6 - Acquire the knowledge of non-linear optical techniques.

TEXT / REFERENCES BOOKS

1. Engineering Physics, R. K. Gaur and S. L. Gupta, Dhanpath Rai and Sons.
2. Lasers: Theory and Applications, K. Thyagarajan and A.K. Ghatak, Springer (1981).
3. Laser and Fundamentals, W. T. Silfvast, , Cambridge University Press (2004).
4. Introduction to optical fiber, A.K.Ghatak, Cambridge University Press.
5. Lasers and Nonlinear optics, B. B. Laud, John Wiley & Sons Inc. (1985)
6. Nonlinear optics by Robert W. Boyd (3rd edition).
7. Essentials of Nonlinear optics by Y.G.S. Murthy and C. Vijayan.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5104	INDUSTRIAL ELECTRONICS	L	T	P	EL	Credits	Total Marks
		4	0	0	0	4	100

COURSE OBJECTIVES

- To be able to describe in detail the inherent behaviour and functionality of the many different types of modern lasers.
- To be able to formulate reasonably complicated problems in laser physics.
- Provide solutions to the complicated problems.

UNIT 1 AMPLIFIERS 9 Hrs.

Basic amplifier concept using BJT-CE mode.- reason for wide use of CE amplifier .concept of DC and AC load line- the Q-point-thermal runaway- need for proper biasing in amplifier circuits.-types of biasing circuits- stabilization in amplifier circuits- various stability factors.

UNIT 2 TRANSISTORS 9 Hrs.

Compare JFET and BJT- principle of operation of n-channel JFET -drain characteristics of JFET- pinch-off voltage of JFET- Important parameters of JFET -JFET classification -Construction and principle of -MOSFET.-Explain the construction and principle of operation of enhancement type MOSFET. – JFET and MOSFET Comparison – Principle of operation of CMOSFET.

UNIT 3 SEMICONDUCTING DEVICES 9 Hrs.

Optical absorption in a semiconductor, Solar cells – p-n junction, conversion efficiency, Photo detectors – photo conductors, photodiode, p-i-n diode-applicatios.

UNIT 4 I OPTICAL DEVICES 9 Hrs.

Light emitting diode (LED) – generation of light, internal and external quantum efficiency. Modern semiconducting devices: CCD – introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

UNIT 5 WIRELESS COMMUNICATION 9 Hrs.

Fundamental concepts in wireless, Basic Terminologies, cellular technology, Standards evolved, Mobile Radio Propagation, Mobile System and Network Architectures, Advanced Wireless IP network Architectures, Wireless Standards.

Max. 45 Hrs

COURSE OUTCOMES

By the end of this course students will be able to:

CO1 - Explain the operational principles and construction of lasers
CO2 - Describe optical components that can be used to tailor the properties of the laser
CO3 - Distinguish between the different optical cavities/resonators.
CO4 - Describe the conditions of producing a laser beam.
CO5 - Describe how pulsed laser beams can be obtained from a laser cavity.
CO6 - Acquire the knowledge of wireless communication.

TEXT / REFERENCES BOOKS

1. Charles A. Schuler and William.L. Mc. Namee, “Indistrial Electronics and Robotics:, International McGraw Hill, 1986.
2. S. K. Bhattacharya and S. Chatterjee, “Industrial Electronics &Control”, Tata Mc Graw Hill, 2003.
3. Terry. L. M. Bartell, “Industrial Electronics”, Delmer Publishers, 1997.
4. Thomas. E. Kissell, “ Industrial Electronics”, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5105	PHYSICS OF THIN FILMS	L	T	P	EL	Credits	Total Marks
		3	1	0	0	4	100

COURSE OBJECTIVES

- To make the students to understand about the difference between bulk and thin film, the optical, electrical, dielectric and magnetic properties of thin film.
- To understand the theories explaining the formation of thin film
- To know about the fabrication and advantages of thin film devices.

UNIT 1 PHYSICS OF SURFACES, INTERFACES AND THIN FILMS 9 Hrs.

Mechanism of thin film formation: Condensation and nucleation, growth and coalescence of islands, Crystallographic structure of films, Properties of thin films:- Transport and optical properties of metallic, semiconducting and dielectric films; Application of thin films.

UNIT 2 THIN FILMS: FORMATION & MEASUREMENT 9 Hrs.

Vacuum Techniques: Review - Production of low pressures; Measurement of pressure, Leak detections, Materials used Preparation of Thin Films: Thermal evaporation, Cathode Sputtering, Chemical Deposition.

UNIT 3 THICKNESS MEAUREMENT 9 Hrs.

Stylus Method, Electrical Method, Quartz Crystal Method, Optical Methods, mass measurements (microbalance), Stress measurement by optical method, Gravimetric method.

UNIT 4 PROPERTIES OF THIN FILMS 9 Hrs.

Electrical Properties: Source of Resistivity in Metallic conductors, Influence of thickness on the resistivity of thin films, Magneto resistance in thin films, Fuch-Sondhemir theory, TCR and its effects. Mechanical properties: Adhesion & its measurement with mechanical and nucleation methods, stress measurement by using optical method.

UNIT 5 EMERGING THIN FILM MATERIALS AND APPLICATIONS 9 Hrs.

Patterning techniques (Photolithography), Diamond Films, Thin film resistors, capacitors, Junction devices (Diodes, Transistors, Solar cells), ICs, Thin film sensors (gas and humidity), Thin films for information storage (Magnetic and optical recording), Metallurgical applications, Photo thermal converters, Optical coatings.

Max. 45 Hrs

COURSE OUTCOMES

By the end of this course students will be able to:

CO1 - Apply the knowledge of basic principles of material science in thin film technology.
CO2 - Use various techniques to synthesize thin films of desired characteristics.
CO3 - Characterize thin films employing various techniques
CO4 - Acquire skills required for entrepreneurship or jobs in the field of thin films
CO5 - Make applications of thin films for devices fabrication.
CO6 - Acquire the knowledge of thin film materials.

TEXT / REFERENCES BOOKS

1. K.L. Chopra, “Thin Film Phenomena”, First Edition, McGraw-Hill, 1969.
2. George Hass, “Physics of Thin Films”, Volumes 1, Academic Press Inc., 1963.
3. K. L. Chopra and S. R. Das, “Thin Film Solar Cells”, Springer, 1983.
4. L. I. Maissel and Glang, “Handbook of Thin Film Technology”, McGraw Hill Higher Education, 1970.
5. J. C. Anderson, “The Use of Thin Films in Physical Investigation”, Academic Press Inc., 1966.
6. J. J. Coutts, “Active and Passive Thin Film Devices”, Academic Press Inc., 1978.
7. R.W. Berry, P.M. Hall and M.T. Harris, “Thin Film Technology”, Van Nostrand, 1968.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB6101	GENERAL PHYSICS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

OBJECTIVE

- to verify some fundamental laws of physics and to measure different physical quantities
- to perform some historically important experiments in the development of physics
- to design experiments and to learn to extract meaningful physics principles from the experimental observation

LIST OF EXPERIMENTS

1. Meyer disc- Viscosity of a liquid
2. Hall Effect in Semiconductor-carrier concentration and mobility
3. Ultrasonic interferometer- velocity of ultrasound in liquid at different temperatures
4. Acoustic Diffraction
5. Michelson Interferometer-determination of wavelength
6. Cornu's Method – Determination of Elastic Constants of Transparent Materials (Elliptical fringes)
7. Dielectric constant and Curie temperature of ferroelectric ceramics
8. Fresnel biprism-determine the wavelength of given light source
9. Fabry–Pérot interferometer
10. Arc spectra
11. He-Ne laser- diffraction at straight wire and circular aperture
12. Stefan's constant

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire in depth knowledge about Fundamental Laws of Physics
CO2 - Apply the Concepts to several relevant fields like Material Science,
CO3 - Develop the practical skills towards industrial applications,
CO4 - Acquire in knowledge of Light experiments
CO5 - Gain the knowledge of Historical experiment.
CO6 - Acquire knowledge meaningful physics principles

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

Internal CAE practical exam **50 marks**
ESE practical exam **50 marks**

SPHB5201	ADVANCES IN QUANTUM MECHANICS	L	T	P	EL	Credits	Total Marks
		4	0	0	0	4	100

OBJECTIVE

- To develop the physical principles and the mathematical background important to quantum mechanical descriptions.
- To describe the propagation of a particle in a simple, one-dimensional potential.
- To formulate and solve Schrodinger's equation to obtain eigenvectors and energies for particles in a three-dimensional potential.

UNIT 1 BASIC FORMALISM 9 Hrs.

Interpretation of the wave function – Postulates of Quantum Mechanics – Stationary states - Time dependent Schrodinger equation –Time independent Schrodinger equation – Ehrenfest's theorem (statement only) – Hilbert space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator – General Uncertainty relation - Dirac's notation - Equation of motion - momentum representation.

UNIT 2 ONE DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE 9 Hrs.

Free particle - Square well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Linear harmonic oscillator: schrodinger method – Particle moving in a spherically symmetric potential — Hydrogen atom – Rigid rotator.

UNIT 3 ANGULAR MOMENTUM 9 Hrs.

The Angular Momentum Operators - Angular Momentum Commutation Relations - Eigenvalues and Eigenfunctions of L2 and L - General Angular Momentum - Eigenvalues of J2 and J - Angular Momentum Matrices - Spin Angular Momentum - Spin Vectors for Spin-(1/2) System -
Addition of Angular Momenta - CG Coefficients.

UNIT 4 APPROXIMATION METHODS 9 Hrs.

Time independent perturbation theory: basic concepts - non-degenerate energy levels –Application : anharmonic oscillator - effect of electric field on ground state of hydrogen - Degenerate energy levels – effect of electric field on ground state of hydrogen (n = 2).
WKB approximation : the WKB Method – Connection formula - Validity – Application : bound state in a potential well - harmonic oscillator.
Variation Method : variational principle - Rayleigh - Ritz Method - Ground state of Deuteron.

UNIT 5 SCATTERING THEORY 9 Hrs.

scattering cross section - scattering amplitude - partial wave analysis - scattering by a central potential - Ramsauer-Townsend effect -integral equation - Born approximation - validity of the Born approximation - scattering by screened coulomb potential.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Derivation of Lagrange equation from D'Alembert principle
CO2 - Apply the Lagrange equation to study the motion under central force problems
CO3 - Apply the Lagrange equation to study the motion of rigid bodies
CO4 - Derivation of Hamilton equation of motion
CO5 - Apply the same for systems such as relativistic particles and light rays
CO6 - Use of canonical transformation to find the constants of motion according to Hamilton-Jacobi theory

TEXT / REFERENCE BOOKS

1. G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009.
2. David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
3. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2nd edition(37th Reprint),Tata McGraw-Hill, New Delhi, 2010.
4. SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S.Chand& Co., New Delhi, 1982.
5. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4thEdition, Macmillan, India, 1984.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5202	ELEMENTARY PARTICLE PHYSICS	L	T	P	EL	Credits	Total Marks
		4	0	0	0	4	100

COURSE OBJECTIVES

- To present an introducing account of nuclear physics and elementary particle physics
- including observational aspects of nuclei, including their binding energy, size, spin and parity
- To overview basic relativistic quantum mechanics and quantum electrodynamics for particle physics

UNIT 1 INTRODUCTION 9 Hrs.

Introduction: Fermions and bosons- Particles and antiparticles- Quarks and leptons- Yukawa picture- Types of fundamental interactions - electromagnetic, weak, strong and gravitational, HEP Units, Bound states of quarks- Hadron- Mesons and Baryons.

UNIT 2 INVARIANCE PRINCIPLE AND CONSERVATION LAWS 9 Hrs.

Interactions and fields in particle physics, Classical and quantum pictures Invariance in classical mechanics and in quantum mechanics types of symmetries and their breaking, Parity, Pion parity, Charge conjugation, Time reversal invariance, CP violation, CPT theorem.

UNIT 3 HADRON -HADRON INTERACTION 9 Hrs.

Hadron-Hadron Interactions: Cross section and decay rates, Pion spin, Isospin, Two-nucleon system, Pion-nucleon system, Strangeness and Isospin, and Hypercharge.

UNIT 4 STATIC QUARK MODEL OF HADRONS 9 Hrs.

Static Quark model of Hadrons: The Eightfold way, Meson nonet, Baryon octet, Baryon Decuplet, hypothesis of quarks, SU (3) symmetry, Quark spin and color, Quark-antiquark combinations.

UNIT 5 WEAK INTERACTIONS 9 Hrs.

Classification of weak interactions, Fermi theory, Parity non-conservation in β-decay, Helicity of neutrino, Experimental verification of parity violation.

Max. 45 Hrs

COURSE OUTCOMES

CO1 - Explain the need of standard model and its limitations and the properties of QCD
CO2 - Draw Feynman diagrams and to check if interactions are allowed or forbidden.
CO3 - Use the quark model for understanding the properties ofhadrons e.g. neutrons and protons.
CO4 - Describe weak interactions between quarks
CO5 - Understanding how that is responsible for β decay, inverse beta decay.
CO6 - Explain the symmetry in baryon decuplets and octets for JP states.

TEXT / REFERENCES BOOK

1. Perkins, D.H., Introduction to High Energy Physics, Cambridge University Press, (2000).
2. D. Griffiths, Introduction to Elementary particles, 2nd Ed, Wiley International Edition, New York 1987.
3. Hughes, I.S., Elementary Particles, Cambridge University Press, (1991).
4. Close, F.E., Introduction to Quarks and Partons, Academic Press, (1979).
6. Segre, E., Nuclei and Particles, Benjamin-Cummings, (1977).
7. Khanna, M.P., Introduction to Particle Physics, Prentice-Hall of India, (2004)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5203	MATHEMATICAL PHYSICS & NUMERICAL METHODS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program
- To extend their manipulative skills to apply mathematical techniques in their fields
- To help students apply Mathematics in solving problems of Physics

UNIT 1 MATRIX AND VECTOR ANALYSIS 9 Hrs.

Special Type of matrix and their properties - Rank of matrix - eigenvalues and eigenvector - Diagonalisation and Cayley–Hamilton theorem. Vector Analysis : The Scalar and vector fields – Gradient, divergence and curl – Orthogonal curvilinear coordinates - Vector integration – Line, surface and volume integrals – Gauss divergence theorem (problem only) - Stokes theorem in the space (problem only)

UNIT 2 FOURIER AND LAPLACE TRANSFORM 9 Hrs.

FOURIER TRANSFORM: Definition of Fourier transform, sin and cosine transform and inverse transform – Fourier transform of elementary functions - Some important theorems: Parseval's, derivatives, and convolution - Application of FT in solving partial differential equations for heat conduction and wave equation.

LAPLACE TRANSFORM: Transforms of standard functions – Some important theorems : derivatives of LT, Shifting theorem I and II – inverse of Laplace Transform - Simple problems only- Solution to Ordinary Differential Equation.

UNIT 3 COMPLEX ANALYSIS 9 Hrs.

Properties of complex numbers, Differentiability, analytic function - CR equation and its properties problems only, Cauchy's first integral theorem, Cauchy's second integral (integral formula), Its theorems and simple problems, Singular points and their classification - Laurent series - Resides - Cauchy's residue theorem - calculation of residue at a point - evolution of definite integrals: (i) around the unit circle, (ii) around a semi-circular contour, and (iii) integral of the form.

UNIT 4 SPECIAL FUNCTIONS 9 Hrs.

Singular points - Series solution : Frobenius's method. Legendre and Hermite : their solution - polynomial – Rodrigues' formula - generating function - recurrence relation - orthogonality relations.

UNIT 5 NUMERICAL TECHNIQUES 9 Hrs.

Roots of Nonlinear equations - Methods of false position and Newton-Raphson method and its testing of convergence. Numerical integration: Trapezoidal, Simpson's rules - Truncation error. First order ODE: Taylor series - Euler's method, improved and modified methods - Predictor- corrector method and Fourth-order Runge-Kutta method.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Quantitatively understand physical parameters which describe behaviour of the system subjected to various boundary conditions

CO1 - Acquire knowledge of different techniques to solve differential and integral equations

CO3 - Provide foundation for complex analysis

CO4 - Understand the theorems to solve problems

CO5 - Understand various special functions and important transforms and their applications

CO6 - To provide a firm basis for future study of numerical analysis and scientific computing

TEXT / REFERENCES BOOK

1. Mathematical methods for Physics, G. Arfken Elsevier, 6th edition, 2010
2. Mathematical Physics, B.D.Gupta, Vikas Publishing House, 4th edition, 2010
3. Topics in Mathematical Physics, Parthasarathy H Ane Books Pvt. Ltd 2007
4. Mathematical Physics,, Rajput, Pragati Prakashan, 17th Edition, 2004
5. Advanced Engineering mathematics, Erwin Kreyszig, Wiley Eastern Limited, 7th Edition, 1993
6. Numerical Methods", S. Balachandra Rao, C.K. Shantha, University Press, 1992.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5204	RESEARCH METHODOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

]

COURSE OBJECTIVES

- To understand the research techniques involved in successful research.
- To develop the required skills about data analysis and
- To learn application of software.

UNIT 1 INTRODUCTION AND DESIGN OF RESEARCH 9 Hrs.

Meaning, objectives and significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of construct and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative vs. quantitative research methodology, field studies, field experiments vs. laboratory experiments, research design in social and Physical sciences.

UNIT 2 DATA AND METHODS OF DATA COLLECTION 9 Hrs.

Survey, assessment and analysis: data collection, primary and secondary sources of data, Collection of primary data through questionnaire and schedules. Collection of secondary data, processing and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling and multistage sampling. Pilot survey, scaling techniques, validity & reliability.

UNIT 3 PRESENTATION OF RESEARCH FINDINGS 9 Hrs.

Methods of presentation - Oral, communication to conferences, journals in a prescribed template – graphical abstract – ORIGIN software – case studies, contents of power point presentation. Motive, aim, objective, methodology, novelty, originality, usefulness to the society, Paper Writing and preparation of Dissertation: Basic concepts of paper writing - Steps of paperwriting, , Precautions in preparing the research Dissertation – Concepts of bibliography and annexure, Discussion of results, Drawing conclusions, Giving suggestion and recommendation of concerned persons.

UNIT 4 QUALITY OF RESEARCH 9 Hrs.

Web of Science, Scopus, UGC, ICI Indexed Journals. Blind reviewed journals, Importance of peer reviewed journals, Plagiarism, Clarivate analytics, Indexing – i – index, h-index, citation index, Collaborative research work, Intellectual property rights – Patents – types-process-filing, publishing, registered patents, product, and commercialization. Improving the research career – INSPIRE Fellowships, CSIR NET Exam, GATE, JEST, etc – Funding opportunities – JRF, SRF in various government funded research agencies, Online courses – MOOC, NPTEL. Attributes of the research scholar –Keen observation, Passion for Knowledge, Spirit of enquiry, Insight etc, Possible approaches to be followed by research scholar.

UNIT 5 INTRODUCTION TO WORD PROCESSING PACKAGE 9 Hrs.

Creating and Editing a word document, creating a research paper, creating a cover letter and a resume, Creating a document with a title page, table, chart and watermark, Creating a webpage using word, Mail Merge, creating a professional newsletter. MS-office – Excel, PPT, Word etc.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the structure of the individual research topic
CO1 - Enhance their analytical mind
CO3 - Bring out the hidden skills
CO4 - Make them aware of updation in their research area
CO5 - Identify the future research problems and
CO6 - Improve their ability as a researcher in a new field

TEXT / REFERENCES BOOK

1. Sriwastava, S. C. : Foundation of Social Research and Economics Techniques, Himalaya Publishing House, 1990.
2. Chou, Ya-Lun : Statistical Analysis with Business and Economics Applications, 2nd Eds., New York, Hold Rinchart and Wrintston, 1974.
3. Clover, Vernon t and Balsely, Howerd L : Business Research Methods, Colombus O. Grid, Inc, 1974.
4. Emary C. Willima : Business Research Methods, Illinois : Richard D. Irwin Inc. Homewood, 1976.
5. Sharma H.D. and Mukherji S. P. : Research Methods in Economics and Business, New York : The Macmillan Company, 1992.
6. Business Research Methods- Donald Cooper & Pamela Schindler, TMGH, 9th editions.
7. Business Research Methods- Alan Bryman & Emma Bell, Oxford University Press.
8. Research Methodology- C. R. Kothari

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5205	SEMICONDUCTOR DEVICES & MICROPROCESSOR	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the physics of junction diodes and to learn to implement them in various applications
- To explore the various applications
- To study the modern day transistor technology involving MOS devices

UNIT 1 BIPOLAR TRANSISTORS 9 Hrs.

Bipolar transistor action and minority carrier distribution Field Effect Transistors: JFET; concept and characterization, MOSFET; MOS structure, energy band diagrams, depletion layer thickness-Light-Emitting Diodes: Principles and device structure, Homojunction and Heterostructure LEDs, LED characteristics.

UNIT 2 MODERN DAY TRANSISTOR TECHNOLOGY 9 Hrs.

MOSFET, C-MOS & CCD, HEMT MOSFET structure, MOS capacitor band diagram-quantitative analysis, I-V characteristics, small signal equivalent circuit, C-MOS technology, CCD structure and its operational principle, CCD applications.

UNIT 3 OPERATIONAL AMPLIFIER 9 Hrs.

Characteristics, Definitions, Differential amplifier, common mode gain, Differential mode gain, CMRR, Introduction of Feedback principle & properties, Four Basic Feedback Topologies, Voltage series feedback amplifier, Voltage shunt feedback amplifier. Differential amplifier with one op-amp. Op-Amp as an inverter, summer, Integrator, Differentiator.

UNIT 4 POWER ELECTRONICS 9 Hrs.

UJT, Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillatorexpression. SCR, Construction, Working and Characteristics, TRIAC, DIAC, Circuit symbols, Basic constructional features, Operation and Applications.

UNIT 5 MICROPROCESSOR 9 Hrs.

Microprocessor 8085 (10 Lec) Introduction to microprocessors & microcomputers, Microprocessor Architecture, Introduction to Assembly language Programming, Operation Bus, Timing (Read/ Write) Cycles, I/O Addressing.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamental principles and concepts governing classical nuclear and particle physics and have a

CO2 - working knowledge of their application to real-life problems.

CO3 - Understand alpha, beta and gamma decay theories and how to detect and measure types of radiation.

CO4 - Induce nuclear fission process and their effects.

CO5 - Understand how scattering process, scattering cross section and amplitude will change with respect to various reactions.

CO6 - Understand, how to identify elementary particles based on their properties

TEXT / REFERENCES BOOK:

1. S M Zee, Solid State Devices, Wiley Publication
2. S M Zee, Physics of Semiconductor Devices, Wiley Publication
3. David A.Bell, Electronic Devices and Circuits, Prentice Hall of India, 4 th edition, 2003.
4. Jacob Millman, Christos C. Halkias, Electronic Devices and Circuits, Tata McGraw-Hill edition, 1991.
5. Kittel, Solid State Physics, Wiley Publication
6. Robert Boylestad, Louis Nashelsky, Eelctron Devices and Circuit Theory, Pearson Education, 9th edition, 2007.
7. Thomas L. Floyd, Electronic Devices, Pearson Education, 6 th Edition, 2002.
8. Albert Malvino, David J.Bates, Electronic Principles, Tata McGraw-Hill, 7th Edition, 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB6201	MICRO PROCESSOR LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVE

- To expose students to the operation of typical microprocessor (8085) trainer kit.
- To prepare the students to be able to solve different problems by developing different programs.
- To develop the quality of assessing and analyzing the obtained data.

LIST OF EXPERIMENTS

1. Simple arithmetic operations: BCD Addition - 8-bit & 16 bit
2. Simple arithmetic operations: BCD Subtraction - 8-bit & 16 bit
3. Simple arithmetic operations: BCD multiplication
4. Simple arithmetic operations: BCD division.
5. Programming with control instructions: Ascending / Descending order
6. Programming with control instructions: Maximum / Minimum of numbers
7. Programming with control instructions: Programs using Rotate instructions
8. Programming with control instructions: Hex / ASCII / BCD code conversions.
9. Interface Experiments: with 8085 : A/D Interfacing. & D/A Interfacing.
10. Interface Experiments: with 8085 : Traffic light controller.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify relevant information to supplement to the Microprocessor and Microcontroller course.
CO2 - Set up programming strategies and select proper mnemonics
CO3 - Run their program on the training boards.
CO4 - Practice different types of programming keeping in mind technical issues and evaluate possible causes of discrepancy in practical experimental observations in comparison.
CO5 - Develop testing and experimental procedures on Microprocessor and Microcontroller analyze their operation under different cases.
CO6 - Prepare professional quality textual and computational results, incorporating accepted data analysis and synthesis methods, simulation software, and word-processing tools.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB5301	MATERIALS PHYSICS & PROCESSING TECHNIQUES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	4	100

COURSE OBJECTIVES

- The syllabus gives a brief idea of the physical parameters and their relevance in our day-to-day life.
- To introduce the students to the principles of batteries, super capacitors and carbon nano tubes.
- To introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques.

UNIT 1 BATTERIES 9 Hrs.

Basic concepts of Batteries, Supercapacitors and Fuel cells, Thermodynamics and kinetics involved in electrochemical reactions, Primary and rechargeable batteries, Li-ion Battery, Components and processes in batteries (Battery operations), Cell characterization: (Charging/discharging cycles, overpotential, battery capacity, state of charge, state of health, impedance spectroscopy), Large scale applications, Plot of Energy Vs Power Density.

UNIT 2 SUPERCAPACITORS 9 Hrs.

Different types of supercapacitors (Electrochemical double layer capacitor, pseudo capacitor and hybrid capacitor), Components of supercapacitors, Electrochemical properties (Charging/discharging cycles, Cyclic Voltammetry and impedance spectroscope, lifetime stability), Different applications.

UNIT 3 THERMOELECTRIC MATERIALS & CATALYSIS 9 Hrs.

Fundamentals of thermoelectricity, Thermoelectric Effects and Transport Properties, Basics of Thermoelectric devices, Heat Conduction in Bulk Thermoelectric Materials, Thermoelectric Devices. Catalysis-Concepts of Electrocatalysis and Photocatalysis, Basic principles and properties for photocatalytic and electrocatalytic water splitting, Few examples of Electro and photo catalysts.

UNIT 4 CARBONNANO TUBES: INTRODUCTION TO GRAPHENE 9 Hrs.

Structure of graphene; Preparation of graphene Electronic Properties CNT: The Structure of Carbon Nanotubes- Nomenclature, Structure of Single-Walled Carbon Nanotubes and Structure of Multiwalled Carbon Nanotubes; Structure and Production of Carbon Materials- Spectroscopic Properties of Carbon Nanotubes- Raman and Infrared Spectroscopy of Carbon Nanotubes, Absorption and Emission Spectroscopy of Carbon Nanotubes,

UNIT 5 CHARACTERIZATION TECHNIQUES 9 Hrs.

Electron Microscopy: Scanning electron microscopy- Transmission electron microscopy and specimen preparation techniques-, X-ray diffraction techniques, Surface Analysis: Atomic force microscopy, Atomic absorption spectroscopy, UV/Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy: Thermo gravimetric analysis, Differential thermal analysis.

Max:45 Hrs

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - To apply appropriate characterization techniques for microstructure examination at different magnification level and use them

CO2 - To understand the microstructure of various materials

CO3 - To choose an appropriate electron microscopy technique to investigate microstructure of materials at high resolution

CO4 - To Understand the Fundamentals of thermoelectric Effects

CO5 - To Differentiate the diverse CNT

CO6 - To Understand the Importance of various characterization Techniques

TEXT BOOK / REFERENCES

1. Materials principles and characterization methods by Chen Liao, 2021
2. Electrochemical Supercapacitors for Energy Storage and Delivery: Fundamentals and Applications (Electrochemical Energy Storage and Conversion), Aiping Yu, Victor Chabot, Jiujun Zhang
3. Charge Density and Structural Characterization of Thermoelectric Materials: 1 (Materials Research Foundations), R. Saravanan, 2016
4. Introduction to Graphene: Chemical and Biochemical Applications 1st Edition, Kindle Edition,2017
5. Handbook Of Instrumentation And Techniques For Semiconductor Nanostructure Characterization (In 2 Volumes) (Materials and Energy)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5302	THERMODYNAMICS & STATISTICAL MECHANICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study the thermal properties of materials by different methods
- To explain of the properties of macroscopic system
- To know the Quantum statistical mechanics.

UNIT 1 REVIEW OF THE LAWS OF THERMODYNAMICS AND THEIR CONSEQUENCES 9 Hrs.

Energy and first law of thermodynamics – Heat content and Heat capacity –Specific heat – Entropy and its significance - second law of thermodynamics –thermodynamic potential and the reciprocity relations – Maxwell's relations – Deductions – properties of thermodynamics relations – Gibb's-Helmholtz relation – Thermodynamic equilibrium – Nernst Heat theorem of third law – consequences of third law – phase-Gibb's phase rule – chemical potential

UNIT 2 KINETIC THEORY 9 Hrs.

Equilibrium state of dilute gas; Binary collisions – Boltzmann transport equation and its validity Boltzmann's H-theorem and its analysis – Maxwell – Boltzmann distribution – Method of most probable distribution. Transport phenomena: Mean free path – Conservation laws – Zero and first order approximations –Navier – Stokes equation – Examples in hydrodynamics.

UNIT 3 CLASSICAL STATISTICAL MECHANICS 9 Hrs.

Macro and micro states – Statistical equilibrium – Phase space and ensembles – Micro canonical ensemble – Liouville's theorem – Maxwell – Boltzmann distribution law – Distribution of energy and velocity – principles of equipartition of energy – Energy fluctuations – Partition function – Free energy – Boltzmann's entropy relation – Grand canonical ensemble – Basic concepts of distribution laws – Maxwell–Boltzmann, Bose-Einstein and Fermi-Dirac statistics.

UNIT 4 QUANTUM STATISTICAL MECHANICS 9 Hrs.

Black body and Planck's radiation – Phonons – Partition Function for a harmonic oscillator – Specific heat of solids – Einstein's theory – Debye's theory – Specific heat of diatomic molecules – Ideal Bose gas – Energy, pressure and thermal properties – Bose – Einstein condensation – Liquid helium – Fermi – Dirac gas – Properties – Degeneracy– Electron gas – Quantum mechanical ensemble theory.

UNIT 5 ADVANCED TOPICS IN STATISTICALMECHANICS 9 Hrs.

Critical phenomena and phase transition – Weiss molecular field theory – Ferromagnetic transition – Analogy between phase transitions — Ising and Heisenberg models –Fluctuations – Weiner- Khinchine theorem – Thermodynamics of irreversible processes – Onsagar's reciprocity relations.

Max:45 Hrs

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Explain statistical physics as logical consequences of the postulates of statistical mechanics

CO2 - Apply the principles and techniques of statistical mechanics to selected problems and to a range of situations

CO3 - Use tools and methodologies to physics to test and communicate ideas and explanations

CO4 - Able to understand statistical mechanics of bosons and fermions (quantum fluids)

CO5 - Able to understand the classical limit and strongly degenerate quantum systems including Fermi Gases and

CO6 - To understand the classical limit and strongly degenerate quantum systems including Fermi Gases Bose-Einstein condensates

TEXT BOOK / REFERENCES

1. F. Reif, Statistical and Thermal physics, McGraw Hill, International Edition, Singapore, 1979, revised - 2019
2. B.R. Agarwal and N. Eisnor, Statistiacal Mechanics, 2nd ed, Wiley Eastern Limited, New Delhi
3. R. Huang, Statistical Mechanics, Wiley Eastern Ltd., New Delhi, 1983
4. F. Mandl, Statistical physics, John Wiley, London, 1971
5. C. Kittel, W. H. Freeman, Thermal Physics, 2nd ed 1980
6. F.W.Sears and G.L.Salinger, Thermodynamics, kinetic theory and statistical thermodynamics, 3rd edition, Narosa publishing house, 1998

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB5303	ELECTROMAGNETIC THEORY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To apprise the students regarding the concepts of electrodynamics and Maxwell equations and use them various situations
- To provide mathematical concepts, techniques.
- To know the essential tools for the studies of advance Physics.

UNIT 1 ELECTROSTATICS 9 Hrs.

Coulomb‟s Law– Charge distributions– Lines of force and flux–Gauss‟s Law and its applications –The potential function– Poission‟s equation and Laplace equation– Equipotential surfaces– Field due to continues charge distribution– Energy associated to an electrostatic field– Electrostatic uniqueness theorem.

UNIT 2 MAGNETOSTATICS 9 Hrs.

Lorentz force – Faraday‟s law – Magnetic field strength and Ampere‟s circuital law– Biot-Savart‟s law – Ampere‟s force law – Magnetic vector potential – Equation of continuity–The far magnetic field of a current distribution– Magnetic field due to volume distribution of current.

UNIT 3 DIELECTRICS 9 Hrs.

Dielectrics; Polarization – the electric field inside a dielectric medium – Gauss law in dielectric and the electric displacement – Electric susceptibility and dielectric constant – Boundary conditions on the field vectors – Dielectric sphere in a uniform electric field– Force on a point charge embedded in a dielectric.

UNIT 4 FIELD EQUATIONS 9 Hrs.

Maxwell's equation and propagation of EM waves: Maxwell‟s equations and their physical significance – Plane wave equation in homogeneous medium and in free space – relation between E and H vectors in a uniform plane wave– The wave equation for a conducting medium – Skin depth – Wave propagation in dielectric– Poynting vector – Poynting‟s theorem.

UNIT 5 RELATIVISTIC ELECTRODYNAMICS 9 Hrs.

Waves in bounded region and Radiation Reflection and refraction of EM waves at the boundary of two conducting media – Normal incidence and oblique incidence – Brewster‟s angle– Wave guides – Rectangular wave guide – Cavity resonators – Radiation from and oscillating dipole –Transmission line theory – Transmission line as distribution circuit– Basic transmission line equations.

Max:45 Hrs

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - To use Maxwell equations in analysing the electromagnetic field due to time varying charge and current distribution.
CO2 - To describe the nature of electromagnetic wave.
CO3 - Its propagation through different media and interfaces.
CO4 - To explain charged particle dynamics and radiation from localized time varying electromagnetic Source
CO5 - To discuss Maxwell's equations and apply in broad range of applications
CO6 - To analysis boundary conditions followed by wave guides principle

TEXT / REFERENCE BOOKS

1. Foundation of EMT – Third edition –John R. Reity, Frederick J. Milford and Robert W. Christy.
2. Electromagnetic theory – Prabir K. Basu and HrishikeshDhasmana.
3. Introduction to Electrodynamics– David J Griffiths.
4. Electromagnetic fields and waves– P.Lorrain and D.Corson.
5. A Students guide to waves - Daniel Fleisch and Laura Kinnaman

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks **70 Marks**

SPHB5304	SPECTROSCOPY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide understanding and knowledge of atomic structure and
- To know the interaction between atoms and fields.
- To deals with the binding of atoms into molecules, and theory of electronic, vibrational, rotational and molecular spectroscopy.

UNIT 1 MICROWAVE SPECTROSCOPY 9 Hrs.

Rotation of molecules-Rotational spectra-Rigid and non-rigid diatomic rotator-Intensity of spectral lines-Isotopic substitution-Poly atomic molecules (Linear and symmetric top)-Hyperfine structure and Quadra pole effects-Inversion spectrum of ammonia-Chemical analysis by microwave spectroscopy-Techniques and instrumentation.

UNIT 2 SPECTRA OF ONE ELECTRON ATOM 9 Hrs.

Vector atom model, Sterrn-Gerlach Experiment, hydrogen spectrum, spin-orbit interaction and fine structure in alkali spectra, intensity rules - equivalent and non-equivalent electrons, l-s and j-j couplinghyperfine structure and isotopic shift.

UNIT 3 SPECTRA OF MANY ELECTRON ATOMS 9 Hrs.

Zeeman effect-normal and anomalous, Paschen-Back effect, Stark effect, two electron systems, broadening of spectral lines– line broadening, Doppler and Lorentz broadening mechanisms, lamb shift, X- ray spectra-Moseley's Law.

UNIT 4 THEORY OF MOLECULAR SPECTRA 9 Hrs.

Born-Openheimer approximation, rotational spectra of diatomic molecules-rigid rotator and non-rigid rotator, vibrational-rotational spectra of diatomic molecule- harmonic oscillator, effect of anharmonicity, electronic spectra of diatomic molecules, Frank-Condon principle.

UNIT 5 RAMAN SPECTROSCOPY 9 Hrs.

Raman spectroscopy, Rotational and vibrational Raman spectra of diatomic molecules, Electron spin resonance (ESR), Nuclear magnetic resonance (NMR), Effect of Nuclear spin on intensities of rotational

Max:45 Hrs

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Demonstrate knowledge of atomic and molecular physics
CO2 - Analyze and solve simple problems related to atomic and molecular physics
CO3 - Formulate new methods to study atomic
CO4 - Formulate new methods to study molecular physics.
CO5 - To analyze the diatomic molecules and its corresponding spectra
CO6 - To understand the working of ESR and NMR in detail

TEXT BOOK/ REFERENCES:

1. Introduction to Atomic Spectra; White; Mcgraw-Hill Education.
2. Atomic Spectra and Atomic Structure; Herzberg; Dover
3. Physics of Atoms and Molecules: Bransden and Joachain; Pearson.
4. Atomic & Molecular Spectra; Raj Kumar, Kedar Nath Ram Nath, New Delhi.
5. Raman Spectroscopy and its Application in Nanostructures

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 marks each - No choice	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SPHB6301	ADVANCED PHYSICS LABORATORY	L	T	P	EL	Credits	Total Marks
		0	0	4	0	3	100

COURSE OBJECTIVES

- To introduce the basic concepts of various advanced experimental techniques
- To use in research through hands on experience
- To understand the working of spectrometer and thin film deposition techniques

LIST OF EXPERIMENTS

1. UV-Vis Spectrophotometer – Determination of absorption coefficient and band gap
2. Fluorescence spectrometer – Emission spectra of a fluorophore
3. FTIR Spectrometer – Determination of vibration levels in a compound
4. Thin Film Deposition and Measurement of Electrical Conductivity – Four Probe Method
5. Impedance Spectroscopy – measurement of impedance of capacitor
6. Band structure study of Si at ambient and under pressure
7. Bridgmann technique – method of growing single crystal
8. Thermo gravimetric analysis and Differential Scanning calorimeter
9. Measurement of thickness of thin film
10. Experiment with microwaves – measurement of dielectric constant of solid
11. Non-Destructive Testing

12 IR Pyrometer

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Calculated the absorption co efficient and bank gap by spectrophotometer
CO2 - Determine the vibrational levels in a compound by FTIR spectrometer
CO3 - Measurement of electrical conductivity of a thin film by four probe method
CO4 - Identifying structural problems by NDT method
CO5 - The student will be able to understand the fundamental physics
CO6 - To study behind modern scientific equipment used in research through hands on experience

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

CAE Model Practical Exam **50 Marks**
ESE University Practical Exam **50 Marks**

SPHB3001	**Waves and Oscillations**	**L**	**T**	**P**	**EL**	**C**
		3	0	0	0	3

Course Objectives:

- To know the different modes of vibrations in the string and find out how different harmonics can be produced.
- To describe reflection, refraction, transmission of sound wave and attenuation of sound waves.
- To study the application of oscillation and waves through the vibration of rods, bells, air columns and tuning fork

Unit-1: Vibrations and Sound Waves: 9 Hrs

Vibration of Strings: Equation of motion of a vibrating string, velocity of waves along a string, frequency and period of vibration of a string, harmonics and overtones. Propagation and velocity of sound wave in solid. Stationary Waves:Reflection of waves in strings from free and fixed ends, stationary waves, nodes and antinodes, pressure and density changes at nodes and anti-nodes, distribution of energy in a stationary wave.

Unit-2: Reflection, Refraction Diffraction and attenuation ofSound Waves 9 Hrs Reflection of sound waves, Huygen's Principle, Refraction of sound waves, Huygen's Principle, Diffraction of sound waves, Attenuation of Sound Waves: Causes of dissipation of sound energy, effect of viscosity, attenuation constant, effect of heat conduction, absorption of high frequency waves in gases, sound absorption in narrow tubes and cavities, transmission of power by plane waves, radiation resistance.

Unit-3: Oscillations and Waves: Applications 9 Hrs

Vibration of Rods and Surfaces Longitudinal vibrations of rods, velocity of a longitudinal wave in a rod, stationary longitudinal waves in rods, transverse vibration of rods, tuning fork, vibration of plates, Chladni's figures, vibration of bells, vibration of stretched membranes and diaphragms, (non-mathematical treatment). Vibration of Air Column. Flue pipes and reed pipes, vibrations of air columns in closed and open organ pipe, overtones, resonance in air columns, end corrections, effect of temperature on pitch.

Unit-4: Acoustics 9 Hrs

Musical Sounds: Noise and musical sounds, loudness, intensity level, decibel and phon, intensity of a sound, pitch, quality of sound. Musical Scales and Consonance. Architectural Acoustics: reverberation, absorption coefficient, Sabine's law, good acoustical designs of rooms, noise, measurement, noise reduction and sound insulation. Technical Applications of Acoustical Principles: Sound ranging, geophone, hydrophone, echo sounding, seismograph.

Unit-5: Ultrasonics 9 Hrs Ultrasonic waves - Different modes - Characteristic properties - Behaviour - Focusing - Stationary waves and resonance - Attenuation - Diffraction - Sources of ultrasound. Magnetostriction method -Piezoelectric method - Low frequency / high Intensity applications - high frequency - low intensity applications - clinical applications of different scans.

Max. 45 Hrs

COURSE OUTCOMES

By the end of this course students will be able to

CO1:Visualize the vibrations of strings and propagation interference of sound waves.

CO2:Find the behavior of sound waves at interfaces of Reflection, Refraction of diffraction, Transmission and their attenuation.

CO3:Understand the different application of oscillation and waves.

CO4:Analyze the properties of musical sound and apply into architecture.

CO5::Clarify the ultrasonic characterization, production.

CO6: Explain the application at high & low intensity towards clinical application.

TEXT / REFERENCE BOOKS

1. A Text Book of Sound, D. R. Khanna and R. S. Bedi, (Atma Ram & Sons) New Delhi 1985
2. Vibrations, Waves and Acoustics, D. Chattopadhyay and P. C. Rakshit, (New Central BookAgency)
3. A Text Book of Sound, M. Ghosh, (S. Chand & Company)
4. Text book of sound by M N Srinivasan – Himalaya Publications (1991)
5. Science and technology of Ultrasonics by Bladevraj, Narosa (2004)
6. Text book of sound by BrijLal&Subramaniam, N Vikas Publishing House, New Delhi, 1982
7. Fundamentals of Acoustic, Lawrence Kinsler and Austin Frey, (Wiley Eastern)
8. Introduction to Mechanics, Mahendra K. Verma, (Universities Press)
9. Waves & Oscillations ,Subrahmanyam N &BrijLal, Vikas Publishing House Pvt. Ltd., New Delhi, 1994

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks. **70 Marks**

		L	T	P	EL	C
SPHB3002	Digital, Analog and Microprocessor system	3	0	0	0	3

COURSE OBJECTIVES

- It introduces to the fundamentals of diode theory, P.N junctions and bipolar junction transistor (BJT).
- It covers the basics and design of field effect transistors (FET) and transistors amplifiers.
- It explains the various feedback transistor and operational amplifiers.

UNIT I: P-N Junctions and Bipolar Junction Transistors (BJT) 9 Hrs

Diode theory, forward and reverse-biased junctions, reverse-bias breakdown, diode applications - clippers, clampers, voltage multipliers, half wave & full wave rectification, Special purpose diodes - Zener diode, Varactor, light emitting diodes, Laser diodes, Transistor fundamentals, transistor configurations, DC operating point, BJT characteristics & parameters.

UNIT II: Field-Effect Transistors (FET) and Transistors Amplifier 9 Hrs

JFET- current-voltage characteristics, Small Signal BJT amplifiers: AC equivalent circuit, hybrid, r_e model and their use in amplifier design, Multistage amplifiers, frequency response of basic & compound configuration, Power amplifiers: Class A, B, AB, C and D stages, IC output stages.

UNIT III: Feedback & Oscillator Circuits and Operational Amplifiers 9 Hrs

Effect of positive and negative feedbacks, basic feedback topologies & their properties, Analysis of feedbacks, Sinusodial Oscillators (RC, LC and Crystal), Multivibrators, The 555 timer, Op-Amp Basics, practical Op-Amp circuits, differential and Common mode operation, Inverting & Non Inverting Amplifier, differential and cascade amplifier, Op-Amp applications.

UNIT IV: Number Systems and Boolean Algebra 9 Hrs

Decimal, binary, octal, hexadecimal number system and conversion, binary weighted codes, signed numbers, 1s and 2s complement codes, Binary arithmetic, Binary logic functions, Boolean laws, truth tables, associative and distributive properties, DeMorgans theorems, realization of switching functions using logic gates.

UNIT V: Introduction to Microprocessor 9 Hrs

Basics of microcomputer - block diagram - types of memories - ROM - PROM - EPROM -EEPROM - dynamic RAM - static RAM 8085 microprocessor architecture - address, data and control buses - flag registers - generation of control signals - demultiplexing of address and data lines - interrupt signals - types of interrupt - hardware and software interrupts, multiple interrupts and priorities - stack and subroutine

Max. 45 Hrs

COURSE OUTCOMES

By the end of this course students will be able to

CO1: Understand the fundamentals of diode theory, P.N junctions and bipolar junction transistor (BJT).
CO2: Understand the basics and design of field effect transistors (FET) and transistors amplifiers.
CO3: Study the principle and working of various feedback transistor and operational amplifiers.
CO4: Acquire basic knowledge on various number systems and Boolean algebra.
CO5: Acquire a broader understanding on analysis and
CO6: Design of combinational logic systems.

TEXT / REFERENCE BOOKS

1. A.S. Sedra&K.C.Smith, Microelectronics Circuits, Oxford University Press (1997)
2. A.P. Malvino, Electronic Principles, Tata Mcgraw Hill Publications
3. Robert L. Boylestad& Louis Nashelsky, Electronic Devices & Circuit Theory
4. William Kleitz, Digital Electronics, Prentice Hall International Inc.
5. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, John Wiley & Sons Inc.
6. Michael Shur, Introduction to Electronic Devices, John Wiley & Sons Inc., 2000.
7. R. T. Howe and C. G. Sodini, Microelectronics: An Integrated Approach, Prentice-Hall Inc. 1997.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks. **70 Marks**

SPHB3003	Nano materials	L	T	P	EL	C
		3	0	0	0	3

Course Objectives:

- Understand the influence of dimensionality
- Explain the object at nanoscale on their properties
- Analise size and shape controlled synthesis of nanomaterials and their future applications in industry.

Unit I: Nanoscale Science **9 Hrs**

Interconversion of units. Introduction to surface area to volume ratio and aspect ratio. Difference between surface area to volume ratio of bulk materials and nanomaterials (sphere, hollow sphere, rods, hollow rods, cubes and hollow cubes) and related numerical problems.

Unit II: Classification of Nanomaterials **9 Hrs**

Introduction to dimensional growth process. Classification of nanomaterials into 0D, 1D, 2D and 3D. Relationship between dimension and shape of nanomaterials (Quantum dots, Quantum wires, Carbon nanotubes, Bucky balls, Fullerenes).

Unit III: Basics of Fabrication Methods **9 Hrs**

Top-Down fabrication methods –Types of Top-Down fabrication methods (mechanosynthesis, thermal, high energy, chemical fabrication and lithography-concepts with examples only). Bottom-Up fabrication methods-Types of Bottom-Up fabrication methods (gaseous-phae, liquidphase)

Unit IV: Properties of Nanomaterials: **9 Hrs**

Size and shape dependence of optical, electronic, photonic, mechanical, magnetic and catalytic properties.

Unit.V: **Nanomaterials and their applications**: **9 Hrs**

Nanoparticles, Nanocoatings and Nanocomposites, Nanotubes, Fullerenes, Thin film chemical sensors, gas sensors, biosensors, Carbon fullerenes and Carbon nanotubes, Thin film chemical sensors, biosensors, Solar cells, Drug deliveries and optoelectronic devices.

Max. 45 Hrs

Course outcomes:

By the end of this course students will be able to

CO1: Explain the effects of quantum confinement on the electronic structure.

CO2: To know corresponding physical and chemical properties of materials at nanoscale.

CO3: Choose appropriate synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties.

CO4: Correlate properties of nanostructures with their size, shape and surface characteristics.

CO5: Appreciate enhanced sensitivity of nanomaterial based sensors and

CO6: To know their novel applications in industry.

TEXT / REFERENCE BOOKS

1.The Physics and Chemistry of NanoSolids by Frank J. Owens and Charles P. Poole Jr, Wiley-Interscience, 2008.

2. Reference Books Nanomaterials- Synthesis, Properties and Applications, Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, London, 1998 (paper back edition)

3. Nanochemistry: A Chemical Approach to Nanomaterials, by G. Ozin and A. Arsenault, RSC Publishing, 2005

4. Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf, Wiley-VCH, 2nd Reprint (2005)

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks. **70 Marks**

SPHB3004	BASIC INSTRUMENTATION SKILLS	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVES

- To make the student familiar with measurement techniques of force, torque and speed
- To make the student familiar with measurement techniques of acceleration, Vibration and density
- To make the student familiar with pressure measurement techniques

UNIT I BASIC CONCEPT OF INSTRUMENTATION 9 HRS

Basic concepts of Instrumentation: Methods of measurement-direct method, indirect method, mechanical, electrical and electronic instruments; Measurement systems: static characteristics- accuracy, sensitivity, linearity, precision, resolution, threshold, range, hysteresis, drift; dynamic characteristics -measuring lag fidelity, speed of response, dynamic error; Definition and type of errors- systematic errors, instrumental errors, environmental errors, random errors; propagation of error; Error calculation.

UNIT II MEASUREMENT OF FORCE, TORQUE, SPEED, ACCELERATION 9 HRS

Force and torque measurement: Load cell, Different types of load cells: Hydraulic, Pneumatic, Magneto-elastic and Piezoelectric load cells (concept); Strain gauge- concept and required mathematical expression for measurement of force and torque; Speed measurement- capacitive tachometer, DC and AC tacho generators; Acceleration measurement – LDVT accelerometer and its mathematics, particle accelerometer.

UNIT III TEMPERATURE AND PRESSURE MEASUREMENT 9 HRS

Definition, standards and different temperature scales; Bimetallic thermometer, Resistance thermometers; Thermistors- types and their mathematical expression for R-T variation; Thermocouples- types, laws of thermocouple, cold junction compensation; Thermopiles in series and parallel connection; Pyrometer- radiation type; IC temperature sensors. Pressure - Definition and unit, Direct and indirect pressure gauges; Manometer types, U-tube manometer with derivation of pressure; Elastic type pressure transducer (concept); Electric pressure transducer – capacitive, resistive; Vacuum gauges- Mc Leod gauge with derivation of unknown pressure; Thermocouple gauge; hot and cold cathode ionization gauge.

UNIT IV MEASUREMENT OF FLOW, LEVEL, DENSITY, VISCOSITY, HUMIDITY 9 HRS

Types of flowmeter, Bernoulli's principle in flow measurement; Differential flowmeter- orifice plate, venturi tube; Electromagnetic flowmeter with mathematical expression of flow rate; Ultrasonic flowmeter; Level measurement- float gauge, resistive type level indicator, ultrasonic level gauging; Density measurement- hydrometer, Radioactive densitometer, gas densitometer; Viscosity measurement- Saybolt viscometer, rotameter type; Humidity measurement- Hygrometer (resistive and capacitive type); Electrolytic hygrometer.

UNIT V DIGITAL MEASUREMENT AND DISPLAYS 9 HRS

Digital Instruments: Block diagram, principle of operation and accuracy of measurement of -Digital Multimeter, Kilowatt Hour meter, Digital Tachometer, Ultrasonic Distance meter, Digital Thermometer, Frequency meter. Seven segment digital display devices- construction and operation.

Max. 45 Hours

COURSE OUTCOMES:

CO1: Applying the concept of measurement, error calculation while performing experiments practically
CO2: Acquire a detailed knowledge of industrial measurement
CO3: An exposure to various available techniques of temperature and pressure measurement
CO4: A detailed knowledge of fluid property measurement will be obtained
CO5: An idea of newly evolving digital measurement techniques is gained.
CO6: To handle the Thermometer and other devices.

TEXT / REFERENCE BOOKS

1. Patranabis D., "Principles of Industrial Instrumentation", Tata McGraw Hill, II Edition, New Delhi, Reprint 2009.
2. Singh. S.K., "Industrial Instrumentation &Control" 3rd Edition, Tata McGraw Hill, Reprint 2009.
3. Krishnaswamy. K &Vijayachitra. S, "Industrial Instrumentation" New age International, Reprint 2008.
4. Ernest O. Doebelin, Dhanish. N. Manik, "Measurement Systems Application & Design", TMH, 5th Edition, 2004.
5. Jain R.K, "Mechanical & Industrial Measurements", Khanna Publishers, 11th Edition, 2004.
6. T. S. Rathore, "Digital Measurement Techniques" CRC Press, 2003.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks. **70 Marks**

SPHB3005	**Fundamentals of Agricultural Physics**	**L**	**T**	**P**	**EL**	**C**
		3	0	0	0	3

COURSE OBJECTIVE

- The objective of this discipline is to educate students on
- Understanding of climate and weather elements, principles and processes, and their impact on agricultural activities.
- Agricultural Physics deals with the application of physical principles and processes in agriculture.

Unit I: Basic concepts of physics

Importance of physics related to agriculture- physical laws – Brownian movement – Tyndoll effect – Raman Effect – Spectroscopy – Adhesion and Cohesion properties – relevant to agriculture

Unit II: Soil physics

soil moisture movement – physical classification of soil moisture – soil air movement – thermal diffusion in soils – thermal properties of soils – heat capacity – heat conductivity – specific heat. (6 Lectures)

Unit III: Nanophysics

Nano particles – physical properties of nanoparticles – Moore's law – semi conductors – diode – biosensors – quantum dots – working principles of Transmission Electron microscope – Scanning Electron Microscope – Scanning Tunneling Microscope – their applications (7 Lectures)

Unit IV: Soil

plant - water continuum – capillary movement of water in soil and plant – tortousity of water in soils – Hysterisis effect – osmosis – diffusion. (6 Lectures)

Unit V: Physical constraints in agriculture

soil constraints – impermeability of soil – compaction methods – physical constants of soils – Soil physics as a factor in soil management.

Max. 45 Hours

Course outcomes:

CO1: Agrophysics is a science that studies physical processes
CO2: To know the properties affecting plant production.
CO3: The knowledge of physical phenomena in agricultural environment
CO4: It creates increasing efficiency of use of water and chemicals in agriculture and
CO5: Understanding the decreasing biomass losses during harvest, transport, storage, and processing.
CO5They understand about the soil characteristics before starts cultivating,
CO6: To understand about the constraints of soil in agriculture

TEXT / REFERENCE BOOKS

1. William Lambe, T. and Robert V.Whitman. 1979. Soil Mechanics. Wiley Eastern Ltd. New Delhi.
2. Helmut Kohnke, 1979. Soil Physics. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
3. Biswas, T.D. and Mukherjee, S.K. 1997. Text book of soil science. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
4. Chinnamuthu, C.R., B.Chandrasekaran and C.Ramasamy, 2007. Nanotechnology Applications in Agriculture.TNAU Offset & Printing Press, Directorate of Open and Distance Learning, TNAU, Coimbatore.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.
PART A: 10 Questions of 2 mark each - No choice. 30 Marks
PART B: 2 Questions from each unit of internal choice, each carrying 16 marks. 70 Marks

SPHB3006	Astronomy and Astrophysics	L	T	P	EL	C
		3	0	0	0	3

Course outcomes:

- Develop skills to design observing projects with research telescopes and projects drawing upon data in the literature and in archives
- Establish competence in focused areas of astrophysical theory and experiment
- Generate fluency in the scientific enterprise and awareness of possible career paths available to the undergraduate astronomy and astrophysics major

UNIT I INTRODUCTION TO ASTRONOMY 9Hrs

The constellations and their identification - Earth's rotation and other motions - Eclipses - Contents of the Universe: A general perspective - Identificaion of stars - Geometry of the celestial sphere - The alt-azimuth coordinate system - The equatorial coordinate system - The ecliptic coordinate system -The galactic coordinate system - Astronomy in the Era of Copernicus, Tycho, Kepler, and Galileo; Kepler's Laws of Planetary Motion

UNIT II DIFFERENT OPTICAL TECHNIQUES 9Hrs

Optical telescopes - Light gathering power - Observing in different spectral regions - Magnifying power - Resolving power - Limiting magnitude - Measurement of stellar distances - Stellar magnitudes - Stellar parallaxes - Stellar photography - Stellar photometry - CCD and its uses - Multicolor photometry - Spectrophotometry - Radio telescopes - detection of flux density nd brightness

UNIT III EVOLUTION- FORMATION AND STRUCTURE OF STARS 9Hrs

Novae and Supernovae - Black holes - Stars formation - Interstellar medium - Stellar energy generation - Stellar prime of life - Stellar structure - Dying stars - Nebulae and supernovae remnants - Pulsars, neutron stars and black holes - Spiral structure of the Galaxy - The Big Bang theory - The Steady State theory - Quasars - The Hubble's law

UNIT IV SUN AND SOLAR SYSTEM 9Hrs

Basic structure of the Sun - The solar constant - Solar energy for Earth - Origin of the solar system -The planets and their origins - The Moon -The planets Mercury, Venus and Mars - The planets Jupiter, Saturn, Uranus, Neptune - Comets, meteors and asteroids

UNIT V SPACE ASTRONOMY 9Hrs

Effects of the Earth's atmosphere on incident electromagnetic radiation - Introduction to X-ray astronomy and related technique - X-ray studies of the Sun - X-ray studies of supernova remnants - X-rays from normal and active galaxies - Diffuse X-ray background - IR, UV, X-ray and Gamma ray satellites

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the physical significance of Maxwell"s equations and hence estimate the speed of light.
CO2 - To understand the various types of optical aberration.
CO3 - To know about the basics of electromagnetic waves and their characteristics.
CO4 - To know the principle of air wedge and Jamin's & Rayleigh's interferometers.
CO5 - To understand the basics of polarization and applications of polarization.
CO6 - To understand the basics of diffraction and applications of diffraction.

TEXT / REFERENCE BOOKS

1. Fundamental Astronomy by Hannu Karttunen, Pekka Kroger, Heikki Oja, Markku Poutanen, Karl Johan Donner, Cham, Switzerland : Springer-Verlag Berlin An, 2016
2. Encyclopedia of Astronomy and Astrophysics by Paul Murdin, New York : Nature Pub. Group, 2001.
3. History of Astronomy by John Lankford, Marc Rothenberg New York : Garland Pub., 1997
4. New Perspectives in Astrophysical Cosmology by Martin Rees, New York : Cambridge University Press, 2000
5. An Introduction to Modern Cosmology by Andrew Liddle, New York : Wiley, 1999

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks. **70 Marks**

SPHB3007	Communication System	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVE

- Study the various types of communication techniques.
- Analysizing based on Fourier transform.
- Provide fundamental knowledge of pulse modulation techniques and their types.

UNIT I DIGITAL COMMUNICATION (9 Hrs)

Basic Elements Of Digital Communication System – Block Diagram-Characteristics Of Data Transmission Circuits - Bandwidth Requirement – Speed - Baud Rate - Noise -Crosstalk – Distortion. Digital Codes: ASCII Code – EBCDIC Code - Error Detection Codes – Parity Check Codes – Redundant Codes - Error Correction Codes – Retransmission- Forward Error Correcting Code – Hamming Code

UNIT II.OPTICAL FIBER COMMUNICATION (9 Hrs)

Introduction-need for OFC. Block diagram of OFC system. Fiber optic cables, light propagation through fiber-step index fiber, graded index fiber, Snell's law, numerical aperture (derivation). Types of optical fiber cables, light sources-requirements, LEDs and semiconductor laser diodes. Photo detectors -PN, PIN and avalanche photodiodes. Losses in optical fibers -Rayleigh scattering, absorption, leaky modes, bending, joint junction losses. Advantages and disadvantages of OFC over metallic cables.

UNIT III CELLULAR COMMUNICATION (9 Hrs)

Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts.

UNIT IV SATELLITE COMMUNICATION (9 Hrs)

Introduction, need, satellite orbits, advantages and disadvantages of geostationary satellites. Satellite visibility, satellite system – space segment, block diagrams of satellite sub systems, up link, down link, cross link, transponders (C- Band), effect of solar eclipse, path loss, ground station, simplified block diagram of earth station. Satellite access – TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA, Satellite antenna (parabolic dish antenna).

UNIT V WIRELESS NETWORKS (9 Hrs)

Wireless LAN's Major components of local area network- Primary characteristics of Ethernet-mobile IP, OSI model, wireless LAN requirements-concept of Bluetooth, WiFi and WiMAX.

Max. 45 Hrs

Course Outcomes:

By the end of this course students will be able to

CO1: Design, operation, and troubleshoot of electronic systems
CO2: Solve electronic devices and systems using mathematical concepts.
CO3: Analyze electronics devices and circuits using computer simulations.
CO4: Analyze components associated with digital and analog electronic/communication systems.
CO5: Analyze basic wireless and communication circuits using computer simulations
CO6: Identify the communication system knowledge of the future perspective.

TEXT / REFERENCE BOOKS

1. Advanced Electronic Communication Systems-Wayne Tomasi, PHI 6th edition.
2. Telecommunication Systems –P.H Smale, Wheeler Publication 2nd edition.
3. Optical Fiber Communications-Gerd Kaiser, McGraw-hill 2nd edition.
4. Satellite Communications- Roddy, McGraw-hill 4th edition.
5. Electronic Communication systems, Kennedy & Davis, IVth edition-TATA McGraw Hill.
6. Electronic Communication systems, Fundamentals through Advanced, Wayne Tomasi - 5th edition.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max.Marks:100	**Exam Duration: 3Hrs.**
PART A: 5 Questions of 6 mark each –Nochoice.	**30Marks**
PART B: 2 Questions from each unit of internal choice, each carrying14marks.	**70Marks**

SPHB3008	Bio physics	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVES:

- To emphasize the importance of different biomaterials in application.
- Understanding the problems in biology and medicine.
- Motivate the students to pursue research in the field of biophysics.

UNIT 1 MODERN BIOLOGY (9 Hrs)

The reductionist program in biology - the use of physics and chemistry in biology - introduction to modern molecular biology - elementary description of the cell - DNA, proteins and the molecules of Life - the central dogma of information transfer within a cell - introduction to Darwinian evolution and prebiotic evolution.

UNIT 2 SEPARATION TECHNIQUES AND PHYSICO-CHEMICALTECHNIQUES (9 Hrs)

Chromatography - column chromatography - thin layer chromatography - Ion exchange, molecular exclusion and partition chromatography - electrophoresis - gel electrophoresis - SDS - PAGE - hydration of molecules - role of friction - diffusion - sedimentation - ultracentrifuge - viscosity - rotational diffusion - light scattering.

UNIT 3 EXPERIMENTALTECHNIQUES (9 Hrs)

General Introduction To Spectroscopic Techniques In Biology - UV - Visible Spectroscopy - Applications And Results In Biology - IR And Raman Spectroscopy - Applications And Results - Circular Dichroism And Optical Rotatory Dispersion - Fluorescence Spectroscopy - NMR - Use Of NMR In Biological Structure Determination And Medical Imaging - X-Ray Crystallography, Its Use To Determine The Structures Of Biological Molecules.

UNIT 4 STRUCTURES OF BIOLOGICALMOLECULES (9 Hrs)

Level of protein structure - amino acids and the primary structure of proteins - the peptide bond and the secondary structure of proteins - the Ramachandran Plot - tertiary and quaternary structure of proteins - the double helical structure of DNA - how it explains DNA function - the structure of viruses.

UNIT 5 BIOMECHANICS, NEURO- BIOPHYSICS (9 Hrs)

Contractile proteins - mechanical properties of muscles - contraction mechanism - the cardiovascular system - blood pressure - electrocardiography - the nervous system, CNS and PNS - nerve cells - membrane potentials - sensory mechanisms - eye and ear - signal transduction.

Max. 45 Hrs

Course Outcomes:

Upon successful completion of this course students will be able to

CO1: Understand to modern molecular biology.
CO2: Know the principles of Separation techniques and physico - chemical techniques
CO3: Use spectroscopic techniques in biology
CO4: Explain Level of protein structure
CO5: Understand the Biomechanics of heart, eye, ear, nervous system
CO6: Identify the knowledge of the medical physics and their applications in various fields.

TEXT / REFERENCEBOOKS

1. VasanthaPattabhi and N. Gautham , Biophysics, Narosa Publishing Company, New Delhi, 2001.
2. P. Narayanan,. Introductory Biopshyiscs, New Age Publishing Co., Mumbai. India, 1999.
3. E. Ackerman, L.B.M. Ellis and L.E. Williams, Biophysical Science, Prentice Hall Inc., New Jersey, USA,1979.
4. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Tata: McGraw Hill Publishing Co., Ltd., New Delhi, India, 1983.
5. C.R. Cantor and P. Schimmel, Biophysical Chemistry, Vol.I, II and III, W.H. Freemand and Co.New York, U.S.A. 1985.
6. D. Freifelder, Physical Biochemistry, W.H. Freeman and Company, New York, USA, 1982
7. F.W. Sears, M.W. Zemansky and H.D. Young, College Physics, Addison Welsey Publishing Co, Massachusetts, USA, 1985.

8. G.M. Barrow, Molecular Spectroscopy, Mcgraw - Hill Book Company, Inc., New York, USA, 1962.
9. J.M. Haile, Molecular Dynamics Simulation, John Wiley and Sons, New York, USA, 1992.
10. C. Branden and J. Tooze, Introduction to Protein Structure, Garland Publishing Company, New York USA, 1991.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
PART A: 6 Questions of 5 mark each - No choice.	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks.	**70 Marks**

SPHB8001	MEDICAL PHYSICS	L	T	P	EL	C
		3	0	0	0	3

Course Objectives:

- Understand the basic principles of biophysics
- Understand the fundamentals of medical instrumentation
- Describe the applications of lasers in medicine.

UNIT I INTERACTION OF RADIATION WITH MATTER **9Hrs**

Interaction of electromagnetic radiation with matter, Thomson scattering, Rayleigh scattering, Compton scattering, Photoelectric absorption, Pair production – Interaction of light (electrons and positrons) and heavy charged particles with matter–specific ionization – Cerenkov radiation-mass-energy- attenuation and absorption coefficient - Interaction of neutron with matter.

UNIT II LASER – TISSUE INTERACTION AND MEDICAL LASER **9Hrs**

Laser tissue interaction - photophysical process - photobiological process - absorption by biological systems - different types of interactions - thermal - photochemical (one photon and multiphoton) - electro mechanical photo ablative process. Laser systems for biophotonics- CO2 Laser- Nd-YAG Laser - Ar Ion Laser - Excimer laser- Diode lasers- Ti :Sapphire Laser- Beam Characteristics and Radiometry - Nano Imaging and PDT

UNIT III DOSIMETRIC QUANTITIES AND UNITS **9Hrs**

Introduction -exposure-Roentgen - photon fluence and energy fluence -KERMA-Kerma and absorbed dose - CEMA -Absorbed dose - Radiation Dose Equivalent - stopping power - relationship between the dosimetric quantities - stopping power ratio. Principles of Radiation detection – properties of dosimeters - Theory of gas filled detectors - film dosimetery- Luminescence dosimetry - Gel dosimetry.

UNIT IV GENERATION AND DETECTION OF ULTRASOUND **9Hrs**

Propagation of ultrasound in biological materials - Piezoelectric effect - intensity changes by reflection, scattering, refraction, absorption and attenuation – impedance – transducer probes - Principles of Echo ranging - A scan - detection, smoothing and filtering - time gain compensation - application of A, B, and M mode scan

UNIT V TYPES OF DOSIMETERS **9Hrs**

Thermoluminescence Dosimeters – Optically Stimulated Luminescence (OSL) Dosimeters – Principles and materials used – OSL measuring technology - Compound semiconductor dosimeters – GaAs detectors – HgI2 detectors - CdTe dosimeters - Role of impurities: Zn-doped CdTe detectors –Neutron detectors. Radiation dosimeters – pMOS and direct ion storage (DIS) dosimeters - In-vivo dosimetery – Materials and methods

Max. 45 Hrs

Course Outcomes:

At the course end, the students will be able to

CO1: Understand Dosimetry and standardization in clinical medical physics.
CO2: Analyse Radiation detectors and instrumentations,
CO3: Handling the Ion champers, radiation chemistry and chemical dosimetry, various dosimeters,
CO4: Knowledge about Personnel monitoring instruments
CO5: Know about the different type of Dosemetries
CO6: Identity the radiations and application in various aspects.

TEXT / REFERENCE BOOKS

1. Frank Herbert Attix, Introduction to Radiological Physics and Radiation Dosimetry, Wiley-VCH Verlag, 2007.
2. Donald T. Graham, Paul J. Cloke, Principles of Radiological Physics, Churchill Livingstone, 2003.
3. Markolf H. Neimz, Laser-Tissue Interactions, Springer Verlag, Germany, 1996.
4. W. R. Hendee, Medical Radiation Physics, Year Book Medical Publishers Inc., London,2003.
5. Charles Kittel.," Introduction to Solid State Physics", John Wiley, 8th edition, 2013
6. S.W.S. McKeever, "Thermoluminescence Dosimetry Materials: Properties and Uses", Ramtrans Publishing (December 1995).

END SEMESTER EXAMQUESTION PAPER PATTERN

Max.Marks:100	**Exam Duration: 3Hrs.**
PART A: 5 Questions of 6 mark each –Nochoice.	**30Marks**
PART B: 2 Questions from each unit of internal choice, each carrying14marks.	**70Marks**

SPHB8002	APPLIED DYNAMICS	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVES:

- Introduce students to the concepts of dynamics.
- The students are expected to develop working skills in the dynamic analysis of both particles and rigid bodies.
- Master the basics of dynamics, including free body diagrams and kinematics.

Unit-I. Fundamentals of Dynamics: **9Hrs**

Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Review of Newton's Laws of Motion. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Momentum of variable-mass system: motion of rocket.

Unit-II Rotational Dynamics: **9Hrs**

Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Unit-III Introduction to Dynamical systems: **9Hrs**

Definition of a continuous first order dynamical system. The idea of phase space, flows and trajectories. Simple mechanical systems as first order dynamical systems : the free particle, particle under uniform gravity, simple and damped harmonic oscillator. Sketching flows and trajectories in phase space; sketching variables as functions of time, relating the equations and pictures to the underlying physical intuition.

Unit-IV Elementary Fluid Dynamics: **9Hrs**

Importance of fluids: Fluids in the pure sciences, fluids in technology. Study of fluids: Theoretical approach, experimental fluid dynamics, computational fluid dynamics. Basic physics of fluids: Basic physics of fluids: The continuum hypothesisconcept of fluid element or fluid parcel; Definition of a fluid- shear stress; Fluid properties- viscosity, thermal conductivity, mass diffusivity, other fluid properties and equation of state;

Unit-V Applications of Fluid Dynamics: **9Hrs**

Flow phenomena- flow dimensionality, steady and unsteady flows, uniform & non-uniform flows, viscous & inviscid flows, incompressible & compressible flows, laminar and turbulent flows, rotational and irrotational flows, separated & unseparated flows. Flow visualization - streamlines, pathlines, Streaklines. Applications:Find the coupling coefficient of coupled pendulums and To determine the coupling coefficient of coupled oscillators.

Max. 45 Hrs

CO1: Knowledge about the fundamental dynamics
CO2: Details of Rotational dynamics and relative concepts
CO3: Identify the ideas about the dynamical system
CO4: Enhance the knowledge about the elementary fluid dynamics
CO5: Identify the application of fluid dynamics
CO6: Basics of fluid dynamics and also its application.

Reference Books

1. Nonlinear Dynamics and Chaos, S.H. Strogatz, Levant Books, Kolkata, 2007 48
2. Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, Springer.
3. An Introduction to Fluid Dynamics, G.K.Batchelor, Cambridge Univ. Press, 2002
4. Fluid Mechanics, 2nd Edition, L. D. Landau and E. M. Lifshitz, Pergamon Press, Oxford, 1987.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3Hrs.**
PART A: 5 Questions of 6 mark each –Nochoice. **30Marks**
PART B: 2 Questions from each unit of internal choice, each carrying14marks. **70Marks**

SPHB8003	Renewable Energy Resources	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVE

- To obtain an overview of various renewable energy sources
- Study the exists and gives insight to the actual status of various renewable energy sources.
- Knowledge about Bio energy ocean energy.

UNIT 1 **INTRODUCTION TO ENERGY** **9Hrs.**

Definition and units of energy, power, Forms of energy, Conservation of energy, second law of thermodynamics, Energy flow diagram to the earth. Origin and time scale of fossil fuels, Conventional energy sources, Role of energy in economic development and socialtransformation.

UNIT 2 **SOLAR ENERGY FUNDAMENTALS** 9Hrs.

Solar constant –Solar radiation at the earth's surface – Solar radiation Geometry – Solar Radiation measurements – Estimation of average solar radiation – Solar radiation on tilted surface. Physical principles of the conversion of solar radiation into heat – Flat plate collectors – Transmissivity of the cover system – Energy balance equation and collector efficiency – Concentrating collector – Focusing type – Advantages and disadvantages of concentrating collectors over flat-plate collectors.

UNIT 3 **SOLAR ENERGY APPLICATIONS** 9Hrs.

Solar photovoltaic – Solar distillation – Solar pumping – Solar furnace – Solar cooking – Solar energy storage systems – Solar pond (quantitative study only). Wind Energy: Basic principles of wind energy conversion – Basic components of wind energy conversion system – Classification of wind energy conversion systems – Wind energy collectors – Performance of wind machines.

UNIT 4 **BIO ENERGY** 9Hrs.

Biomass conversion techniques – Biogas generation – Factors affecting bio digestion – Classification of biogas plants – Types of biogas plants – Materials used for biogas generation. Geothermal Energy: Nature of Geothermal fields – Geothermal sources – Vapour dominated systems – Liquid dominated systems – Magma resources – Geothermal exploration – Geothermal energy in India.

UNIT 5 OCEAN ENERGY CONVERSION 9Hrs

Ocean Energy: Introduction, Principle of ocean thermal energy conversion (OTEC), Tidal power generation, Tidal energy technologies, Energy from waves, Wave energy conversion, Wave energy technologies, advantages anddisadvantages.

Max. 45 Hrs

Course Outcomes:

At the course end, the students will be able to

CO1: Understand the importance of renewable energy sources
CO2: Acquire the knowledge of solar energy
CO3: Learn the solar energy application in different form like solar voltaic, solar furnace, solar energy storage system etc.
CO4: Illustrate the biomass conversion technique and geothermal energy
CO5: Understand the concept of ocean thermal energy and hydrogen energy
CO6: Knowledge about the natural resources.

T EXT / REFERENCEBOOKS

1. G.D.Rai, Non-conventional Sources of energy, Fourth edition, Khanna Publishers, New Delhi, 2000.
2. S Rao and Dr.B.B.Parulekar, Energy Technology: Nonconventional, Renewable and Conventional, Third edition, Khanna Publishers, New Delhi, 1999.
3. S P Sukhatme, Solar Energy: Principles of thermal collection and storage, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.1996. M V R KoteswaraRao, Energy Resources: Conventional and non-conventional BS Publications, 2nd Edn, 2006.
4. B.H. Khan, Non conventional energy Resources, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd. 2009.
5. John Twindell and Tony Weir, Renewable energy Resources, 2nd Edn,Taylor and Francis, 2006. 3.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3Hrs.**
PART A: 5 Questions of 6 mark each –Nochoice. **30Marks**
PART B: 2 Questions from each unit of internal choice, each carrying14marks. **70Marks**

SPHB8004	**INDUSTRY 4.0**	**L**	**T**	**P**	**EL**	**C**
		3	0	0	0	3

COURSE OBJECTIVES

- To obtain an overview of various renewable energy sources
- Study the exists and gives insight to the actual status of various renewable energy sources.
- Knowledge about Bio energy ocean energy

UNIT 1 ADVANCED TECHNOLOGY AND MATERIALS 9 Hrs.

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nanomechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaic's, Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT 9 Hrs.

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal, public health issues-improving water management in surface and overhead irrigation- Integration of energy, water and environmental systems for a sustainable development

UNIT 3 SMART MANUFACTURING 9 Hrs.

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations – Intellectual Property Rights (IPR): Case Studies.

UNIT 4 SMART WORLD 9 Hrs.

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Intellectual Property Rights- Case Studies.

UNIT 5 CYBER PHYSICAL SYSTEMS 9 Hrs.

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : CaseStudies.

Max. 45 Hrs

Course Outcomes:

At the course end, the students will be able to

CO1: Understand the advanced Materials/Technology

CO2: Acquire knowledge about environmental systems for a sustainable development

CO3: Covers many different technologies from Smart Manufacturing

CO4: Effectively learning the smart technology

CO5: Understand various modeling formalisms for CPS, such as hybrid automata, state-space methods, etc

CO6: To know about the cyber physical systems.

TEXT / REFERENCE BOOKS

1. William D. Callister,"Materials Science and Engineering, An Introduction, John Willey and Sons Inc. Singapore, 2001.
2. V. Raghavan, "Physical Metallurgy: Principle and Practice,. Prentice Hall India Pvt Ltd, 2006.
3. FlavioCraveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103,pp. 251-267, 2019.
3. Klaus Schwab, " Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
4. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies" , Studylab Publications, 2016

5. Alasdair Gilchrist, “INDUSTRY 4.0: Industrial Internet of Things”, Apress, 2016

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
PART A: 5 Questions of 6 mark each - No choice.	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks.	**70 Marks**

SPHB8005	INTELLECTUAL PROPERTY LAW	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVES:

- This course is intended to introduce the different categories of Intellectual Property, the minimum standard to indentify the items of protection.
- Bundle of rights conferred to the right holder and remedies available in the case of infringement are also examined.
- Students can understand the trademark and designs act

UNIT 1 INTRODUCTION 9Hrs

Meaning and concept of intellectual Property and the need for protection - The world Intellectual property Organization (WIPO) Convention - Origin and functions of World Trade Organisation (WTO) - Trade Related Intellectual property Rights (TRIPS) Agreement of WTO and its effects on Intellectual Property law in India; Dispute Settlement Mechanism.

UNIT 2 COPYRIGHT ACT 9Hrs

The Copyright Act (1957) and recent amendments-works in which copyright subsist-Authorship And Ownership-Different Rights-Registration of copyright-Term of copyright-Administration of copyright law-Performer's rights-Broadcaster's rights-Collective administration of copyrights-Moral rights-Copyright infringements-Remedies-Composition of Copyright Board.

UNIT 3 TRADEMARK & DESIGNS ACT 9Hrs

The Trade Mark Act (1999), object, definitions, salient features- Distinctiveness, deceptive similarity- Assignment and transmission -Registration: Procedure-Term-Effects-Grounds for refusal- Powers and functions of Registrar- collective marks-certification marks-Trade mark agents - Appellate board - Infringement action, passing off action –Well known marks-The designs Act 2000; definitions, registration of designs, copyright in registered designs, piracy of registered designs, remedies, powers and duties of Controller - Semi conductor integrated circuit layout-Trade secrets.

UNIT 4 LAW OF PATENTS 9Hrs

The Patents Act (1970):object definitions, salient features-Invention: patentable and non- patentable inventions-product and process patents- -Rights of patentees-assignment and transmission-term of patent–Registration-opposition to grant of patent, anticipation- Revocation of patents- Compulsory licences- Exclusive marketing rights-Infringement- exclusive marketing rights- Patent office and power of Controller, patents of addition-Patenting of biotechnology-Nanotechnology.

UNIT 5 FARMERS AND BREEDERS RIGHT & GEOGRAPHICAL INDICATION 9Hrs

The Protection of Plant Varieties And Farmers' Rights Act, 2001: object definitions, salient features The Geographical Indications Of Goods (Registration And Protection) Act, 1999- object definitions, salient features

Max. 45 Hrs

COURSE OUTCOME:

CO1: To introduce fundamental aspects of Intellectual property Rights.
CO2: Understanding of the IPR Acts.
CO3: Explain the basic principles of patents, trademarks, geographical designs, industrial designs, and copyright.
CO4: The course follows an international perspective and examines the international IP legal regime rather than focusing solely or predominantly on the national framework.
CO5: Revolves around the protection of plant varieties and farmers right act
CO6: Equip the students with the required Professional Skills.

TEXT / REFERENCE BOOKS

1. V.K. Ahuja, Law Relating to Intellectual Property Law, Lexis Nexis, 2nd ed., 2013.
2. N.S. Gopalakrishnan& T.G. Ajitha, Principles of Intellectual Property, Eastern Book Company, 2nd ed., 2014
B.L. Wadhera, Law Relating to Intellectual Property, Universal Law Publishing, 5th ed., 2014.
1. S. Narayan, Intellectual Property Law in India, Gogia Law Agency, Hyderabad, 3rd ed., 2005.
2. Holyoak&Torreman, Intellectual Property Law, Oxford University Press, New York, 2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**
PART A :5 Questions of 6 marks each-No choice **30 Marks**
PART B :2 Questions from each unit with internal choice, each carrying 14 marks **70 Marks**

SPHB8006	THIN FILM TECHNOLOGY	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVES:

- Understanding the basics of Thinfilm technology
- Understanding the chemical methods involved in thinfilm deposition
- Knowledge about the characterization methods of thiniflm.

UNIT 1 VACUUM TECHNOLOGY 9 Hrs.

Fundamentals of vacuum, basic definition and pressure regions of vacuum, kinetic theory of gases mean free path, types of flow, conductance, vacuum pumps and systems, rotary mechanical pump, roots pump, diffusion pump, turbo molecular pump, sputter ion pump, measurement of vacuum, concept of different gauges, capacitance gauges, Pirani gauge, ionization gauge and penning gauge, vacuum system components and operation.

UNIT 2 PHYSICAL METHODS OF THIN FILM DEPOSITION 9 Hrs.

Thermal evaporation, resistive heating, flash evaporation, laser evaporation, rf-heating, coevaporation, electron bombardment heating, sputtering plasma, discharges and arc, sputtering variants, sputtering yield low pressure sputtering, rf-sputtering, reactive sputtering, magnetron sputtering, magnetron configurations, bias sputtering, evaporation versus sputtering.

UNIT 3 CHEMICAL METHODS OF THIN FILM DEPOSITION 9 Hrs.

Electrodeposition, electrolytic deposition, electro less deposition, anodic oxidation, spray pyrolysis, spin and dip coating, chemical vapor deposition (CVD), homogenous and heterogeneous process, CVD reactions, pyrolysis, hydrogen reduction, halide disproportionation, transfer reactions, CVD processes and systems, low pressure CVD, laser enhanced CVD, metalorganic CVD (MOCVD).

UNIT 4 GROWTH OF THIN FILMS AND THICKNESS MEASUREMENTS 9 Hrs.

Introduction: nucleation and early stages of film growth, thermodynamic aspects of nucleation, capillary theory, thin film growth modes Volmert, Weber (VW) growth, Frank-van der Merwe (FM) growth, Stranski-Krastanov growth, thickness measurement, electrical methods, microbalance monitors, quartz crystal monitor, mechanical method (stylus), optical interference methods, ellipsometry, interference fringes.

UNIT 5 CHARACTERIZATION METHODS OF THINFILMS 9Hrs.

X-ray diffraction (XRD), scanning electron microscopy, transmission electron microscopy, energy dispersive analysis, Auger electron spectroscopy, X-ray photoelectron spectroscopy,Rutherford backscattering spectroscopy, secondary ion mass spectrometry.

Max. 45 Hrs

Course Outcomes:

At the course end, the students will be able to

CO1: Understand the Vaccum process and they can know how to create Technology.
CO2: Identify the physical synthesis of thin film methods
CO3: Identify the chemicall synthesis of thin film methods
CO4: Analyze the Basic sciences behind the thin film growth and the thickness factor
CO5: Characterize the thinfilm in various methods.
CO6: Growth analysis has been detail analyzed with some materials.

TEXT /REFERENCE BOOKS:

1. Maissel and Glang, Hand Book of Thin Film Technology
2. K.L. Choppra, Thin Film Phenomena
3. Dupy and Kachard, Physics of Non-Metallic Thin Films –
4. S. Dushman and J.M. Lafferty, Scientific Foundations of Vacuum Technology
5. M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Ed., Academic Press, 2002.

6. S. Campbell, The Science and Engineering of Microelectronic Fabrication, 2nd Ed., OUP, 1996. 3. Kaufmann, Characterization of Materials, 2 nd Ed., Wiley, 2003.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SPHB8007	CRYSTALLOGRAPHY AND CRYSTAL GROWTH	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVES:

- To provide the fundamental knowledge in the crystal growth theory,
- To understand the various synthesis techniques and structural characterization of crystals.
- Also to motivate the students to pursue research in the field of crystal growth.

UNIT 1 CRYSTALLOGRAPHY 9 Hrs.

Lattice – Unit cell Bravais lattices – Crystal planes and directions – Basic symmetry elements operations – Transnational symmetries – Point groups – Space groups – Nomenclature of planes – Crystal projections – Symmetry projections of thirty two point groups.

UNIT 2 DIFFRACTION METHODS 9 Hrs.

X-ray- generation – Properties – Absorption – Diffraction by X-rays, Neutron and electron – Atomic scattering factor – scattering by solids, liquids and gases - **XRD -** Introduction – Single crystal XRD and Powder XRD methods – interpretations of diffraction patterns – Cell parameter determinations – Indexing – identification of compounds.

UNIT 3 CRYSTAL GROWTH THEORY 9 Hrs.

Introduction – Nucleation – Gibbs-Thomson equation for melt and solution – Kinetic theory of nucleation – Limitations of classical nucleation – Rate of nucleation – Different shapes of nucleus- spherical, cap shaped and cylindrical.

UNIT 4 CRYSTAL GROWTH TECHNIQUES 9 Hrs.

Gel growth – Solution growth methods – low and high temperature techniques – Bridgman technique – Stockbarger technique – Czochralski method – growth rate – Verneuil technique – Zone melting – Matter transport – Epitaxial growth.

UNIT 5 GROWTH FROM SOLUTIONS 9 Hrs.

Preparation of a solution – Saturation and Supersaturation – Measurement of supersaturation – Expression for supersaturation – Low temperature solution growth – Slow cooling method – Manson Jar method – Evaporation method – Temperature gradient method. Growth from Gels – Experimental methods – Chemical reaction method – Reduction method –Solubility reduction method – Growth by hydrothermal method

Max. 45 Hrs

Course Outcomes:

After the end of this course, the students will be able to;

CO1: Know the various types of crystal structure
CO2: Predict the structure of crystal using X-ray diffraction pattern
CO3: Understand the basic knowledge theory of formation of crystal
CO4: Acquire the ability to operate the Bridgman apparatus for the growth of crystal
CO5: Execute the growth process from solution
CO6: Analyze the characterization of crystals

TEXT / REFERENCEBOOKS

1. K. Sangwal, Elementary Crystal, Saaan Publisher, UK, 1994.
2. J.C. Brice, Crystal growth processes, John Wiley and Sons, New York, 1986.
3. V.N. Joshi, Photoconductivity, Marcel Dekker, Newyork, 1990.
4. Sangwal, K. and Rodriguez-Clemente, R. Surface Morphology of Crystalline Materials, Trans Tech Pub. Switzerland, 1991.
5. Komatsu, H. Studies and Concepts in Crystal Growth, Pergamon Press, Oxford, 1993.
6. Hurle, D.T.J. Handbook of Crystals Growth, Vol. 3, North-Holland, Amsterdam, 1994.
7. Van der Eerden, J.P. and Bruinsma, O.S.L. Science and Technology of Crystal Growth, Kluwer Academic Pub, 1995.
8. M.A.Wahab, Essentials of crystallography, Alpha Science International Ltd, 2009.
9. P.Santhanaraghavan and P.Ramasamy, Crystal growth process and method, KRU Publications, 2001.
10. H.K.Henisch, Crystals in gels and Liesegang rings, Cambridge University Press, 2005.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 5 Questions of 6 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SPHB8008	PHYSICS OF DIELECTRICS	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVES

- To acquire knowledge concerning the electrical behaviour of dielectric materials (polar and non polar).
- To Learn the different theories of static and complex permitivities
- To familiarize with the experimental investigation methods of dielectrics.

UNIT 1 INTRODUCTION TO PHYSICS OF DIELECTRICS 9 Hrs

Permanent dipole moment.Induced dipole moment.Polarization and dielectric constant.Types of polarization, Electron polarization, Atomic polarization, Orientation polarization.Ionic polarization.Dipole moments and electrostatic problems.Polarizability.Polarization and energy.Internal field Langeven function.Non-polar dielectrics.Lorentz's field.Clausius-Massotti formula.

UNIT 2 THEORIES OF DIELECTRICS 9 Hrs

Reaction field.Debye's Theories, Polar molecules in nonpolar solvent.Onsager's theory.The dielectric properties of polar non-associative liquids.Kirkwood-Frolich's theory, the dipole-dipole interaction, the correlation factor of Kirkwood.The static dielectric permittivity of strong polar associative liquids.The modern theories of the static dielectric permittivity (Böttcher, Nienhuis and Deutch, Ramshaw, Wertheim etc).

UNIT3 THEORIES OF DIELECTRIC RELAXATION 9 Hrs

The theory of linear response.The time dependent fields.The dielectric response function.The dielectric relaxation theory.Frequency and Time Domain.The complex dielectric permittivity.Dielectric losses and dispersion. The distribution functions of the relaxation times. Cole-Cole distribution.Cole-Davidson distribution.Havriliak-Nehamy and Johnsher distributions The dipole correlation function. The relationship between the complex dielectric permittivity and the dipole correlation function. Short-range and long range correlation functions. Fulton's Theory.The memory function.Kohlrausch-Williams-Watts (KWW) non-exponential behavior in complex systems.

UNIT 4 EXPERIMENTAL METHODS OF DIELECTRIC SPECTROSCOPY 9 Hrs

Dielectric Spectroscopy.Classification of the experimental methods. Frequency methods: Bridges, Resonance methods, Coaxial lines, Waveguides, Transient methods, Strip lines, Slot lines, etc. Broad Band Dielectric Spectroscopy. A frequency response analyzer (10^{-5} Hz - 10^{6} Hz), automatic radio - frequency bridge (10 Hz - 10^{7} Hz) coaxial line reflectometer (10^{6} Hz - 10^{9} Hz) and coaxial vector network analyzer (10^{7} Hz - 10^{11} Hz). Time Domain Dielectric Spectroscopy.The single reflection and transition methods. Multiple reflection, transition, lumped capacitance methods. Non uniform sampling. Fourier transform and the time domain treatment

UNIT 5 APPLICATIONS OF DIELECTRIC SPECTROSCOPY 9 Hrs

Application of DS to Pure liquids and Solutions.Glass forming liquids.Dielectric relaxation of water.Dielectric relaxation of ice.The dielectric properties of heterogeneous substances. Emulsions and Micro emulsions. Polarization of Maxwell Wagner.Dielectrics with conductive paths.Percolation Phenomena.Dielectric properties of biological materials.

Max. 45 Hrs

Course Outcomes:

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

CO1: Different polarization mechanisms
CO2: Enhance the knowledge of Various theories of static and complex permittivity
CO3: Various theories on dielectric mechanisms
CO4: Experimental methods of dielectric spectroscopy
CO5: Applications of dielectric spectroscopy to pure liquids and solutions, emulsions and biological molecules
CO6: Knowledge of the Experimental methods of Spectroscopy.

TEXT / REFERENCE BOOKS

1. Boetcher. C. J. F, Theory of Electric Polarization 2nd Edition, Elsevier Scientific Publication Company, 1973.
2. H. Fröehlich, Theory of Dielectrics ,Oxford University/Clarendon Press, 1950 reprinted 1992.
3. Mansel Davies, Dielectric and Related Molecular Processes volume 3, Royal Society of Chemistry, 1972.
4. J.B. Hasted, Aqueous Dielectrics, Chapman and Hall, 1973.
5. N.E. Hill, Dielectric properties and Molecular Behaviour, Van Nostrand Reinhold; 1st edition, 1969.
6. C.H. L. Goodman, Physics of Dielectrics Solids, Institute of Physics, 1980.
7. S. Takashima, Electrical Properties of Biopolymers and Membranes 1st edition, CRC Press,1989.
8. E.H. Grant, R.J. Sheppard andG.P.South, Dielectric Behaviour of Biological Molecules in Solutions, Oxford Univ. Press, 1978.
9. S.Bone and B.Zaba, Bioelectronics, John Wiley and Sons Ltd, 1992.
10. V. Raicu and Yu. Feldman, Dielectric Relaxation in Biological Systems: Physical Principles, Methods, and Applications,

Oxford University Press, 2015.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
PART A: 5 Questions of 6 mark each - No choice.	**30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks.	**70 Marks**

SPHB8009	ULTRASONICS	L	T	P	EL	C
		3	0	0	0	3

COURSE OBJECTIVES

- To understand the production and propagation of ultrasonics waves by different methods.
- To help the students to understand the fundamental and advanced applications of ultrasonics.
- Also to motivate the students to pursue research in the field of Ultrasonic characteristics of solids, liquids and polymer medium.

UNIT 1 ULTRASONICPROPAGATION IN LIQUIDSANDSOLIDS 9 Hrs.

Propagation of Ultrasonic waves in Solids – Plane wave propagation – Relation of the velocity of sound to the elastic properties – Adiabatic and Isothermal elastic constants – Ultrasonic propagation in liquids – Internal pressure and free volume calculations.Other acoustic parameters-Acoustic impedance, Acoustic intensity, attenuation

UNIT 2 DETERMINATIONOF VELOCITYOF PROPAGATIONOF ULTRASONIC 9 Hrs.

Pulse Echo methods – Phase comparison methods – Pulse superposition – Measurements t high pressure and high temperature – Transducer coupling materials.

UNIT 3 ULTRASONIC TRANSDUCERS 9 Hrs.

Piezoelectric ,Magnetostrctive transducers and immersion transducers-piezo-electric materials for ultrasonic probes – Equivalent circuits – Efficiency – Transducer mounting – Linear and sector transducers – Variable frequency systems.

UNIT 4 ABSORPTION OF ULTRASONICRADIATION 9 Hrs.

Classical absorption due to viscosity – Absorption due to thermal conductivity – Relaxation process – Evaluation of dispersion and absorption curves – Structural relaxation – Relation between collision frequency and relaxation time – Ultrasonic attenuation in solids.

UNIT 5 APPLICATION OF ULTRASONICS 9 Hrs.

Application of ultrasonic in NDT – Medical Applications – Biological effects of ultrasound - Ultrasonic transaxial tomogram (U.T.T) – Acoustic microscope – Acoustic hologram- A study of ultrasonic wave propagation in bones-ultrasonic imaging technology for industrial applications-underwater acoustic communications.

Max. 45 Hrs

Course Outcomes:

Upon successful completion of this course, students should be able to:

CO1: Learn about the nature and applications of Acoustical waves.

CO2: Apply the concept in many diversified areas which include fluid mechanics, communication, NDT (Non Destructive Testing), SONAR, Real time tracking of objects and devices, imaging (i.e. sonography), medicine, cleaning, welding etc.

CO3: Identify the ultrasonic parameters and deviation in viscosity and infer the results in determining the interaction types, in the Binary and Ternary mixtures.

CO4: Apply the measured viscosity and ultrasonic velocity data to various theories in

CO5: Determining the best applicability of the theory for the given binary mixture.

CO6: Apply Acoustic ultrasonic in appropriate applications.

TEXT /REFERENCEBOOKS

1. Gooberman G.L., Ultrasonics – Theory and Applications, The English universities press Ltd., London, 1968.
2. Schreiber Edwar, Elastic constants and their measurement, Anderson and Soga, McGraw hill Book Co., New Delhi, 1973.
3. Lerski R.A., Practical Ultrasound, IRL Press, Oxford, 1988.
4. Robert T. Beyer and Stephen V. Letcher, Practical ultrasonics, Academic Press London, 1969.
5. Woodcock J.P., Ultrasonics, Adam hilger., U.K., 1979.
6. Krautkramer, Josef and Hebert Krautkramer, Ultrasonic testing of materials, 3rd edition Springer-Verlag, New York, 1983.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A:5 Questions of 6 mark each - No choice. **30 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks. **70 Marks**

SPHB8010	RADIATION PHYSICS	L	T	P	EL	C
		3	0	0	0	3

Course Objectives:

- To expose the students of M.Sc. class to the relatively advanced topics Radiation Physics and nuclear reactions.
- They understand the details of the underlying aspects 0f nuclear detectors and spectroscopy.
- This can use the techniques if they decide to be radiation or nuclear physicists in their career.

UNIT 1 INTERACTION OF ELECTROMAGNETIC RADIATIONS WITH MATTER 9 Hrs.

Different photon interaction processes viz. photoelectric effect, Compton scattering and pair production. Minor interaction processes, Energy and Z dependence of partial photon interaction processes. Attenuation coefficients, Broad and narrow beam geometries.Multiple scattering.

UNIT 2 INTERACTION OF CHARGED PARTICLES WITH MATTER 9 Hrs.

Elastic and inelastic collisions with electrons and atomic nucleus.Energy loss of heavy charged particles. Range-energy relationships, Straggling. Radiative collisions of electrons with atomic nucleus.

UNIT 3 NUCLEAR DETECTORS AND SPECTROSCOPY 9 Hrs.

General characteristics of detectors, Gas filled detectors, Organic and inorganic scintillation detectors, Semi-conductor detectors [Si(Li), Ge(Li) HPGe]. Room temperature detectors, Gamma ray spectrometers. Gamma ray spectrometry with NaI(Tl) scintillation and semiconductor detectors.

UNIT 4 NUCLEAR SPECTROMETRY AND APPLICATIONS 9 Hrs.

Analysis of nuclear spectrometric data, Measurements of nuclear energy levels, spins, parities, moments, internal conversion coefficients, Angular correlation, Perturbed angular correlation, Measurement of g-factors and hyperfine fields.

UNIT 5 ANALYTICAL TECHNIQUES 9 Hrs.

Principle, instrumentation and spectrum analysis of XRF, PIXE and neutron activation analysis (NAA) techniques. Theory, instrumentation and applications of electron spin resonance spectroscopy (ESR). Experimental techniques and applications of Mossbauer Effect, Rutherford backscattering.Applications of elemental analysis, Diagnostic nuclear medicine, Therapeutic nuclear medicine.

Max. 45 Hrs

COURSE OUTCOMES:

Upon successful completion of this course, students should be able to

CO1: Understand various modes of interaction of electromagnetic radiations and charged particles with matter.
CO2: Distinguish various types of radiations based on their interaction with matter.
CO3: Learn and understand about different detectors and their use for spectroscopy.
CO4: Use different analytical technique such as XRF, PIXE, neutron
CO5: Activation analysis and electron spin resonance spectroscopy.
CO6: Understand various analysis techniques and way to apply the materials in suitable manner

TEXT/REFERENCE BOOKS:

1. The Atomic Nucleus: R.D. Evans, Tata McGraw Hill, New Delhi.
2. Nuclear Radiation Detectors: S. S. Kapoor and V. S. Ramamurthy, New Age, International, New Delhi.
3. Radiation Detection and Measurements: G. F. Knoll, Wiley & Sons, New Delhi.
4. Introductory Nuclear Physics: K. S. Krane, Wiley & Sons, New Delhi.
5. An Introduction to X-ray Spectrometry: Ron Jenkin, Wiley.
6. Techniques for Nuclear and Particle Physics Experiments: W. R. Leo, Narosa Publishing House, New Delhi.
7. Introduction to experimental Nuclear Physics: R.M. Singru, Wiley & Sons, New Delhi

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**
PART A: 5 Questions of 6 mark each - No choice. **30 Marks**
PART B: 2 Questions from each unit of internal choice, each carrying 14 marks**.** **70 Marks**