

BSC PHYSICS
Regulation -2017

SPH 1111	PROPERTIES OF MATTER	L	T	P	Credits	Total Marks
		3	0	0	3	100

Learning Objectives:

- To explain the laws of orbit and the gravitational phenomenon surrounding us. It gives a brief idea of the physical Parameters and their relevance in our day to day life.
- To give details about physical properties of materials and inculcates interest to observe facts experimentally.
- To impart basic understanding of the various physical techniques theoretically. It caters the needs for engineering applications.
- To deal with general phenomena in Physics and creates a platform for in depth understanding in low temperature Physics.
- To impart a thorough knowledge about liquid motion and various relevant theoretical facts.

Unit 1: Gravitation**9 Hrs**

Keplers Laws- Newton's law of gravitation, Determination of gravitational constant-Boy's method, Poynting's method-Gravitational field, Intensity of the field, Gravitational potential due to a spherical sphere, Escape velocity.

Unit 2: Elasticity**9 Hrs**

Hooke's law – Stress – Strain Diagram – Elastic Moduli – Work done in deforming a body – Relation between elastic constants – Poisson's Ratio – Expression for Poisson's ratio in terms of elastic constants – Twisting couple on a wire – Rigidity modulus by static torsion – Work done in twisting a wire – Torsional pendulum – Determination of rigidity modulus of a wire.

Unit 3: Bending of Beams**9 Hrs**

Expression for bending moment – Cantilever – Expression for depression – Experiment to find Young's Modulus – Cantilever oscillation – Expression for period – Uniform bending – Expression for elevation – Experiment to find Young's modulus using microscope – Non Uniform bending – Expression for depression – Experiment to find Young's modulus using mirror and telescope.

Unit 4: Surface Tension and Physics of Low Pressure**9 Hrs**

Definition and dimensions of surface tension – Examples – Excess of pressure over curved surfaces – Variation of surface tension with temperature – Jaeger's Experiment. Physics of Low Pressure Production and measurement of low pressure – Gaede's molecular pump – Mercury diffusion pump – Knudsen's absolute gauge – Detection of leakage – McLeod gauge.

Unit 5: Viscosity**9 Hrs**

Streamlined motion – Turbulent motion – Coefficient of viscosity and its dimension – Rate of flow of liquid in a capillary tube – Poiseuille's formula – Experiment to determine the coefficient of viscosity of liquid – Variation of viscosity of liquid with temperature.

Max. 45 Hours**Learning Outcomes:**

By the end of this course students will be able to

- CO1: Acquire in depth knowledge about our Universe and its awesome creation. It paves way to solve complex problems more confidently.
- 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.

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

SPH 1112	MECHANICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- 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.
- To introduce the concept of special relativity and its applications.
- To study detailed description of the Simple Harmonic Oscillation.

Unit – I 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- II 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 - atmospheric pressure and its variation with altitude.

UNIT-III 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-IV 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-V 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: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

Max. 45 Hours**Learning Outcomes:**

By the end of this course students 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 learned about the Newton s laws of motion and conservation principles.
- CO4: Establish the knowledge about Michelson-Morley experiments with interferometer, Lorentz Transformation
- CO5: Understand the concept of oscillations, constant relative motion of different bodies.

TEXT / REFERENCE BOOKS

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson
6. Education Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
8. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A.Serway, 2010,
9. Cengage Learning Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
10. Mechanics -J.C. Slater and N. H. Frank (McGraw-Hill)

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

SPH1211	THERMAL PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

Course Objectives:

- To acquire working knowledge of thermometry and calorimetry.
- To acquire working knowledge of the zero-th, first and second law of thermodynamics.
- To acquire basic understanding of liquid and solid cryogenics working principle and their functionality
- To understand conduction, radiation and various laws such as Wien's law, Planck's law Rayleigh-Jean's law
- To link thermodynamics to the micro description used in Statistical Mechanics.

Unit I - Thermometry and Calorimetry**9 Hrs**

Introduction -Platinum resistance thermometer - Callender & Griffith's bridge - Thermistor - Specific heat capacity - Specific heat capacity of solids & Specific heat capacity of liquid by method of mixtures - Specific heat capacity of gases - C_p and C_v by Regnault's, Callender and Barne's methods- Variation of specific heat capacity of diatomic gases.

Unit II – Thermodynamics**9 Hrs**

Zeroth law of thermodynamics-First law of thermodynamics - Heat engines - petrol and diesel engines - Reversible and irreversible processes - Second law of thermodynamics - Entropy- Change of entropy in reversible and irreversible processes - Third law of thermodynamics - Temperature vs Entropy diagram.

Unit III - Low temperature Physics**9 Hrs**

Introduction-Joule-Thomson effect - porous plug experiment: - liquefaction of gas by Linde's Process - Adiabatic demagnetisation - Practical applications of low temperatures - Refrigerating machines - electroflux refrigerator - Air conditioning machines - Effects of CF_2Cl_2 on Ozone layer.

Unit IV - Conduction and radiation**9 Hrs**

Introduction -Definition of thermal conductivity - thermal conductivity of bad conductor - Lee's disc method - Radiation - Black body radiation - Wien's law, Rayleigh-Jean's law and Planck's law - Stefan's law -Experimental verification of Stefan's law- solar constant -Temperature of the sun by Angstrom's pyrheliometer- Some every day applications.

Unit V - Statistical Physics 9 Hrs

Quantum statistics of identical particles - Maxwell-Boltzmann, Bose-Einstein and Fermi Dirac Statistics - applications Bose-Einstein and Fermi-Dirac gases as degenerate gases.

Max. 45 Hours**Learning Outcomes:**

- CO1: Students are able to apply the concept to determine temperature and specific heat capacity of the substance experimentally.
- CO2: An ability to understand concepts, working methods and applications of liquid and solid cryogenics.
- CO3: A knowledge based problem requiring the formulations of solid conduction and fluid convection and technique of numerical will be assigned and studied in detail.
- CO4: Student identifies the relationship and correct usage of infinitesimal work, work, energy, heat capacity, specific heat, latent heat, and enthalpy.
- CO5: Student uses the thermodynamically identity to derive the Maxwell relations.

TEXT / REFERENCE BOOKS

1. Heat and Thermodynamics - J. B. Rajam & C. L. Arora
2. Thermodynamics and statistical Physics - Sharma & Sarkar
3. Statistical Mechanics - Sathya Prakash & C. Agarwal
4. Fundamentals of Physics, 6th Edition, by D. Halliday, R. Resnick and J. Walker, Wiley, NY, 2001.
5. Thermal Physics, A.B. Gupta and H. Roy, Books and Allied (P) Ltd., (2002.)
6. CRC Handbook of Physics & Chemistry, 80th Ed., CRS Press, NY, 1999.
7. The Feynman Lectures on Physics, Vols. I, II, and III, by R P. Feynman, R B Leighton and M Sands, Narosa, 1998.

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**

SPH1212	OSCILLATIONS AND WAVE	L	T	P	Credits	Total Marks
		3	0	0	3	100

Learning 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
- To learn the musical sound properties and acoustics in architecture.
- To provide deep knowledge in the field of ultrasonic wave and its applications.

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 of Sound 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 Hours**Learning Outcomes:** By the end of this course students will be able to

- Visualize the vibrations of strings and propagation interference of sound waves.
- Find the behavior of sound waves at interfaces of Reflection, Refraction of diffraction, Transmission and their attenuation.
- Understand the different application of oscillation and waves.
- Analyze the properties of musical sound and apply into architecture.
- Clarify the ultrasonic characterization, production and its 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 Book Agency)
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 Bladdevraj, Narosa (2004)
6. Text book of sound by Brij Lal & 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 & Brij Lal, 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.**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks.**80 Marks**

SPH1213	ELECTRICITY AND MAGNETISM	L	T	P	Credits	Total Marks
		3	0	0	3	100

Learning Objectives:

- To understand the basic concepts in static electric field and such as Coulomb's law and electric potential.
- To derive equations for current charges and its applications.
- To know about the basic concepts of magnetism and basic laws.
- To learn the properties of various circuits are going to be analyzed.
- To evaluate magnetic concepts and magnetic circuits

UNIT I 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 II 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– Kirchhoff'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 III 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 IV 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 V 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.

Max. 45 Hours**Learning Outcomes:**

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

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.

TEXT / REFERENCE BOOKS

1. Brij Lal and N. Subrahmanyam, *A Text Book of Electricity and Magnetism*, Ratan Prakashan Mandir Educational & University Publishers, New Delhi, 2000.
2. R. Murugesan, *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 mark each - No choice.

20 Marks

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

80 Marks

SPH1214	OPTICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To learn the fundamental principles of optics.
- To learn the mathematical techniques employed in optics.
- To use these principles and techniques to solve problems in optics
- To be able to identify and illustrate physical concepts and terminology used in optics.
- To be able to make approximate judgements about optical and other wave phenomena when necessary.

Unit I - Geometrical Optics**9 Hrs**

Thin lens equation - compound thin lenses - Thick lens formula - Power of a thick lens – Lens combination - Refracting surfaces- Spherical aperture and stops - Single lens magnifier – Single lens camera – Two lens optical systems – The Microscope – The Telescope – Telephoto Lens.

Unit II Lens Aberrations**9 Hrs**

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 - Huygen's and Ramsden's eye pieces.

Unit III - Light waves**9 Hrs**

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

Unit IV – Interference**9 Hrs**

Colours of thin films - 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 - Refractive index of gases - Jamin's & Rayleigh's Interferometers - Stationary waves in light - Colour photography (principle only), Holography (principle only).

Unit V - Polarization and Diffraction**9 Hrs**

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, Opaque circular disc, Straight edge and Narrow wire - Fraunhofer diffraction - single slit - Double slit - Plane diffraction grating - theory and experiment to determine wave length.

Max. 45 Hours**Learning Outcomes:**

Students should gain fundamental knowledge of optics. This implies that the student will be able to:

- CO1: Understand the physical significance of Maxwell's equations and hence estimate the speed of light.
- CO2: Explain the basics and applications of LASER.
- CO3: Explain the propagation mechanism of light through optical fiber.
- CO4: Derive the relation between Numerical Aperture and Refractive indices.
- CO5: Classify the types of optical fibers and attenuation mechanisms.

TEXT / REFERENCE BOOKS

- Optics by Subramaniam, N.Brij Lal, S.Chand & Co. Pvt. Ltd., New Delhi.
- Optics by Khanna D.R. & Gulati H.R., R.Chand & Co. Pvt. Ltd., New Delhi.
- Optics by K.K.Sharma, Elsevier, New Delhi, 2006.
- Optics by Eugene Hecht, Tata Mcgraw Hill, New Delhi, 2011.
- Fundamentals of Optics by Jenkins A Francis and White E. Harvey, McGraw Hill Inc., New Delhi, 1976.
- Optical Physics by Lipson. S.G., Lipson H., and Tannhauser D.S., Cambridge University press, (1995).
- Fundamentals of Optics by Raj M.G., Anmol Publications Pvt. Ltd., (1996), New Delhi.
- Waves by Frank S Crawford Jr, Special Indian edition, 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 mark each - No choice.**20 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks.**80 Marks**

SPH1216	DIGITAL AND ANALOG ELECTRONICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- 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.
- It deals with various number systems and Boolean algebra.
- It mainly focuses on the analysis and design of combinational logic systems.

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, Sinusoidal 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: Analysis & design of Combinational Logic**9 Hrs**

Switching equations, canonical logic forms, sum of product & product of sums, Karnaugh maps, two, three and four variable Karnaugh maps, Introduction to combinational circuits, code conversions, decoder, encoder, priority encoder, multiplexers as function generators, binary adder, subtractor, BCD adder, Binary comparator, arithmetic logic units.

Max. 45 Hours**Learning Outcomes:**

Upon successful completion of this course, students should 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 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.

20 Marks

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

80 Marks

SPH1312	LASER PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

Learning Objectives:

- To acquire basic understanding of fundamentals of Laser Physics.
- To acquire basic understanding of types of Lasers and output modulation methods
- To acquire basic understanding of applications of Lasers
- To acquire basic understanding of optical fibers
- To acquire basic understanding of optical fiber communication system

UNIT – I: LASER PHYSICS 9 Hrs

Basic Principle of Laser – Einstein Coefficients – Condition for light amplification – Population Inversion – Threshold Condition – Line Shape Function – Optical Resonators – Three level and four level systems.

UNIT – II: TYPES OF LASERS AND OUTPUT MODULATION METHODS**9 Hrs**

Solid State Lasers – Ruby and Nd-YAG Laser – Gas Lasers – He-Ne and Co₂ lasers – semiconductor lasers – Heterojunction Lasers – Liquid Dye Lasers – Q switching and mode locking.

UNIT – III: APPLICATIONS OF LASER**9 Hrs**

Application of laser in industry – cutting and welding – Drilling – Surface Hardening – Medical applications – Laser as diagnostic and therapeutic tool – Holography – Theory of recording and reconstruction – application of Holography.

UNIT – IV: OPTIC FIBERS**9 Hrs**

Fiber optic revolution – basic characteristics of optical fiber – acceptance angle – numerical aperture – propagation of light through optical fiber – theory of mode formation – classification of fibers – step index and graded index fibers – single mode and multi mode fibers – losses in fibers – fabrication techniques of fibers.

UNIT – V: FIBER OPTIC COMMUNICATION**9 Hrs**

Source and detectors for fiber optic communication – Laser and LED – Analog and digital modulation methods – Principle of optical detection – Pin APD photodetectors – Noise – Design consideration of a fiber optic communication system.

Max. 45 Hours**Learning Outcomes:**

Having successfully completed this course, students will be able to demonstrate knowledge and understanding of

- CO1: Light matter interaction, Einstein treatment of transition rates and three level and four level systems and treatment of optical resonators.
- CO2: Various types of Lasers such as solid state lasers, gas lasers semiconductor lasers and Q switching and mode locking.
- CO3: Various applications of lasers in industry, medical field and Holography
- CO4: Characteristics of optical fiber, propagation of light through optical fiber, classification of fibers, losses in fibers and fabrication techniques.
- CO4: Source and detectors for optical fiber communication and optical fiber communication system.

TEXT / REFERENCE BOOKS

1. Laser theory and applications by K. Thyagarajan and Ajoy Ghatak, Cambridge University Press, 1999.
2. Introduction to Fiber optics by K. Thyagarajan and Ajoy Ghatak, Cambridge University Press, 1999.
3. Optical Fiber Communications by John M. Senior, Cambridge University Press, 1996.
4. Fiber-Optic Communication Systems, Govind P. Agarwal, John-Wiley & Sons,
5. An Introduction to laser : Theory and Applications by M. N. Avadhanulu, S. Chand and Co., NewDelhi 2001.
6. P.K. Palanisamy, Physics for Engineering, Scitech Publishing Pvt. Ltd., Chennai.

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**

SPH1313	MICRO PROCESSOR AND MICRO CONTROLLER	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand basic architecture of 16 bit and 32 bit microprocessors.
- To understand interfacing of 16 bit microprocessor with memory and peripheral chips involving system design.
- To learn simple programs with 8085 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To understand concept of 8051 microcontroller

Unit – 1 THE 8085 MICROPROCESSORS & INTRODUCTION SET**9 Hrs**

Microprocessor

Architecture and its operations, Memory, Buses, Input / Output devices, Pin Configuration, ALU, Flag registers, General Purpose registers, Pointer and index registers, Instruction Cycle, Timing Diagram.

Unit – 2 8085 INSTRUCTIONS & ASSEMBLY LANGUAGE PROGRAMMING**9 Hrs**

8085 Microprocessor - Addressing modes - Instruction set - Interrupts – Simple Programmes using 8085 microprocessor, BCD to Binary and Binary to BCD Conversion, BCD Addition, BCD Subtraction, and Multiplication.

Unit – 3 THE 8086 MICROPROCESSOR**9 Hrs**

Microprocessor architecture of 8086 – Addressing modes - Instruction set and assembler directives – Assembly language programming – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT 4 I/O INTERFACING**9 Hrs**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display and Alarm Controller.

UNIT 5 MICROCONTROLLER**9 Hrs**

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming

Max. 45 Hours**Learning Outcomes:**

Having successfully completed this course, students will be able to

- CO1: Describe the architecture and instruction set of 8085 and 8086 microcontroller
- CO2: Write programs to run on 8085 microprocessor based systems.
- CO3: Design system using memory chips and peripheral chips for 16 bit 8086 microprocessor.
- CO4: Design basic concepts of interfacing memory and peripheral devices to a microprocessor.
- CO5: Design and implement 8051 microcontroller based systems.

TEXT / REFERENCE BOOKS

1. Ramesh Goyankar, Microprocessor Architecture- Programming and Applications – 8085, Prentice Hall, 2011.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson Education, 2011.
3. Krishna Kant, "MICROPROCESSORS AND MICROCONTROLLERS Arch, Programming and system design using 8085, 8086, 8051 and 8096". PHI 2007.
4. Douglas V. Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012

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**

SPH1316	SOLID STATE PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the importance of the crystalline order in solids
- To acquire basic concept of crystalline lattices and the techniques.
- To understand the importance of the dynamics of electrons in the conductance properties of materials
- To understand the importance of the quantum behaviour of electrons in metals
- To understand the origin of the energy bands in solids and basic notions on their calculation

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 - Symmetry considerations – point groups - Bravais lattices in two dimensions–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–Neutron diffraction.

Unit 2. Magnetic and Dielectric materials:**9 Hrs**

Magnetic materials: Magnetic moment – dia and paramagnetism – Ferromagnetism – Domain theory of ferromagnetism – Antiferromagnetic – Ferrites -; applications – floppy and magnetic disc devices, magnetic bubble memory.
Dielectric materials: Electronic, ionic, oriental and space charge polarization – Internal field – Determination of Clausius – Mosotti relation – dielectric loss – dielectric breakdown.

Unit 3. Superconductivity:**9 Hrs**

Introduction – properties of superconductors – High and low temperatures superconductors - BCS theory - Meissner effect – Levitation – Josephson's effect -SQUID -Type I and Type II superconductivity.

Unit 4 -Semiconducting materials:**9 Hrs**

Semiconductors - expressions for the carrier concentration in intrinsic and extrinsic semiconductors – calculation of density of holes and electrons – Fermi level and its variation with temperature – Determination of band gap energy – Hall effect – Determination of Hall coefficient.

Unit 5. Optical properties of solids:**9 Hrs**

Introduction- Ionic conduction – Optical absorption in metals, Insulators and semiconductors – colour Centres – Excitons – Luminescence – Maser and Laser – applications of lasers.

Max. 45 Hours

Learning Outcomes: Students should gain basic knowledge of solid state physics. This implies that the student will:

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

TEXT / REFERENCE BOOKS

1. Modern Physics by R.Murugesan S.Kiruthiga Sivaprasad. S.Chand Publishers (2012).
2. Modern Physics by Sehgal Chopra Sehgal S.Chand Publishers
3. Modern Physics by J.B. Rajam (1967).
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 (5th edition), Kittel. C
7. Solid State Physics, Dekker A.N. MacMillan
8. Fundamentals of Electricity and Magnetism, Mandiratta, Sawhey

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

SPH1317	Electrical Wiring	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT – I FUNDAMENTALS OF ELECTRIC CIRCUITS**9 Hrs**

Introduction to DC and AC circuits: Charge, Electric potential, Potential difference, Voltage, Electric current, Resistance, Inductance, Capacitance, Work, Power, Energy - Ohm's Law - Resistors – Series and parallel combinations, Introduction to single phase and three phase AC systems – Merits of three phase system over single phase system.

UNIT – II WIRING MATERIALS AND ACCESSORIES**9 Hrs**

Types of wires – Switches – Lamp holders – Ceiling roses – Sockets – Plug – Main boards – Distribution boards – Switch boards – Cables – Fuse and fuse materials – CBs and MCBs – Wiring tools – Types of joints.

UNIT – III TYPES OF WIRING SYSTEM**9 Hrs**

Looping system and ring system – distribution box system – Selection of particular system of wiring – Types of house wiring – Cleat wiring, CTS / TRS wiring, Conduit wiring, Casing Capping wiring – Comparison between different types of wiring.

UNIT – IV WIRING CIRCUITS**9 Hrs**

Simple lamp circuit – Stair case wiring - series and parallel circuits – Godown wiring circuits – Fluorescent tube light circuit – Sodium vapour lamp circuits – Selection of number of sub circuits and selection of wires and cables.

UNIT – V EARTHING AND ELECTRICITY RULES**9 Hrs**

Necessity of earthing – Types of earthing – Pipe earthing, Strip earthing, Plate earthing – Specifications of materials used for earthing – Measurement of earth resistance – Electrical safety – Safety precautions for indoor and outdoor installations – First aid practice – Indian Electricity Rules regarding wiring.

Total No of Hours: 45 Hrs**REFERENCE BOOKS:**

1. R.P. Singh, "Electrical Workshop – Safety, Commissioning, Maintenance & Testing of Electrical Equipment", I.K. International Publishing House Pvt. Ltd, 3rd Edition, 2012.
2. R. Muthu Subramanian, S. Salivahanan and K.A. Muraleedharan, "Basic Electrical, Electronics and computer Engineering" Tata McGraw Hill, 2nd Edition, March 2017.
3. Frederic P. Hartwell and Herbert P. Richter, "Practical Electrical Wiring: Residential, Farm, Commercial and Industrial", Park Publications, 22nd Edition, March 2014.
4. Michael Litchfield and Michael McAlister, "Wiring Complete – Expert Advice from start to Finish" Taunton Press, 3rd Edition, 2017.

SPH1318	INDUSTRIAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	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 measurement techniques of acceleration, Vibration and density
- To make the student familiar with pressure measurement techniques
- To make the student familiar with temperature measurement techniques

UNIT-1 INDUSTRIAL MEASUREMENTS**9 Hrs**

Measurement of straightness, flatness, roundness and roughness. Force Measurement - Load cell, different types of load cells - elastic load cell-strain gauge load cell. Torque measurement-Using strain gauge and magneto elastic principle, Speed Measurement - Revolution counter-capacitive tachometer, D.C and A.C tachometer generators - stroboscopic methods. Acceleration Measurement- Elementary accelerometer, Seismic accelerometer, Practical accelerometers.

UNIT- 2 TEMPERATURE MEASUREMENT & APPLICATION**9 Hrs**

Definition & Standards, Temperature scales, Calibration of thermometers, Bimetallic thermometer, filled-in thermometers, Vapour pressure thermometers, Resistance thermometers, Thermistors- color code testing and installation procedure, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers.

UNIT- 3 PRESSURE MEASUREMENT**9 Hrs**

Manometers - different types of manometers, Elastic pressure transducers, Dead weight Tester, Electrical types, Vacuum gauges - McLeod gauge, Knudsen gauge, Thermocouple gauge, Ionization gauge, Differential pressure Transmitter - electrical & pneumatic types, Complete air supply system for pneumatic control equipment and the different components and their function.

UNIT- 4 MEASUREMENT OF FLOW & LEVEL**9 Hrs**

Orifice, Venturi, Pitot tube, flow nozzle rotameter, Doherty tube, Positive displacement meter, Turbine flow meter, Electromagnetic flow meter, Ultrasonic flow meter, Open channel flow measurement, Solid flow measurement. Level: Sight glass, float gauge, displacer, torque tube, bubble tube, diaphragm box, Differential Pressure methods, electrical methods- resistance type, capacitance type, ultrasonic level gauging.

UNIT- 5 MEASUREMENT OF DENSITY, VISCOSITY, HUMIDITY**9 Hrs**

Hydrometer - continuous weight measurement, liquid densitometer - float principle, air pressure balanced method, using gamma rays - gas density measurements – gas specific gravity measurements - Viscosity terms, saybolt viscometer, rotometer type viscometer, Industrial consistency meters. Humidity terms - dry & wet bulb psychrometers - hot wire electrode type hygrometer, electrolytic hygrometer, Dew point hygrometer.

Max. 45 Hours**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.

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

MSC PHYSICS
Regulation -2019

SALA4001	INTELLECTUAL PROPERTY LAW	L	T	P	Credit	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE:

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

UNIT 1 INTRODUCTION**8 Hrs**

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**12 Hrs**

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**12 Hrs**

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**12 Hrs**

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**12 Hrs**

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

COURSE OUTCOME:

- CO1 :** The course is designed to introduce fundamental aspects of Intellectual property Rights.
- CO2 :** The course introduces all aspects of the IPR Acts.
- CO3 :** The course is intended to 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 :** This course revolves around the protection of plant varieties and farmers right act and This Course will equip the students with the required Professional Skills.

TEXT 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

REFERENCE BOOKS

1. B.L. Wadhera, Law Relating to Intellectual Property, Universal Law Publishing, 5th ed., 2014.
2. S. Narayan, Intellectual Property Law in India, Gogia Law Agency, Hyderabad, 3rd ed., 2005.
3. Holyoak & Torremans, 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**

SCCA9501	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	-	2	2	100

UNIT 1 ADVANCED TECHNOLOGY AND MATERIALS 7 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 7 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 8 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 8 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 8 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) : Case Studies.

Course Outcomes:

Upon successful completion of this course, students should 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

TEXT / REFERENCE BOOKS

1. William D. Callister, "Materials Science and Engineering, An Introduction, John Wiley and Sons Inc. Singapore, 2001.

2. V. Raghavan, "Physical Metallurgy: Principle and Practice,. Prentice Hall India Pvt Ltd, 2006.
3. Flavio Craveiro, 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**

SPHA5103	MATERIALS SCIENCE	L	T	P	Credits	Total Marks
		3	0	0	3	100

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

M.E. / M. Tech / M.Sc. REGULAR

REGULATIONS 2019

COURSE OBJECTIVE

- To acquire enveloping knowledge of physics, chemistry, metallurgy and mathematics to know wider field of materials science this is an interdisciplinary subject.
- Also to motivate the students to pursue research in the field of materials science.

UNIT 1 CHARACTERISATION OF MATERIALS 12 Hrs.

Introduction, **Structural characterization** - X-ray diffraction, Laue's method, Bragg's law, Determination of crystal structure by Bragg's Spectrometer and powder X-ray diffractometer (Debye Scherrer camera) with principle, construction and working. **Microstructural characterization** - electromagnetic lens system, Determination of surface morphology by Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM) with principle, construction, working. **Microhardness testing** - Determination of microhardness by Vickers hardness test and Knoop hardness test with principle construction, working, formula. **Nanohardness test** - Determination of nanohardness by AFM.

UNIT 2 METALS ALLOYS 12 Hrs.

Introduction, Classification of metal alloys-Ferrous and Non Ferrous Alloys, **Ferrous Alloys**- classification, composition, properties and applications; **Synthesization of alloy steels** - construction and working of Electric Furnace process (Heroult furnace); **Phase diagram**- definition and its significance; micro structure-definition, types of micro structures-ferrite, cementite, pearlite, austenite, martensite with diagrams; Iron-Carbon Alloy Phase diagram - graphical description and explanation with all the necessary parameters. **Non-Ferrous Alloys** - Aluminum, Copper, Titanium, Magnesium alloys - composition, properties and applications. **Shape Memory Alloys** -Shape memory effect- mechanism and transformation temperature types of SMA - one way and two way shape memory effect; characteristics of SMA- hysteresis, pseudo-elasticity, super elasticity; characterization of shape memory alloys - explanation with reference to Differential Scanning Calorimetry, resistivity, transformation temperature, tensile test; Advantages and disadvantages of SMA, General applications.

UNIT 3 CERAMICS, COMPOSITES AND POLYMERS 12 Hrs.

Ceramics: Structural features - Types of ceramics, Production techniques - Mechanical properties - Industrial ceramics like tungsten carbide, silica-alumina, zirconia, silicon carbide and sialons. **Composites:** Definition of composites - Continuous and Discontinuous fiber composites-Polymer and matrix-based composites - Examples of commercial composites. Structural features of polymer materials - Mechanism s of polymerisation and types of polymers- Thermoplastics - rubbers and elastomers - mechanical, physical and chemical properties - Cellular plastics - Liquid crystal polymers .

UNIT 4 ELECTRONIC MATERIALS 12 Hrs.

Introduction Purification of electronic materials - Crystal growth and doping techniques (an overview) - Epitaxial growth - Impurity diffusion - Ion implantation - Junction formation - Metallisation - Lithography (an overview) - Contact formation.

UNIT 5 NANO MATERIALS 12 Hrs.

Introduction, Top down and bottom up approach, synthesis and properties, Nanomagnetic-OMR, GMR, TMR, Nano semiconductors- quantum cascade laser, quantum dot-optical memory, Blockade device, quantum well.

Max. 60 Hours

Course Outcomes:

Having successfully completed this course, students will be able to

CO1: Characterize the materials by AFM, TEM, SEM, XRD etc.

CO2: Describe the nature and types of alloys and understand its applications

CO3: Develop the system by using ceramics, composites and polymers to the modern society

CO4: Understand the Crystal growth and Lithography techniques

CO5: Apply Nano materials in appropriate application.

TEXT / REFERENCE BOOKS

1. J.C.Anderson, K.D.Leaver, R. D. Rawlings and J.M.Alexander, Materials Science, 4th Edition, Chapman-Hall, London, 1990.
2. V. Raghavan, Materials Science and Engineering, 3rd Ed. Prentice-Hall India, New Delhi, 1993.
3. C. M. Srivastava and C. Srinivasan, Science of Engineering Materials, Wiley-Eastern Ltd., New Delhi, 1987.
4. G. K. Narula, K. S. Narula and V. K. Gupta, Materials Science, Tata McGraw-Hill, 1988.
5. Z. D. Jaberezki, The Nature and Properties of Engineering Materials, Wiley Eastern.
6. R. K. Gupta Editor, Physics of Particles, Nuclei and Materials - Recent Trends New Horizons of Physics Series, Narosa, New Delhi, 2002.
7. M.A.Wahab, Solid State Physics, Structure and properties of materials, second edition, Narosa publishing house, 2005

END SEMESTER EXAM QUESTION PAPER PATTERN

SPHA5203	NUMERICAL METHODS AND COMPUTER PROGRAMMING	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To provide the understanding of numerically obtained roots of nonlinear equations and system of linear equations.
- Also to apply programming practices into mathematical computing to solve mathematical problems effectively.

UNIT 1 SYSTEM OF EQUATIONS 12 Hrs.

Roots of equations-Methods of bisection and false position-Newton-Raphson method-solution of simultaneous linear algebraic equations-Gauss elimination-Gauss Jordan methods-matrix inversion and LU decomposition methods-Gauss-Seidel iterative method-Eigen values of matrices-Power method and Jacobi's method.

UNIT 2 INTERPOLATION, CURVE FITTING AND STATISTICS 12 Hrs.

Newton's forward and backward interpolation formulae-Lagrange's method-Lagrange's inverse interpolation-curve fitting-principle of least squares-correlation and regression analysis-sampling distributions-small and large samples-tests of hypothesis-Student's distribution-Chi square distribution.

UNIT 3 NUMERICAL DIFFERENTIATION AND INTEGRATION 12 Hrs.

Newton's forward and backward difference formulae-numerical integration-Trapezoidal rule and Simpson's rule-numerical solution of ordinary differential equations-Taylor series-Euler's method, improved and modified methods-Runge-Kutta methods-Milne's predictor-corrector method.

UNIT 4 C PROGRAMMING 12 Hrs.

Introduction, operator, expressions, variables, input, output statements, control statements, functions, arrays, categories of functions, programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials / non-linear equations by the Newton-Raphson method, (c) Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.

UNIT 5 INTRODUCTION TO LABVIEW and MATLAB 12 Hrs.

Introduction to LABVIEW tools palette, controls & functions palette, data types, conversion – front panel, block diagram construction, parallel data flow, create indicators/controls/constants math operations, booleans, arrays, case structures, sequences – for loops, while loops – I/O reading and writing to files, paths, graphing, timed loops, signal generation/processing, waveform types, connecting to hardware, DAQ, serial, GPIB, TCP/IP and USB interface

Max. 60 Hours**Course Outcomes:**

Having successfully completed this course, students will be able to

CO1: Understand the numerically obtained roots of nonlinear equations and system of linear equations

CO2: Apply the programming concept in physics related mathematical problems,

CO3: Apply the object oriented concept in real time mathematical problems.

CO4: Apply C- programming concept in physics related mathematical problems

CO5: Apply Labview and Matlab tools to understand the basic concept in physics by programming in a real way.

TEXT / REFERENCEBOOKS

1. M.K. Venkatraman, Numerical Methods in Science and Engineering, National Publishing company, Madras, 1996.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, New Delhi, 1992.
3. Kernighan and Ritchie, The C Programming language, Prentice Hall of India, 1999.
4. B.S. Gottfried, Programming with C, Tata McGraw Hill, 2000.
5. V. Rajaraman, Computer Programming in FORTRAN, Prentice Hall of India, New Delhi, 1994.
6. P.Dey and M.Ghosh, Computer fundamentals and Programming in C, 2nd edition, Oxford University Press, 2006.

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**

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks.**70 Marks****M.E. / M. Tech / M.Sc. REGULAR****REGULATIONS 2019**

SPHA5303	SPECTROSCOPY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the basic principles of molecular spectroscopy in terms of the quantization of molecular energy and transitions between molecular energy levels when matter interacts with radiation.

UNIT1 MICROWAVESPECTROSCOPY**12 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 VIBRATIONAL SPECTROSCOPY**12 Hrs.**

Vibration of molecules - Diatomic vibrating rotator- vibrational spectrum interactions of rotation and vibrations. Rotational Energy of spherical, Prolate and Oblate Symmetric Rotors, Rotational Raman and IR Spectra of Linear molecules and Determination of their Geometry. Rotation Vibration Band of a Diatomic Molecule, Parallel and Perpendicular type Bands in Linear and symmetric Rotor Molecules. Qualitative description of Type A, B and C bands in Asymmetric Rotor Molecules.

UNIT3 ELECTRONICSPECTROSCOPY**12Hrs.**

Electronic spectra-Frank-Condon principle-Dissociation energy and dissociation products-Fortrat diagram- predissociation-shapes of some molecular orbits-Chemical analysis by electronic spectroscopy-Techniques and instrumentation-Mass spectroscopy-ESR spectroscopy-Introduction-techniques and instrumentation-Double resonance.

UNIT4 NUCLEAR SPECTROSCOPY**12Hrs.**

Nuclear magnetic resonance spectroscopy-Introduction-Interaction of spin and magnetic field-population of energy levels-Larmor precession-Relaxation times-Chemical shift and its measurement-Coupling constant-coupling between several nuclei-quadrupole effects-¹³C NMR spectroscopy, Mossbauer spectroscopy: Principle- instrumentation-Effect of electric and magnetic fields.

UNIT5 RAMAN SPECTROSCOPY**12Hrs.**

Classical and quantum mechanical picture of Raman effect-Polarizability-Pure rotational Raman spectrum-Vibrational Raman Spectrum- structural determination from IR and Raman spectroscopy techniques. Stokes and anti-stokes- Raman lines. Selection Rules. Spectral structures. Nuclear spin and its effect on Raman spectra. Vibrational spectra of poly atomic molecules. Normal modes. Selection rules for Raman and infrared spectra. Complementarity of Raman and infrared spectra.

Course Outcomes:

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

CO1: Know the various spectroscopic techniques used in the characterization of materials

CO2: Acquire the ability to operate the FTIR spectrometer

CO3: Plot and interpret the UV-Visible and FTIR spectra of the sample

CO4: Predict the NMR and ESR spectra of the sample

CO5: Understand the basic knowledge of group theory

TEXT / REFERENCEBOOKS

- Colin Banwell and Mc Cash, Fundamentals of molecular spectroscopy, 5th Edition, TMH publishers, 2013.
- J. Michael Hollas, Modern spectroscopy, 4th Edition, Wiley India Pvt. Ltd. 2010.
- S. L. Gupta, V. Kumar and R. C. Sharma, Elements of spectroscopy, 22nd Edition, Pragathi Prakasa publishers, Meerut, India, 2010.
- Gary M. Lampman, Donald L. Pavia, George S. Kriz and James R. Vyan, 4th Edition, Cengage Learning India Pvt. Ltd.
- B. K. Sharma, Instrumental methods of chemical analysis, 24th edition, Goel publishing house, Meerut, 2005.
- J. Mohan, Organic spectroscopy principle and application, 2nd edition, New Age International (P) Ltd, New Delhi, 2001.
- D. N. Sathyanarayana, Vibrational spectroscopy: Theory and applications, New Age International (P) Ltd, New Delhi, 1996.
- Satya Prakash, Mathematical Physics, 6th revised edn, Sultan Chand & sons, Reprint, 2014.
- B. D. Gupta, Mathematical Physics, 3rd Revised Edition, Vikas Publishing House, 2004.

END SEMESTER EXAM QUESTION 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**

SPHA7401	RENEWABLE ENERGY SOURCES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To obtain an overview of various renewable energy sources that exists and gives insight to the actual status of various renewable energy sources.

UNIT 1 INTRODUCTION**12 Hrs.**

World Energy Futures - Energy sources and their availability – India's production and resources – Renewable Energy Sources – Prospects of Renewable Energy Sources. **Energy audit:** Types of energy audits – walk-through Energy audit – Intermediate Energy audit – Comprehensive Energy audit.

UNIT 2 SOLAR ENERGY FUNDAMENTALS**12 Hrs.**

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**12 Hrs.**

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 BIOMASS**12 Hrs.**

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 THERMAL ENERGY CONVERSION**12 Hrs.**

Open cycle OTEC system – Closed cycle OTEC system – Heat exchangers – Bio-fouling – Site selection – Hybrid cycle – energy from tides. **Hydrogen energy:** Hydrogen production – Electrolysis – Thermo chemical methods – Fossil fuel methods – Solar energy methods – Hydrogen storage – Hydrogen transportation – Utilization of hydrogen gas – Hydrogen as an alternative fuel for motor vehicles – safety management.

Max. 60 Hours**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

TEXT / REFERENCE BOOKS

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 Koteswara Rao, 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: 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**

SPHA7403	ENERGY MATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 Indian Energy Scenario: Role of energy in economic development and social transformation, Various types of energy sources: Energy sources and overall energy demand, Availability of energy sources. Non Renewable Energy sources: Coal, Oil, Natural gas, Nuclear power, Hydroelectricity, Renewable Energy sources: Solar, Wind, Biomass, Tidal, Ocean wave, Ocean thermal, Geothermal and other. Energy consumption and its impact on environmental climatic change. Future Energy Option: Sustainable development, Energy crisis, Transition from carbon free technologies, Parameters of transition, Carbon credits.

UNIT 2 Solar Photovoltaics (SPV) Solar Photovoltaics (SPV) Conversion: Basic principles, Types of solar cell materials, Fabrication of solar photovoltaic cells, solar cell parameters and characteristics, Modules. Block diagram of general SPV conversion system and their characteristics, Different configurations, Application (such as street light, water pumps, Radio/TV, Small capacity power generation) Solar Photovoltaic (SPV) Systems Designing : Load estimation, selection of inverters, battery sizing, array sizing.

UNIT 3 Hydrogen Energy : Hydrogen Fuel : Importance of Hydrogen as a future fuel, Sources of Hydrogen, Fuel of vehicles. Hydrogen production : Production of Hydrogen by various methods, Direct electrolysis of water, Direct thermal decomposition of water, Biological and biochemical methods of hydrogen production. Hydrogen storage : Gaseous, Cryogenic and Metal hydride. Utilization of hydrogen : Fuel cell – Principle, construction and applications.

UNIT 4 Wind Energy : Wind Energy : Introduction, Basic principle of wind energy conversion, Extraction of maximum power from wind and its dependence on various parameters. Wind Mills : Types of wind mills, Vertical axis and Horizontal axis wind mills their performance, Merits and Demerits, Limitations of wind energy conversions.

UNIT 5 Bio Energy : Biomass, Generation and utilization, Property of biomass, Agriculture crop and Forestry residues used as fields. Physical, Chemical and biological conversion of biomass into useful form of energy. Gasification, Biomass gasifiers and types. Biogas : Introduction , Generation of biogas, Aerobic and anaerobic bioconversion process. Substances used to produce biogas (Cow dung, Human and other agricultural waste, Municipal waste etc.), Digesters and their designs, Pyrolysis and gasification, Fermentation process. Biofuels : Types of biofuels,, Production processes, Biofuel applications.

COURSE OUTCOMES:

CO1: Understanding of Indian Energy Scenario.They know about the energy sources in india.

CO2: construct the solar photovoltaic cell

CO3: understanding about the production and applications of hydrogen energy

CO4: Design and implement systems of wind energy and wind mills.

CO5: Understand and utilization of Bio energy and bio fuel applications.

REFERENCE BOOKS:

1. Climatological and Solar data for India, Seshadri. (Sarita Prakashan), 1969.
2. Solar Energy Utilization, G.D.Rai, 9Khanna Publishers), 1995.
3. Energy technology, S.Rao and B.B. Parulekar (Khanna Publishers), 1995
4. Terrestrial Solar Photovoltaics, Tapan Bhattacharya, (Namsa : Publication House, New Delhi)
5. Solar Cells-operating Principles, technology and System Applications, Martin A. Green (Prentice Inc. USA).
6. Solar Thermal Engineering, J.A. Duffie (Academic Press)
7. Renewable Energy Sources and Conversion Technology, N.K. Bansal, M. Kleeman and S.N. Sreivas Tata Energy Research Institute, New Delhi), 1996.

END SEMESTER EXAM QUESTION 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

SPHA7404	NANO MATERIALS AND APPLICATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide the fundamental knowledge of nano materials, their synthesis and fabrication, properties and applications. Also to motivate the students to pursue research in the field of nanomaterials.

UNIT 1 INTRODUCTION ABOUT NANO MATERIALS**12 Hrs.**

Classification of Nano structured materials – Present and potential with significant technological impact – Industrial in nano materials – Fullerenes and nano tubes – Metals and inorganic – Fundamental issues in nano materials.

UNIT 2 NANO MATERIALS SYNTHESIS AND PROCESSING**12 Hrs.**

Mechanical grinding – Wet chemical synthesis of nano materials – Sol-gel process – Liquid solid reactions – Gas phase synthesis of nano materials – Gas condensation processing (GPC) – Chemical vapour condensation (CVC) – cold plasma methods–Plasma CVD – Sputtered plasma processing – Microwave plasma processing – Laser ablation – vapour liquid – solid growth – Particle precipitation aided CVD – gas phase synthesis method.

UNIT 3 SYNTHESIS METHODS OF NANO COMPOSITES**12 Hrs.**

Bio-metric process – film – printing mechanism nano particles – dispersion of nano particles – stabilization of nano particles – application of nano materials.

UNIT 4 MECHANICAL PROPERTIES**12 Hrs.**

Ceramics – Strengthening and toughening mechanism – reduction in processing flow size – R-curve effects – crack deflection – Thermal expansion mismatch – Average internal stresses – local stress distribution.

UNIT 5 OPTICAL PROPERTIES**12 Hrs.**

Classical optics – absorption of light in materials – Electronic absorption – lattice absorption – phonons radiative and non-radiative recombination – dynamic Maxwell – garnet equation – application of laser crystals – electrical rectification – powder laser.

Max. 60 Hours**Course Outcomes:**

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

- CO1: Understand the fundamental of nanomaterials and their applications.
 CO2: Synthesize nanomaterials using various physical and chemical methods.
 CO3: Prepare nanocomposites and study their potential applications.
 CO4: Understand the mechanical properties of nanomaterials.
 CO5: Acquire knowledge on the optical properties of nanomaterials.

TEXT / REFERENCE BOOKS

- C.M. Srivastava & C. Srinivasan, Science of Engineering materials, 1st reprinting, Wiley eastern limited, 1991.
- S. K. Hajar choudhury and A.K. Hajar choudhury, Material science and process, J.K. Publishers, 1986.
- Bhushan, B., Luo, D., Schriker, S.R., Sigmund, W, Zauscher, S. Handbook of Nanomaterials Properties, 1st Edn, Springer.
- Giri, P. K., Goswami, D. K., Perumal, A., Advanced Nanomaterials and Nanotechnology, Springer, 2013.
- Lumban Gaol, Ford, Webb, Jeffrey, X, Recent Trends in Nanotechnology and Materials Science, Springer, 2014.

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

SPHA7406	THIN FILM TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

UNIT 1 VACUUM TECHNOLOGY**12 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**12 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**12 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**12 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 THIN FILMS**12 Hrs.**

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. 60 Hours**Course Outcomes:**

At the course end, the students will be able to

CO1: Understand the Vacuum process and they can know how to create

CO2: Identify the physical synthesis of thin film methods

CO3: identify the chemical synthesis of thin film methods

CO4: analyse the Basic sciences behind the thin film growth and the thickness factor

CO5: Characterize the thinfilm in various methods.

TEXT /REFERENCE BOOKS:

1. Maissel and Glang, Hand Book of Thin Film Technology
2. K.L. Chopra, Thin Film Phenomena
3. Dupuy 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, 2nd Ed., Wiley, 2003.

END SEMESTER EXAM QUESTION 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

SPHA7408	PHYSICS OF DIELECTRICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

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 permittivities
- To familiarize with the experimental investigation methods of dielectrics.
- To study applications of dielectric spectroscopy.

UNIT 1 INTRODUCTION TO PHYSICS OF DIELECTRICS**12 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**12 Hrs**

Reaction field. Debye's Theories, Polar molecules in nonpolar solvent. Onsager's theory. The dielectric properties of polar non-associative liquids. Kirkwood-Frohlich'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**12 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**12 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**12 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.

Course Outcomes:

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

CO1: Different polarization mechanisms

CO2: Various theories of static and complex permittivities

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

TEXT / REFERENCE BOOKS

1. Boetcher. C. J. F, Theory of Electric Polarization 2nd Edition, Elsevier Scientific Publication Company, 1973.
2. H. Fröhlich, 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 and G.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****PART A:** 5 Questions of 6 mark each - No choice.**PART B:** 2 Questions from each unit of internal choice, each carrying 14 marks.**Exam Duration: 3 Hrs.****30 Marks****70 Marks**

SPHA7409	ULTRASONICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- 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 ULTRASONIC PROPAGATION IN LIQUIDS AND SOLIDS**12 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 DETERMINATION OF VELOCITY OF PROPAGATION OF ULTRASONIC**12 Hrs.**

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

UNIT 3 ULTRASONIC TRANSDUCERS**12 Hrs.**

Piezoelectric, Magnetostrictive 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 ULTRASONIC RADIATION**12 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**12 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. 60 Hours**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 determining the best applicability of the theory for the given binary mixture.

CO5: Apply Acoustic ultrasonic in appropriate applications.

TEXT / REFERENCE BOOKS

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**

SPHA7410	BIOPHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

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

UNIT 1 MODERN BIOLOGY**12 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-CHEMICAL TECHNIQUES**12 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 EXPERIMENTAL TECHNIQUES**12 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 BIOLOGICAL MOLECULES**12 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**12 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. 60 Hours**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

TEXT / REFERENCE BOOKS

1. Vasantha Pattabhi and N. Gautham , Biophysics, Narosa Publishing Company, New Delhi, 2001.
2. P. Narayanan,. Introductory Biophysics, 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. Freeman 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 EXAM QUESTION 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

SPHA7411	RADIATION PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

Course Objectives:

- The aim and objective of the course on Radiation Physics is 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 and can use the techniques if they decide to be radiation or nuclear physicists in their career.

UNIT 1 INTERACTION OF ELECTROMAGNETIC RADIATIONS WITH MATTER**12 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**12 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**12 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**12 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**12 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. 60 Hours

COURSE OUTCOMES:

- 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 activation analysis and electron spin resonance spectroscopy.
- CO5: Understand various analysis techniques and way to apply the materials in suitable manner

TEXT/REFERENCE BOOKS:

1. The Atomic Nucleus: R.D. Evans, Tata Mc Graw 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 EXAM QUESTION 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**

MSC PHYSICS
Regulation -2015

SPHA5102	CLASSICAL MECHANICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

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

70 Marks

M.E. / M. Tech / M.Sc. REGULAR

REGULATIONS 2019

COURSE OBJECTIVE

- To enable students to understand the description of equations of motion of a system (using Lagrangian, Hamiltonian mechanics and finally canonical transformation).

UNIT 1 LAGRANGIAN FORMULATION

12 Hrs.

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

UNIT 2 MOTION UNDER CENTRAL FORCE: TWO BODY PROBLEM

12 Hrs.

Equivalent one body problem -equation of motion and first integral Two body central force -Kepler'sProblem : 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

12 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

12 Hrs.

Hamilton's function and Hamilton's equations of motion, cyclic coordinates and conservation theorem, Ruth's Procedure and oscillations about steady motion, Lagrangian and Hamiltonian of relativistic particles and light rays-principle of least action. Problems

UNIT5 CANONICAL TRANSFORMATIONS

12 Hrs.

Generating function, Conditions for canonical transformation and problem, **Poisson Brackets:** Definition, invariance under canonical transformation, equation of motion in canonical form-Poisson theorem, Angular momentum Poisson's bracket relations, symmetry groups of mechanical systems, Liouville's Theorem, Hamilton – Jacobi equation for **Hamilton's** principle function. Problems

Max. 60 Hours

Course Outcomes:

Having successfully completed this course, students will be able to demonstrate knowledge and understanding of

- 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 of canonical transformation to find the constants of motion according to Hamilton-Jacobi theory

T EXT / REFERENCEBOOKS

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 EXAMQUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

SPHA5104	INTEGRATED ELCTRONICS	L	T	P	Credits	Total Marks
		3	1	0	4	100

Max. Marks: 100**ExamDuration: 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****M.E. / M. Tech / M.Sc. REGULAR****REGULATIONS 2019****COURSE OBJECTIVE**

- To design waveform generating circuit and understand the concepts of combinational and sequential circuits.
- Also to understand the basic theory of instrument used for measurement.

UNIT 1 INTEGRATEDCIRCUITS & OP-AMPFUNDAMENTALS 12 Hrs.

Integrated Circuits(IC) –Types of integrated circuits-analog and digital integrated circuits- basic monolithic ICs- Building blocks for operational amplifier, Ideal operational amplifier, DC and AC Characteristics Input offset voltage, Input bias current, Input offset current, Total output offset voltage, Thermal drift, Slew rate, CMRR.

UNIT 2 ANALOGELECTRONICS 12 Hrs.

Basics of operational amplifiers, voltage gain, input and output impedance of inverting amplifier, non-inverting amplifier; phase inverter, scale changer, integrator, differentiator, Voltage to current Current to voltage converters Voltage multiplier, limiter, clipper, clamper and peak-to-peak detector, difference amplifier, instrumentation amplifier, active filters(low-pass, high-pass, band-pass, band-reject/ notch), feedback oscillators and applications of oscillators, RC phase shift and Wien bridge oscillators, relaxation oscillators, comparators, schmitt trigger, multivibrators, AMV and MMV using 555 timer, waveform generation.

UNIT 3 PLL&A/DANDD/A CONVERTERS 12 Hrs.

Sample and Hold circuit, Digital to analog converters: R-2R ladder network and Binary weighted, Analog to digital converters: Flash converter, Successive approximation converter, Dual slope, Phase locked loop, Functional diagram description VCO IC LM 566, Applications, Frequency multiplier, Frequency divider, Frequency synthesizer, AM detector and FM demodulator.

UNIT 4 DIGITALELECTRONICS 12 Hrs.

Introduction to Digital Circuit analysis and design, Combinational Circuits- adders, subtractors, multiplexers, demultiplexers, encoders, decoders, Sequential circuits- flip-flops, RS, JK, Master Slaves, T and D Flip-Flops. Asynchronous Counters-4 bit binary ripple counter – mod-7 and mod-5 counter – decade. Counter – up counter – down counter – up-down counter. Synchronous counters-mod -8, mod-7, mod-6 and mod -5 parallel counters – race problem Registers - Serial shift register – Ring counter – Johnson counter.

UNIT 5 ELECTRONIC INSTRUMENTSAND DISPLAYDEVICES 12 Hrs.

Electronic measuring instruments-classification-multimeter, digital multimeter, signal generators and oscilloscope-construction, working and application. Photo diode, ICL 8038 function generator IC –Opto – Coupler, LED-construction, working and sevensegment display, LCD- construction, working and applications.

Max. 60 Hours**Course Outcomes:**

By the end of this course students will be able to

- CO1: Understand the mechanism of sense amplifier and address decoder. a,c,d,e,g, h
- CO2: Design CMOS inverters, logic circuits and transmission gates to specifications.
- CO3: Contrast and compare digital representation of information with the analog representation.
- CO4: Understand the fundamentals of converting from one number system to another.
- CO5: Count, convert among and do arithmetic in the binary, hexadecimal and octal number systems.

T EXT / REFERENCEBOOKS

1. Roy Choudry and Shail Jain, Linear Integrated Circuits, 4th edition, Wiley Eastern Ltd., 2010.
2. Morris. M. Mano and Michael.D.Ciletti, Digital Design, Fourth edition, Pearson Education, 2008.
3. Floyd and Jain, Digital Fundamentals, Eighth edition, Pearson Education, 2003.
4. Gayakwad .R A, Op-amps & Linear Integrated Circuits', Prentice Hall of India, New Delhi, 2009.
5. Millman, J. and Halkias, C.C., Integrated Electronics-Analog and Digital Systems, McGraw Hill, 2009.

END SEMESTER EXAMQUESTION PAPER PATTERN

SPHA5201	ELECTRO MAGNETIC THEORY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the static electric and magnetic fields in various aspects and relating them using Maxwell's equations.
- Also to study propagation of electromagnetic wave and its interaction with matter.

UNIT 1 ELECTROSTATICS AND MAGNETOSTATICS 12 Hrs.

Dielectric and its Polarization – External Field of a Dielectric Medium – Electric Field Inside a Dielectric – Dielectric Constant and Displacement Vector – Relation Between **D**, **P** and **E** – Polarization of Non-Polar Molecules (Clausius-Mossotti Relation) – Polarization of Polar Molecules – Electrostatic Energy. Magnetostatics: Ampere's Circuital Law – Magnetic Scalar Potential – Magnetic Vector Potential – Magnetisation and Magnetisation Current – Magnetic Intensity – Magnetic Susceptibility and Permeability.

UNIT 2 FIELD EQUATION AND CONSERVATION LAWS 12 Hrs.

Equation of Continuity – Displacement Current – Maxwell's Equations – Derivations and Physical Significance – Energy in electromagnetic fields (Poynting's theorem) – Poynting Vector – Electromagnetic Potentials **A** and **V** – Maxwell's Equations in terms of Electromagnetic Potentials – Concept of Gauge – Lorentz Gauge – Coulomb Gauge.

UNIT 3 PROPAGATION OF PLANE ELECTROMAGNETIC WAVES 12 Hrs.

Electromagnetic Waves in Free Space – Propagation of Electromagnetic Waves in Isotropic Dielectrics – Anisotropic Dielectric – In Conducting Media – In Ionized Gases. Interaction of EMW with Matter on Macroscopic Scale: Boundary Condition of interfaces – Reflection and Refraction – Fresnell's Formula – Brewster's Law and Polarization of EMW – Total Internal Reflection and Critical Angle – Reflection from a Metallic Surface – Wave Guides – Rectangular Wave Guide.

UNIT 4 INTERACTION OF EMW WITH MATTER ON MICROSCOPIC SCALE 12 Hrs.

Scattering and Scattering Parameters – Scattering by a Free Electron (Thomson Scattering) – Scattering by a Bound Electron (Rayleigh Scattering) – State of Polarization and Scattered Radiation – Coherence and Incoherence in scattered Light – Dispersion Normal and Anomalous – Dispersion in Gases (Lorentz Theory) – Dispersion in Liquids and Solids.

UNIT 5 RELATIVISTIC ELECTRODYNAMICS 12 Hrs.

Four Vectors and Tensors – Transformation Equations for Charge and Current Densities – For the Electromagnetic Potentials – The Electromagnetic Field Tensor – Transformation Equations for Electric and Magnetic field Vectors – Covariance of Maxwell Equations in four Vector form – In four Tensor form – Covariance and Transformation Law of Lorentz Force.

Max. 60 Hours**Course Outcomes:**

Having successfully completed this course, students will be able to

- CO1: Apply the basic concepts in Mathematics, Science and Engineering
 CO2: Derive Maxwell's equation and to apply many value added problems. and transfer these equations in Gauge factors.
 CO3: Interact electromagnetic waves with matter in macroscopic scale - EM waves changes with respect to medium.
 CO4: Identify the Interaction of EM waves with matter in microscopic view given more values than previous.
 CO5: Transfer EM waves in four vector form gives difference transformation of wave properties

TEXT / REFERENCE BOOKS

1. S.L. Gupta Kumar, V. Kumar and S.P. Singh, Electrodynamics, Pragathi Prakasham.
2. K.K. Chopra and G.C. Agrawal, K. Nath, Electro Magnetic Theory.
3. Paul Lorrain R. Corson, and Dale, Electromagnetic field and waves, 2nd Edition, CBS Publishers.
4. David J. Griffiths, Introduction to electrodynamics, Prentice hall of India.

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

SPHA5202	THERMODYNAMICS AND STATISTICAL MECHANICS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To study the thermal properties of materials by different methods.
- To explain of the properties of macroscopic system.
- Providing definitions of thermodynamic quantities and derivations of the laws of thermodynamics from the laws of quantum mechanics.

UNIT 1 REVIEW OF THE LAWS OF THERMODYNAMICS AND THEIR CONSEQUENCES 12 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 – Gibbs-Helmholtz relation – Thermodynamic equilibrium – Nernst Heat theorem of third law – consequences of third law – phase-Gibbs phase rule – chemical potential.

UNIT 2 KINETIC THEORY 12 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 – Viscous hydrodynamics – Navier – Stokes equation – Examples in hydrodynamics.

UNIT 3 CLASSICAL STATISTICAL MECHANICS 12 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 – Relation between partition function and thermodynamic quantities – 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 12 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 – Free electron model and thermionic emission – Pauli paramagnetism – Quantum mechanical ensemble theory – Density matrix and Partition function.

UNIT 5 ADVANCED TOPICS IN STATISTICAL MECHANICS 12 Hrs.

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

Max. 60 Hours**Course Outcomes:**

Having successfully completed this course, students will be able to

- CO1: Explain statistical physics and thermodynamics 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 Bose-Einstein condensates

TEXT / REFERENCE BOOKS

1. F. Reif, Statistical and Thermal physics, McGraw Hill, International Edition, Singapore, 1979.
2. B.R. Agarwal and N. Eisnor, Statistical 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 EXAM QUESTION 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****M.E. / M. Tech / M.Sc. REGULAR****REGULATIONS 2019**