



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited "A++" Grade by NAAC | 12B Status by UGC | Approved by AICTE

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School of Science and Humanities

Department of Physics

1.2.1 New Courses Introduced in 2023- 2024

CONTENTS

S. No.	Course Code	Course Name
1	SPHB1102	Properties of Matter
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3	SPHB2103	Modern Physics Lab-I
4	SPHB1201	Mechanics
5	SPHB2201	Mechanics Lab
6	SPHB2202	Basic Computer Lab
7	SPHB1301	Thermal and Statistical Physics
8	SPHB1304	Electricity and Magnetism
9	SPHB2301	Thermal, Electricity and Magnetism Lab
10	SPHB1401	Optics
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16	SPHB2502	Digital and Microprocessor Lab



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17	SPHB1601	Solid State Physics
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29	SPHB5204	Research Methodology
30	SPHB5205	Semiconductor Devices & Microprocessor
31	SPHB6201	Microprocessor Lab/ Dissertation (for Hons student)
32	SPHB5301	Material Physics & Processing Techniques
33	SPHB5302	Thermodynamics & Statistical Mechanics
34	SPHB5303	Electromagnetic Theory
35	SPHB5304	Spectroscopy
36	SPHB6301	Advanced Physics lab

Employability

Entrepreneurship

Skill development



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

COURSE OBJECTIVES

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

UNIT 1 ELASTICITY

9 Hrs.

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

UNIT 2 VISCOSITY AND LOW PRESSURE

9 Hrs.

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

UNIT 3 SURFACE TENSION

9 Hrs.

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

UNIT 4 GRAVITATION

9 Hrs.

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

UNIT 5 CRYSTAL PHYSICS

9 Hrs.

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

Max. 45 Hrs.



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COURSE OUTCOMES

On completion of the course, student will be able to

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

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks

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

80 Marks



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

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

CAE Model Practical Exam
ESE University Practical Exam

50 Marks
50 Marks



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

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire in depth knowledge about our ferromagnetism

CO2 - Apply the Concepts to several relevant fields like Material Science,

CO3 - Develop the theoretical and practical skills towards industrial applications,

CO4 - Choose the optional subjects of interest for further study and research.

CO5 - Relate the Zener diode and PN junction diode.

CO6 - Acquire knowledge of Lissajous figure

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

CAE Model Practical Exam

50 Marks

ESE University Practical Exam

50 Marks



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

COURSE OBJECTIVES

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

UNIT 1 DYNAMICS

9 Hrs.

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

UNIT 2 STATICS AND HYDROSTATICS

9 Hrs.

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

UNIT 3 FRAME OF REFERENCE

9 Hrs.

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

UNIT 4 SPECIAL THEORY OF RELATIVITY

9 Hrs.

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

UNIT 5 OSCILLATIONS

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

On completion of the course, student will be able to

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

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

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



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

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - To determine the simple harmonic oscillation for spring.

CO2 - To determine the moment of Inertia of a flywheel

CO3 - To determine the elastic constants of a wire

CO4 - To determine of g using simple pendulum

CO5 - To determine g using Kater's pendulum

CO6 - To determine SHG of a oscillating spring

TEXT/REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

CAE Model Practical Exam

50 Marks

ESE University Practical Exam

50 Marks



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

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

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

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

CAE Model Practical Exam

ESE University Practical Exam

Exam Duration : 3 Hrs.

50 Marks

50 Marks



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

COURSE OBJECTIVE

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

UNIT 1 BASIC CONCEPT OF INSTRUMENTATION

9 Hrs.

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

UNIT 2 MEASUREMENT OF FORCE, TORQUE, SPEED, ACCELERATION

9 Hrs.

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

UNIT 3 TEMPERATURE AND PRESSURE MEASUREMENT

9 Hrs.

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

UNIT 4 MEASUREMENT OF FLOW, LEVEL, DENSITY, VISCOSITY, HUMIDITY

9 Hrs.

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

UNIT 5 DIGITAL MEASUREMENT AND DISPLAYS

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** - Applying the concept of measurement, error calculation while performing experiments practically.
- CO2** - Acquire a detailed knowledge of industrial measurement
- CO3** - An exposure to various available techniques of temperature and pressure measurement
- CO4** - A detailed knowledge of fluid property measurement will be obtained
- CO5** - An idea of newly evolving digital measurement techniques is gained.
- CO6** - An idea on seven segment display and constructions is acknowledged

TEXT BOOKS / REFERENCE

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration 3 Hrs

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

20 Marks

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

80 Marks



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

COURSE OBJECTIVE

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

UNIT 1 ELECTROSTATICS

9 Hrs.

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

UNIT 2 CURRENT ELECTRICITY

9 Hrs.

Ampere's circuital law and its applications -Field along the axis of a circular coil and Solenoid-Theory of Ballistic Galvanometer -Figure of merit- Damping Correction- 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 3 ELECTROMAGNETIC INDUCTION

9 Hrs.

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

UNIT 4 AC CIRCUITS

9 Hrs.

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

UNIT 5 MAGNETISM

9 Hrs.

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



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COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Use of Coulomb's law and Gauss' law for the electrostatic force

CO2 - Relationship between electrostatic field and electrostatic potential

CO3 - Use of the Lorentz force law for the magnetic force

CO4 - Use of Ampere's law to calculate magnetic fields

CO5 - Knowledge of electricity and magnetism to explain natural physical processes and related technological advances.

CO6 - An idea on Ballistic Galvanometer method for plotting B-H curve and its importance

TEXT BOOKS / REFERENCE

1. BrijLal and N. Subrahmanyam, A Text Book of Electricity and Magnetism, Ratan Prakasan Mandir Educational & University Publishers, New 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 marks each-No choice

20 Marks

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

80 Marks



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

COURSE OBJECTIVE

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Explore the physical principle involved in the several instruments.

CO2 - Analyze the physical principle involved in all related fundamental principles.

CO3 - Think inventively and progress the innovative skills that are essential for science.



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CO4 - Apply for new application.

CO5 - Explore new thermal and magnetic techniques

CO6 - Explore ideas about calorimeter

TEXT BOOKS/ REFERENCE

1. BrijLal and N. Subrahmanyam, *A Text Book of Electricity and Magnetism*, RatanPrakasanMandir Educational & University Publishers, New 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.

CAE Model Practical Exam

50 Marks

ESE University Practical Exam

50 Marks



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

COURSE OBJECTIVE

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

UNIT 1 GEOMETRICAL OPTICS

9hrs

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

UNIT 2 LENS ABERRATIONS

9hrs

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

UNIT 3 LIGHT WAVES

9hrs

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

UNIT 4 INTERFERENCE

9hrs

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

UNIT 5 POLARIZATION AND DIFFRACTION

9hrs

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

Max. 45 Hrs



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Course Outcomes

On completion of the course, student will be able to

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

TEXT BOOK / REFERENCES

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks

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

80 Marks



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

COURSE OBJECTIVES

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

COURSE CONTENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

CAE Model Practical Exam

50 Marks

ESE University Practical Exam

50 Marks



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

COURSE OBJECTIVE

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

LIST OF EXPERIMENTS (USING MATLAB)

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

LIST OF EXPERIMENTS (USING MATLAB)

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

COURSE OUTCOMES

On completion of the course, student will be able to

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



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TEXT / REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

CAE Model Practical Exam

50 Marks

ESE University Practical Exam

50 Marks



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

COURSE OBJECTIVE:

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

UNIT I – DISCHARGE PHENOMENON THROUGH GASES

9 Hrs.

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

UNIT 2 : PHOTOELECTRIC EFFECT

9 Hrs.

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

UNIT 2 I: ATOMIC STRUCTURE

9 Hrs.

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

UNIT 4 :ATOM WITH ONE ELECTRON-HYDROGEN ATOM

9 Hrs.

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

UNIT 5:X-RAYS

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

By the end of this course students will be able to

- CO1 - Understand the quantum numbers, including their physical significance, and quantum mechanical states of the hydrogen atom.
- CO2 - Understand time independent perturbation theory including its derivation and be able to apply it to simple systems, including the Stark-Effect and Zeeman Effect.
- CO3 - Know about the origins of fine structure in atomic spectra and understand the exchange degeneracy and how this affects the excited states of helium.
- CO4 - Understand the Periodic table from the viewpoint of the electronic structure and understand and be able to apply to simple cases time dependent perturbation theory.
- CO5 - Understand the derivation of and be able to apply the selection rules for the interaction of electric dipole radiation and atoms.
- CO6 - Fine details of atomic physics will be understood

TEXT/REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

20 Marks

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

80 Marks



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

COURSE OBJECTIVE:

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

UNIT I – CALCULUS I

9 Hrs.

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

UNIT 2 : VECTOR ALGEBRA

9 Hrs.

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

UNIT 2 I: VECTOR CALCULUS

9Hrs

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

UNIT 4 :VECTOR INTEGRATION

9 Hrs.

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

UNIT 5:COMPLEX ANALYSIS

9 Hrs.

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

Max. 45 Hrs

COURSE OUTCOMES

By the end of this course students will be able to

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



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TEXT / REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks

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

80 Marks



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

COURSE OBJECTIVE

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

UNIT 1 INTRODUCTION TO QUANTUM MECHANICS 9 Hrs.

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

UNIT 2 SCHROEDINGER WAVE EQUATION 9 Hrs.

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

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

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

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

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

UNIT 5 FORMALISM OF QUANTUM MECHANICS 9 Hrs.

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

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - To understand the idea of wave function, normalization and uncertainty.
- CO2 - To derive Schrodinger wave equation.
- CO3 - To apply Schrodinger equation to one-dimensional problem, Free Particle in one dimension, particle in a box and square well potential;
- CO4 - To derive Time independent Schrodinger equation in spherical polar coordinates, radial wave equation.



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

CO6 - To learn mathematical concepts of quantum mechanics

TEXT/REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

20 Marks

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

80 Marks



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

COURSE OBJECTIVE

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

LIST OF EXPERIMENTS

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - To use advanced electronic equipments

CO2 - To develop the skill of electrical circuits

CO3 - Use different electronic kits

CO4 - To learn encoders, decoders

CO5 - To use operational amplifiers

CO6 - To understand IC technology



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TEXT / REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

CAE Model Practical Exam

50 Marks

ESE University Practical Exam

50 Marks



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

COURSE OBJECTIVES

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

UNIT 1 CRYSTAL STRUCTURE

9 Hrs.

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

UNIT 2 MAGNETIC AND DIELECTRIC MATERIALS

9 Hrs.

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

UNIT 3 SUPERCONDUCTIVITY

9 Hrs.

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

UNIT 4 SEMICONDUCTING MATERIALS

9 Hrs.

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

UNIT 5 OPTICAL MATERIALS

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

On completion of the course, student will be able to

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

TEXT BOOK / REFERENCES

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks

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

80 Marks



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

COURSE OBJECTIVES

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

UNIT 1 PROPERTIES OF NUCLEI

9 Hrs.

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

UNIT 2 DETECTORS OF NUCLEAR RADIATIONS

9 Hrs.

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

UNIT 3 PARTICLE ACCELERATORS

9 Hrs.

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

UNIT 4 RADIOACTIVITY

9 Hrs.

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

UNIT 5 ELEMENTARY PARTICLES

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** - Understand the fundamental principles and concepts governing classical nuclear and particle physics.
- CO2** - Demonstrate knowledge and understanding of detectors of Nuclear Radiations. Ionization chamber, solid state detectors.
- CO3** - Demonstrate knowledge and understanding of Particle accelerators. Van de Graaff generator, Linear accelerator, Cyclotron.
- CO4** - Acquire relevant information of Radioactivity. Properties, e/m ratio, charge and range of Alpha, Beta and Gamma particles.
- CO5** - Acquire relevant information of Elementary Particles. Classification, fundamental interactions, quantum numbers. Basic ideas about Quarks.
- CO6** - Analyze the quantum numbers

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks

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

80 Marks



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

COURSE OBJECTIVES

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

UNIT 1 SUN AND SOLAR SYSTEM

9 Hrs.

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

UNIT 2 OPTICAL TECHNIQUES

9 Hrs.

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

UNIT 3 EVOLUTION FORMATION AND STRUCTURE OF STARS

9 Hrs.

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

UNIT 4 THE CONSTELLATIONS AND THEIR IDENTIFICATION

9 Hrs.

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

UNIT 5 SPACE ASTRONOMY

9 Hrs.

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

COURSE OUTCOMES

On completion of the course, student will be able to

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



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TEXT / REFERENCE BOOKS

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

PART A : 10 Questions of 2 marks each-No choice

20 Marks

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

80 Marks



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

COURSE OBJECTIVES

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

UNIT 1 CRYSTALLOGRAPHY

9 Hrs.

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

UNIT 2 IMPERFECTION OF CRYSTALS

9 Hrs.

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

UNIT 3 LATTICE ENERGIES AND LATTICE VIBRATIONS

9 Hrs.

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

UNIT 4 FREE ELECTRON FERMI GAS

9 Hrs.

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

UNIT 5 THE BAND THEORY OF SOLIDS

9 Hrs.

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

Max. 45 Hrs

COURSE OUTCOMES

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

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



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TEXT / REFERENCES BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 LAGRANGIAN FORMULATION

9 Hrs.

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

UNIT 2 MOTION UNDER CENTRAL FORCE: TWO BODY PROBLEM

9 Hrs.

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

UNIT 3 MECHANICS OF RIGID BODY

9 Hrs.

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

UNIT 4 HAMILTON'S FORMULATION

9 Hrs.

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

UNIT 5 RELATIVISTIC MECHANICS

9 Hrs.

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

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Derivation of Lagrange equation from D'Alembert principle.

CO2 - Apply the Lagrange equation to study the motion under central force problems.

CO3 - Apply the Lagrange equation to study the motion of rigid bodies.

CO4 - Derivation of Hamilton equation of motion and apply the same for systems such as relativistic particles and light rays.

CO5 - Use canonical transformation to find the constants of motion according to Hamilton-Jacobi theory.

CO6 - Acquire the knowledge of four-dimensional formulation.



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TEXT / REFERENCES BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 INTRODUCTION TO LASERS

9 Hrs.

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

UNIT 2 INDUSTRIAL APPLICATIONS

9 Hrs.

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

UNIT 3 RESEARCH AND DEVELOPMENT APPLICATIONS

9 Hrs.

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

UNIT 4 INTRODUCTION TO NON-LINEAR OPTICS

9 Hrs.

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

UNIT 5 NON-LINEAR OPTICAL TECHNIQUES & MATERIALS

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** - Solve absorption and spontaneous and stimulated emission in two level system, the effects of homogeneous and inhomogeneous line broadening, and the conditions for laser amplification.
- CO2** - Fabry-Perot cavity including mode separation and line-widths, laser gain conditions, gain clamping in both homogeneous and inhomogeneous line broadened media.
- CO3** - Understand the four-level laser system, the simple homogeneous laser and its output behaviour and optimal operating conditions.
- CO4** - Comprehend the spectral properties of a single longitudinal mode, mode locked laser operation, schemes for active and passive mode locking in real laser system.
- CO5** - Understand the operations and basic properties of the most common laser types, He-Ne, Argon-ion, and carbon-dioxide, ruby, titanium sapphire, neodymium YAG and glass, knowledge of other main laser types.
- CO6** - Acquire the knowledge of non-linear optical techniques.

TEXT / REFERENCES BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 AMPLIFIERS

9 Hrs.

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

UNIT 2 TRANSISTORS

9 Hrs.

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

UNIT 3 SEMICONDUCTING DEVICES

9 Hrs.

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

UNIT 4 OPTICAL DEVICES

9 Hrs.

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

UNIT 5 WIRELESS COMMUNICATION

9 Hrs.

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

Max. 45 Hrs

COURSE OUTCOMES

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

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



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TEXT / REFERENCES BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

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

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

UNIT 2 THIN FILMS: FORMATION & MEASUREMENT 9 Hrs.

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

UNIT 3 THICKNESS MEASUREMENT 9 Hrs.

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

UNIT 4 PROPERTIES OF THIN FILMS 9 Hrs.

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

UNIT 5 EMERGING THIN FILM MATERIALS AND APPLICATIONS 9 Hrs.

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

Max. 45 Hrs

COURSE OUTCOMES

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

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



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TEXT / REFERENCES BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

OBJECTIVE

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire in depth knowledge about Fundamental Laws of Physics

CO2 - Apply the Concepts to several relevant fields like Material Science,

CO3 - Develop the practical skills towards industrial applications,

CO4 - Acquire in knowledge of Light experiments

CO5 - Gain the knowledge of Historical experiment.

CO6 - Acquire knowledge meaningful physics principles

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

Internal CAE practical exam

50 marks

ESE practical exam

50 marks



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

OBJECTIVE

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

UNIT 1 BASIC FORMALISM

9 Hrs.

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

UNIT 2 ONE DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE

9 Hrs.

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

UNIT 3 ANGULAR MOMENTUM

9 Hrs.

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

UNIT 4 APPROXIMATION METHODS

9 Hrs.

Time independent perturbation theory: basic concepts - non-degenerate energy levels - Application : anharmonic oscillator - effect of electric field on ground state of hydrogen - Degenerate energy levels - effect of electric field on ground state of hydrogen ($n = 2$).

WKB approximation : the WKB Method - Connection formula - Validity - Application : bound state in a potential well - harmonic oscillator.

Variation Method : variational principle - Rayleigh - Ritz Method - Ground state of Deuteron.

UNIT 5 SCATTERING THEORY

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

On completion of the course, student will be able to

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

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 INTRODUCTION

9 Hrs.

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

UNIT 2 INVARIANCE PRINCIPLE AND CONSERVATION LAWS

9 Hrs.

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

UNIT 3 HADRON -HADRON INTERACTION

9 Hrs.

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

UNIT 4 STATIC QUARK MODEL OF HADRONS

9 Hrs.

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

UNIT 5 WEAK INTERACTIONS

9 Hrs.

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

Max. 45 Hrs

COURSE OUTCOMES

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



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TEXT / REFERENCES BOOK

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 MATRIX AND VECTOR ANALYSIS

9 Hrs.

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

UNIT 2 FOURIER AND LAPLACE TRANSFORM

9 Hrs.

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

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

UNIT 3 COMPLEX ANALYSIS

9 Hrs.

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

UNIT 4 SPECIAL FUNCTIONS

9 Hrs.

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

UNIT 5 NUMERICAL TECHNIQUES

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** - Quantitatively understand physical parameters which describe behaviour of the system subjected to various boundary conditions
- CO1** - Acquire knowledge of different techniques to solve differential and integral equations
- CO3** - Provide foundation for complex analysis
- CO4** - Understand the theorems to solve problems
- CO5** - Understand various special functions and important transforms and their applications
- CO6** - To provide a firm basis for future study of numerical analysis and scientific computing

TEXT / REFERENCES BOOK

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

]

COURSE OBJECTIVES

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

UNIT 1 INTRODUCTION AND DESIGN OF RESEARCH

9 Hrs.

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

UNIT 2 DATA AND METHODS OF DATA COLLECTION

9 Hrs.

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

UNIT 3 PRESENTATION OF RESEARCH FINDINGS

9 Hrs.

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

UNIT 4 QUALITY OF RESEARCH

9 Hrs.

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

UNIT 5 INTRODUCTION TO WORD PROCESSING PACKAGE

9 Hrs.

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

Max. 45 Hrs



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COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the structure of the individual research topic

CO1 - Enhance their analytical mind

CO3 - Bring out the hidden skills

CO4 - Make them aware of updation in their research area

CO5 - Identify the future research problems and

CO6 - Improve their ability as a researcher in a new field

TEXT / REFERENCES BOOK

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 BIPOLAR TRANSISTORS

9 Hrs.

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

UNIT 2 MODERN DAY TRANSISTOR TECHNOLOGY

9 Hrs.

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

UNIT 3 OPERATIONAL AMPLIFIER

9 Hrs.

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

UNIT 4 POWER ELECTRONICS

9 Hrs.

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

UNIT 5 MICROPROCESSOR

9 Hrs.

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

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** - Understand the fundamental principles and concepts governing classical nuclear and particle physics and have a
- CO2** - working knowledge of their application to real-life problems.
- CO3** - Understand alpha, beta and gamma decay theories and how to detect and measure types of radiation.
- CO4** - Induce nuclear fission process and their effects.



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

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

TEXT / REFERENCES BOOK:

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVE

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

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On completion of the course, student will be able to

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

CAE Model Practical Exam
ESE University Practical Exam

50 Marks
50 Marks



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

COURSE OBJECTIVES

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

UNIT 1 BATTERIES

9 Hrs.

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

UNIT 2 SUPERCAPACITORS

9 Hrs.

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

UNIT 3 THERMOELECTRIC MATERIALS & CATALYSIS

9 Hrs.

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

UNIT 4 CARBONNANO TUBES: INTRODUCTION TO GRAPHENE

9 Hrs.

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

UNIT 5 CHARACTERIZATION TECHNIQUES

9 Hrs.

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

Max:45 Hrs



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COURSE OUTCOME

On completion of the course, student will be able to

- CO1** - To apply appropriate characterization techniques for microstructure examination at different magnification level and use them
- CO2** - To understand the microstructure of various materials
- CO3** - To choose an appropriate electron microscopy technique to investigate microstructure of materials at high resolution
- CO4** - To Understand the Fundamentals of thermoelectric Effects
- CO5** - To Differentiate the diverse CNT
- CO6** - To Understand the Importance of various characterization Techniques

TEXT BOOK / REFERENCES

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 REVIEW OF THE LAWS OF THERMODYNAMICS AND THEIR CONSEQUENCES

9 Hrs.

Energy and first law of thermodynamics - Heat content and Heat capacity - Specific heat - Entropy and its significance - second law of thermodynamics - thermodynamic potential and the reciprocity relations - Maxwell's relations - Deductions - properties of thermodynamics relations - 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

9 Hrs.

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

UNIT 3 CLASSICAL STATISTICAL MECHANICS

9 Hrs.

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

UNIT 4 QUANTUM STATISTICAL MECHANICS

9 Hrs.

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

UNIT 5 ADVANCED TOPICS IN STATISTICAL MECHANICS

9 Hrs.

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

Max:45 Hrs

COURSE OUTCOME

On completion of the course, student will be able to

- CO1** - Explain statistical physics as logical consequences of the postulates of statistical mechanics
- CO2** - Apply the principles and techniques of statistical mechanics to selected problems and to a range of situations
- CO3** - Use tools and methodologies to physics to test and communicate ideas and explanations
- CO4** - Able to understand statistical mechanics of bosons and fermions (quantum fluids)
- CO5** - Able to understand the classical limit and strongly degenerate quantum systems including Fermi Gases and
- CO6** - To understand the classical limit and strongly degenerate quantum systems including Fermi Gases Bose-Einstein condensates

TEXT BOOK / REFERENCES

- F. Reif, Statistical and Thermal physics, McGraw Hill, International Edition, Singapore, 1979, revised - 2019
- B.R. Agarwal and N. Eisnor, Statistical Mechanics, 2nd ed, Wiley Eastern Limited, New Delhi
- R. Huang, Statistical Mechanics, Wiley Eastern Ltd., New Delhi, 1983



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4. F. Mandl, Statistical physics, John Wiley, London, 1971
5. C. Kittel, W. H. Freeman, Thermal Physics, 2nd ed 1980
6. F.W.Sears and G.L.Salinger, Thermodynamics, kinetic theory and statistical thermodynamics, 3rd edition, Narosa publishing house, 1998

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 ELECTROSTATICS

9 Hrs.

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

UNIT 2 MAGNETOSTATICS

9 Hrs.

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

UNIT 3 DIELECTRICS

9 Hrs.

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

UNIT 4 FIELD EQUATIONS

9 Hrs.

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

UNIT 5 RELATIVISTIC ELECTRODYNAMICS

9 Hrs.

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

Max:45 Hrs

COURSE OUTCOME

On completion of the course, student will be able to

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



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TEXT / REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

UNIT 1 MICROWAVE SPECTROSCOPY

9 Hrs.

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

UNIT 2 SPECTRA OF ONE ELECTRON ATOM

9 Hrs.

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

UNIT 3 SPECTRA OF MANY ELECTRON ATOMS

9 Hrs.

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

UNIT 4 THEORY OF MOLECULAR SPECTRA

9 Hrs.

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

UNIT 5 RAMAN SPECTROSCOPY

9 Hrs.

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

Max:45 Hrs

COURSE OUTCOME

On completion of the course, student will be able to

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

TEXT BOOK/ REFERENCES:

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



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

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

COURSE OUTCOME

On completion of the course, student will be able to

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

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration : 3 Hrs.

CAE Model Practical Exam

50 Marks

ESE University Practical Exam

50 Marks