VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
Ibrahimbagh, Hyderabad-31

DEPARTMENT OF PHYSICS

B.E Syllabus for **CSE, CSE (AI & ML)**and **IT** Branches w.e.f 2024-2025

PHYSICS OF SEMICONDUCTORS AND OPTOELECTRONIC DEVICES (PSOD)

(Course Code: U24BS110PH)

L : T : P	Credits	CIE		SEE	
3 :0 : 0	03	Marks:40	Exam Duration:90 min	Marks:60	Exam Duration: 3hrs

CO code	Course Objectives	Course Outcomes	Highest BTL
BS110PH.1	Demonstrate the significance of crystal structure in device applications.	Classify crystals based on their structure and apply effects of defects to manipulate properties ofsolids.	3
BS110PH.2	Appreciate the merits of quantum mechanics over classical mechanics.	Apply Schrodinger wave equation to quantum mechanical systems and obtain Eigen values.	4
BS110PH.3	Arrive at the expressions for carrier concentration in semiconductors	Apply semiconductorphysics to fabricate various devices.	3
BS110PH.4	Describe working of optoelectronic devices	Categorize optoelectronic devices and use them for appropriate applications	2
BS110PH.5	Comprehend lasing action and relate the use of lasers in optical fiber communication	Compare different types of lasers.Summarize merits and demerits of optical fibers.	3

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	1
CO4	2	1	-	-	-	-	-	-	-	-	-	1
CO5	3	1	-	-	-	-	-	-	-	-	-	1

UNIT-I: FUNDAMENTALS OF CRYSTALLOGRAPHY (12 hours)

Introduction to crystallography-Miller Indices,inter planar spacing (d_{hkl}),Bragg's law, x- ray diffraction, Debye-Scherrer (Powder) method, distinction between crystalline, polycrystalline, and amorphous materials, Point Defects and their effects, expression for concentration of Schottky and Frankel defects, applications relevant to computer science and engineering.

UNIT-II: INTRODUCTION TO QUANTUM MECHANICS (10 hours)

De Broglie hypothesis,wavepacket, wave function and its significance,Schrodinger time dependent and independent wave equations, Eigen values and Eigen functions of infinite square-well potential (particle in a box). Potential barrier-quantumtunneling problem. Introduction to ket and bra vector notation,representation of Qubit, applications of quantum computing.

UNIT-III: SEMICONDUCTOR PHYSICS (10 hours)

Kronig-Penny model, E-k diagram, effective mass of an electron, energy bands in solids,Fermi energy level, density of states, expression for intrinsic and extrinsic equilibrium carrier concentration, conductivity of intrinsic and extrinsic semiconductors, variation of Fermi level with doping and temperature, Halleffect and its applications, formation of a PN junction, diode current equation.Applications of semiconductor devices tocomputer architecture.

UNIT-IV: OPTOELECTRONIC DEVICES (10 hours)

Light Emitting Diode (LED): Direct and indirect band gap semiconductors, electron-hole pair generation and recombination, non-radiative and radiative recombination in semiconductors, construction and working of homo junction LED, quantum efficiency of LED, advantages, and applications of LED.

Photo detectors: Principle of a photo detector,construction and working of photodiode and PIN diode, applications of photo detectors.

Solar Cell: Photovoltaic effect, construction and working of solar cell, V-I characteristics of solar cell, conversion efficiency, fill factor, applications of solar cells.

UNIT-V: LASERS AND OPTICAL FIBERS (10 hours)

Lasers: Induced absorption, spontaneous and stimulated emissions, characteristics of lasers, population inversion, meta-stable states, pumping mechanisms, components of laser, types of lasers, construction and working of He-Ne laser and semiconductor laser, advantages of lasers, applications oflasersincluding computer devices such as memory, printers.

Optical Fibers: principle of optical fiber, propagation of light in optical fiber, numerical aperture, acceptance angle, types of optical fibers, V- number, signal losses in optical fibers: Attenuation-absorption, scattering, bending and alignment losses, Signal distortion: intermodal and intra model dispersions, block diagram of optical communication system, advantages, and application of optical fibers.

Learning Resources:

1. Charles Kittel, Introduction to Solid State Physics, 8th edition, John Wiley & Sons,2012.
2. Donald A Neamen, Semiconductor Physics and Devices, 3rd edition, Tata McGraw 2008.
3. S.O. Kasap, Optoelectronic and Photonics: Principles and Practices, Pearson, 2001
4. M.N. Avadhanulu and P.G. Kshirsagar and TVS Arun, Murthy ATextbook Engineering Physics, 11th edition, S. Chand,2019.
5. M.R Shenoy, NPTEL MOOCS course, Semiconductor opto-electronics.2020.
6. Prof.Digbijoy N Nath,NPTEL MOOCS,Fundamentals of Semiconductor Devices

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DEPARTMENT OF PHYSICS

B.E Syllabus for **ECE** and **EEE** Branches w.e.f 2024-25

QUANTUM MECHANICS AND MATERIALS SCIENCE (QMMS)
(Course Code: U24BS210PH)

L : T : P	Credits	CIE		SEE	
3 :0 : 0	03	Marks:40	Exam Duration:90 min	Marks:60	Exam Duration: 3hrs

CO code	Course Objectives	Course Outcomes	Highest BTL
BS210PH.1	Demonstrate the significance of crystal structure in device applications.	Classify crystals based on their structure and list appropriate uses	3
BS210PH.2	Appreciate the advantages of quantum mechanics over classical mechanics.	Apply Schrodinger wave equations to quantum mechanical systems.	4
BS210PH.3	Arrive at the expressions for carrier concentration in semiconductors	Apply semiconductor physics to fabricate various devices	3
BS210PH.4	Comprehend lasing action and relate the use of lasers in optical fiber communication	Compare different types of lasers.Summarize merits and demerits of optical fibers.	2
BS210PH.5	Choose appropriate dielectric, magnetic and superconducting materials for required applications	Select various dielectric, magnetic and superconducting materials for specific applications in engineering.	3

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	1
CO2	2	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	1
CO4	3	1	-	-	-	-	-	-	-	-	-	1
CO5	2	1	-	-	-	-	-	-	-	-	-	1

UNIT-I: FUNDAMENTALS OF CRYSTAL STRUCTURE (12 hours)

Introduction to crystallography-Miller Indices, inter planar spacing (d_{hkl}), Bragg's law, x- ray diffraction, Debye-Scherer (powder) method, distinction between crystalline, polycrystalline, and amorphous materials, Point Defects and their effects, expression for concentration of Schottky and Frankel defects and applications relevant to electronics and communication engineering.

UNIT-II: QUANTUM MECHANICS (10hours)

De Broglie Hypothesis, wave packet, Davisson and Germer's experiment, wave function and its significance, Schrodinger time dependent and independent wave equations, Eigen values and Eigen functions of infinite square-well potential (particle in a box). Potential barrier-quantum tunneling problem. Introduction to bra and ket vector notation, representation of Qubit, applications of quantum computing.

UNIT-III: SEMICONDUCTOR PHYSICS (10hours)

Classical free electron (Drude) theory and its limitations,density of states, Kronig-Penney model, formation of energy bands, E-k diagram,Fermi-Dirac statistics (Qualitative),types of semiconductors, Fermi energy level, variation of Fermi energy level with temperature and doping concentration, expression for equilibrium carrier concentration in intrinsic and extrinsicsemiconductors, conductivity of intrinsic and extrinsic semiconductors, formation of P-N Junction, Hall effect and its applications, Applications of semiconductor devices in electronic engineering.

UNIT-IV: LASERS AND OPTICAL FIBRES (10 hours)

Lasers: Induced absorption, spontaneous and stimulated emissions, characteristics of lasers, population inversion, meta-stable states, pumping mechanisms, components of laser, Properties of laser beam, types of lasers, construction and working of He-Nelaser and semiconductor laser, advantages, and applications oflasers.

Optical Fibers: principle of optical fiber, propagation of light in optical fiber, numerical aperture, acceptance angle, types of optical fibers, V- number, signal losses in optical fibers: Attenuation-absorption, scattering, bending, alignment losses, Signal distortion: intermodal and intra modal dispersions, block diagram of optical communication system, advantages and application of optical fibers.

UNIT-V: MATERIALS SCIENCE (10 hours)

DielectricMaterials:Polarandnon-polardielectrics,typesofdielectricpolarizations,Expressions for electronic polarizability and ionic polarizability, Frequency and temperature dependence of dielectric polarizations, applications of dielectricmaterials.

Magnetic Materials: Origin of magnetism, Ferromagnetic materials, antiferromagnetic materials and ferri-magnetic (ferrites) materials, Weiss molecular field theory of ferromagnetism, magnetic domains, hysteresis curve, soft and hard magnetic materialsand their applications.

Superconductivity: Introduction to superconductivity, General properties of superconductors, Meissner effect, Type I and Type II superconductors-fundamentals of BCS Theory - Josephson's Junctions-Josephson's effects–SQUID- Applications of superconductors.

Learning Resources:

1. Charles Kittel, Introduction to Solid State Physics, 8th edition, John Wiley & Sons,2012
2. S O Pillai, Solid State Physics, 8th edition, New Age International Publishers,2018
3. M.N. Avadhanulu and P.G. Kshirsagar and TVS Arun Murthy, A Textbook Engineering Physics, 11thedition, S. Chand,2019.
4. NPTEL MOOCS, Introduction to Solid State Physics, Satyajit Banerjee
5. NPTEL MOOCS,Concepts in Magnetism and Superconductivity, Prof ArghyaTaraphder.
6. NPTEL MOOCS, Solid State Physics,Prof. Amal Kumar Das.

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DEPARTMENT OF PHYSICS

B.E Syllabus for **Civil Engineering** Branch w.e.f 2024-25

OPTICS,ACOUSTICS & SENSORS
(Course Code: U24BS220PH)

L : T : P	Credits	CIE		SEE	
3 :0 : 0	03	Marks:40	Exam Duration:90 min	Marks:60	Exam Duration: 3hrs

CO code	Course Objectives	Course Outcomes	Highest BTL
BS220PH.1	Explain mathematical formulations of waves andoscillations.	Interpret behavior of mechanical oscillators with and without damping effects	2
BS220PH.2	State principles of interference, diffraction and polarization of light.	Outline the principles of wave optics and their applications	1
BS220PH.3	Comprehend lasing action and state application of lasers	Compare different types of lasers.Summarize merits and demerits of optical fibers.	3
BS220PH.4	Describe characteristics of acoustics quieting effects required for a hall.	Explain production of ultrasonics and summarize good building acoustics.	2
BS220PH.5	Interpret the advantages of using sensors in civil engineering.	List various sensors for monitoring health of structures.	3

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	-	1
CO5	2	1	-	-	-	-	-	-	-	-	-	1

UNIT-I: OSCILLATIONS (12 hours)

Definition of SHM, equation of motion and solution to simple harmonic oscillator, energy of simple harmonic oscillator, equation of motion and solution to damped harmonic oscillator, logarithmic decrement, relaxation time, equation of motion and solution to forced harmonic oscillator, Resonance, Q-factor, electromechanical analogy. Real life applications of mass-spring systems.

UNIT-II: WAVE OPTICS (10 hours)

Interference: conditions for sustained interference, interference due to thin parallel film, Newton's rings, applications of interference.

Diffraction: Phenomenon of diffraction of light, classes of diffractions, Fraunhofer diffraction due to a single slit, diffraction due to N- slits (plane transmission grating), application of diffraction.

Polarization: Polarization of light, types of polarized light, double refraction, construction and working of Nicol's Prism, Polarizer and analyzer, Quarter wave and Half wave plates.

Relevant applications of wave optics in the field of engineering.

UNIT-III: LASERS AND OPTICAL FIBRES (10 hours)

Lasers: induced absorption, spontaneous and stimulated emissions, Properties of laser light, population inversion, meta-stable states, pumping mechanisms, components of laser, construction and working of He-Ne laser, advantages and applications oflasers in engineering.

Optical Fibers: introduction to optical fibers, propagation of light in optical fiber, numerical aperture, acceptance angle, types of optical fibers, signal losses in optical fibers: Attenuation-absorption, Scattering, bending, alignment losses, Signal distortion. Block diagram of optical communication system, advantages and application of optical fibers.

UNIT-IV: ACOUSTICS (10 hours)

Architectural Acoustics: classification of sound: musical sound and noise, Characteristics of musical sound-pitch, loudness, timbre, sound intensity, sound pressure levels, reverberation time, absorption coefficient, Sabine's formula, sound absorbent materials,Building acoustic requirements, conditions for acoustic quieting: effects and remedies. Sound proofing applications in Civil Engineering.

Ultrasonics:propertiesofultrasonics,typesofultrasonicwaves,productionofultrasonics by piezoelectric and magnetostriction methods, detection of ultrasonics by piezoelectric, thermal detector, applications of Ultrasonics: SONAR, cavitation, Ultrasonicnon-destructive testing applications in civil engineering.

UNIT-V: SENSORSFOR STRUCTURAL HEALTH MONITORING&THERMODYNAMICS (10 hours)

Introduction to Structural Health Monitoring (SHM):Types of Sensors in structural health monitoring: Strain Gauge (load cells),Optical Fiber Sensors, Accelerometer,Tiltmeter, Temperature Sensors: Thermocouple and Thermistor.

Fundamentals of Thermodynamics:Thermodynamic equilibrium, zeroth law, first law and second law of thermodynamics, workdone in isothermal and adiabatic process, Carnot cycle (Qualitative).

Learning Resources:

1. J Walker, D., Halliday and R Resnick, Principles of Physics, 10th edition, Wiley, 2016.
2. Jewett and Serway, Physics for Scientists and Engineering, 7th edition, 2013.
3. M.N. Avadhanulu and P.G. Kshirsagar and TVS Arun Murthy A Textbook Engineering Physics, 11th edition, S. Chand,2019.
4. John G. Webster and HalitEren, Measurement, instrumentation, and Sensor's handbook: Spatial, Mechanical, Thermaland Radiation Measurement, CRC press, 2014.
5. Patranabis D, Sensors and Transducers,2nd edition, PHI Learning Pvt Ltd.,2015

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DEPARTMENT OF PHYSICS
B.E Syllabus for **Mechanical Engineering** Branch w.e.f 2024-25
ENGINEERING PHYSICS
(Course Code: U24BS230PH)

L : T : P	Credits	CIE		SEE	
3 :0 : 0	03	Marks:40	Exam Duration:90 min	Marks:60	Exam Duration: 3hrs

CO code	Course Objectives	Course Outcomes	Highest BTL
BS230PH.1	Comprehend lasing action and state various applications of lasers	Compare different types of lasers.Summarize merits and demerits of optical fibers.	3
BS230PH.2	Describe characteristics of acoustic quieting effects required for a hall	Explain production of ultrasonics and list out good building acoustics	2
BS230PH.3	List of various properties of magnetic materials	Select various magnetic and for specific applications in mechanical engineering.	3
BS230PH.4	Realizethe principles of liquefaction of gasses	Summarize liquefaction of gases and their applications	2
BS230PH.5	Explore basics of nanomaterials and their applications	Comprehend nanomaterial characterization and summarize applications of nanomaterials.	2

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	1
CO2	3	3	-	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	-	1
CO5	2	2	-	-	-	-	-	-	-	-	-	1

UNIT-I: ACOUSTICS (12 hours)

Architectural Acoustics: classification of sound: musical sound and noise, Characteristics of musical sound: pitch, loudness, timbre, sound intensity, reverberation time, absorption coefficient, Sabine's formula, sound absorbent materials, Building acoustic requirements, conditions for acoustic quieting: effects and remedies.

Ultrasonics:propertiesofultrasonics,typesofultrasonicwaves,productionofultrasonics by piezoelectric and magnetostriction method, detection of ultrasonics by piezoelectric, thermal detector, applications of ultrasonics: SONAR, cavitation. Ultrasonic non-destructive testing.

UNIT-II: LASERS AND OPTICAL FIBRES (10 hours)

Lasers: Induced absorption, spontaneous and stimulated emissions, Properties of laser light, population inversion, meta-stable states, pumping mechanisms, components of laser, construction and working of Ruby laser, applications of lasers in mechanical engineering.

Optical Fibers: introduction to optical fibers, expression for numerical aperture, acceptance angle, types of optical fibers, signal losses in optical fibers: Attenuation-absorption, bending and alignment losses, Block diagram of optical communication system, application of optical fibers in mechanical engineering.

UNIT-III: MAGNETIC MATERIALS (10hours)

Origin of magnetism,Ferromagnetic materials,anti-ferromagnetic materials and ferrimagnetic (ferrites) materials,Weiss molecular field theory of ferromagnetism,hysteresis curve,soft and hard magnetic materials, and their applications.Introduction to superconductivity,General properties of superconductors,Messiner's effect,Type I and Type II superconductors-Josephson's Junctions-Applications of superconductors

UNIT-IV: CRYOGENICS (10 hours)

Introduction to low temperature Physics- Joule Thomson effect, porous plug experiment, J-T effect for a Van der Waal's gas, Inversion temperature, Boyle temperature and critical temperature. Regenerative cooling process, Liquefaction of hydrogen, properties of liquid helium, adiabatic demagnetization, Applications of cryogenicliquids.

UNIT-V: NANOMATERIALS (10 hours)

Nanoscale, Nanoscience and nano technology, distinction between bulk, thin films and nanomaterials, quantum confinement,Surface to volume ratio,mechanical properties, bottom-up and top-down approaches: sol-gel and Ball milling techniques, X-Ray Diffraction: Determination of crystallite size , stress and strain, block diagrams of Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM) and Engineering applications of nano materials.

Learning Resources:

1. M.N. Avadhanulu and P.G. Kshirsagar and TVS Arun Murthy, A Textbook Engineering Physics, 11th edition, S. Chand,2019.
2. MamataMukhopadhyay,Fundamentals of Cryogenics Engineering,3rdedPHI, 2016
3. S O Pillai, Solid State Physics, 8th edition, New Age International Publishers,2018

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DEPARTMENT OF PHYSICS

B.E Syllabus for **CSE, CSE (AI & ML) and IT Branches** w.e.f academic year 2024-2025

SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS LAB

L : T : P	Credits	CIE Marks	SEE Marks	Semester	Course Code
0 : 0 : 2	01	30	50	I	U24BS111PH

Course Objectives	Course Outcomes	Highest BTL
• to study and discuss the characteristics of a given device	1. Conduct experiment independently and in team to record the measurements	2
• to identify probable errors and take in the readings and known possible precautions	2. Outline the precautions required to be taken for each experiment	1
• to compare the experimental and theoretical values and draw possible conclusions.	3. Compare the experimental results with standard values and estimate errors	2
• To interpret the results from the graphs drawn using experimental values.	4. Draw graphs and interpret the results with respect to graphical and theoretical values	2
• To write the record independently with appropriate results.	5. Write the summary of the experiment and draw appropriate conclusions	1

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	1	-	-	-	2

1. Determination of wavelength of laser light.
2. Study of I-V characteristics of LED and Photodiode
3. Calculation of numerical aperture, acceptance angle and power loss due to bending of an opticalfiber.
4. Study of I-V characteristics of solar cell and to calculate fill factor andefficiency.
5. Determination of Planck's constant using Photocell
6. Determination of Hall'scoefficient, carrier concentration of given semiconductor- Hall's effect
7. Study of resonance in LCR seriescircuits and estimation of band width& Q- factor
8. Study of resonance in LCR parallel circuits.
9. Determination of energy gap of a given semiconductor by four probemethod
10. Determination of Seebeck coefficient.
11. Helmholtz coil –calculation of magnetic field along the axis of a solenoid.
12. Study of I-V characteristics of P-N Junction diode.
13. Study of I-V characteristics of Zener Diode

*Each student should perform at least 10 (Ten) experiments.

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B.E Syllabus for **ECE and EEE Branches** w.e.f academic year 2024-2025

ENGINEERING PHYSICS LAB

L : T : P	Credits	**CIE** Marks	**SEE** Marks	**Semester**	**Course Code**
0 : 0 : 2	01	30	50	**II**	U24BS211PH

Course Objectives	**Course Outcomes**	**BTL**
• to study and discuss the characteristics of a given device	1. Conduct experiment independently and in team to record the measurements	2
• to identify probable errors and take in the readings and known possible precautions	2. Outline the precautions required to be taken for each experiment	1
• to compare the experimental and theoretical values and draw possible conclusions.	3. Compare the experimental results with standard values and estimate errors	2
• To interpret the results from the graphs drawn using experimental values.	4. Draw graphs and interpret the results with respect to graphical and theoretical values	2
• To write the record independently with appropriate results.	5. Write the summary of the experiment and draw appropriate conclusions	1

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	2	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	1	-	-	-	2

1. Determination of wavelength of Laser light.
2. Calculation of NA, acceptance angle and power loss due to bending of an optical fibre.
3. Determination of energy gap of a given semiconductor by four probemethod
4. Study of I-V characteristics of solarcell and to calculate fill factor andefficiency.
5. Determination of Hallcoefficient using Halleffect.
6. Determination of e/m of an electron by Thomson'smethod
7. Study of resonance in LCR series circuits and estimation of band width & Q- factor
8. Study of resonance in LCR parallel circuits
9. Determination of wavelength of a light source by Michelson interferometer
10. Determination of Seebeck coefficient
11. Determination of Dielectric constant.
12. Helmholtz coil –calculation of magnetic field along the axis of a solenoid
13. B-H curve-estimation of Hysteresis loss of a ferromagneticsample
14. Study of I-V characteristics of P-N Junction diode.
15. Study of I-V characteristics of Zener Diode

*Each student should perform at least 10 (Ten) experiments.

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B.E Syllabus for **Civil and Mechanical Branches** w.e.f academic year 2024-2025

APPLIED PHYSICS LAB

L : T : P	Credits	CIE Marks	SEE Marks	SEE Duration	Course Code
0 : 0 : 2	01	30	50	3 hours	U24BS221PH

Course Objectives	Course Outcomes	BTL
• to study and discuss the characteristics of a given device	1. Conduct experiment independently and in team to record the measurements	2
• to identify probable errors and take in the readings and known possible precautions	2. Outline the precautions required to be taken for each experiment	1
• to compare the experimental and theoretical values and draw possible conclusions.	3. Compare the experimental results with standard values and estimate errors	2
• To interpret the results from the graphs drawn using experimental values.	4. Draw graphs and interpret the results with respect to graphical and theoretical values	2
• To write the record independently with appropriate results.	5. Write the summary of the experiment and draw appropriate conclusions	1

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	1	-	-	-	2

1. Determination of moment of inertia of a Fly Wheel
2. Computation of rigidity modulus of material of a wire using Torsional Pendulum
3. Estimation of frequency of electrically maintained Tuning fork- Melde's experiment.
4. Determination of radius of gyration and acceleration due to gravity using Compound Pendulum.
5. Assessment of velocity of ultrasonic waves in liquids
6. Calculation of wavelength of laserlight&Estimation of distance by laser light source
7. Measurement of radius of curvature of a Plano-convex lens by formingNewton's Rings.
8. Determination of wavelengths of mercury vapour lamp- diffraction grating
9. Calculation of numerical aperture, acceptance angle and power loss due to bending of an optical fibre.
10. Study of I-V characteristics of P-N Junction diode.
11. Study of I-V characteristics of solarcell and to calculate fill factor andefficiency.
12. Gyroscope- study of gyroscopiceffects.

*Each student should perform at least 10 (Ten) experiments.

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VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
DEPARTMENT OF PHYSICS
Open elective Course
FUNDAMENTALS OF SMART MATERIALS AND APPLICATIONS

L : T : P	Credits	CIE Marks	SEE Marks	SEE Duration	Course Code
02: 0: 0	02	40	60	3 hours	U24OE310PH

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	1
CO3	3	3	-	-	-	-	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1

Course Objectives	Course Outcomes	BTL
The student will be able to	**the student should at least be able:**	
1. To introduce various types of smart materials used in engineering.	1. Identify various smart materials and their significant applications.	2
2. Grasp the concepts of piezo and ferroelectric materials.	2. Summarize various properties and applications of peizo and ferroelectric materials.	3
3. Learn fundamentals of pyro and thermoelectric materials	3. Apply fundamental principles of pyro and thermoelectricity in relevant fields of engineering.	3
4. Gain knowledge on shape memory alloys	4. Explain types of shape memory alloys and their properties and applications	2

UNIT I: INTRODUCTION TO SMART MATERIALS (6 hours)

Characteristics of metals, polymers and ceramics. Introduction to smart materials, need for smart materials, Classification of smart materials, Components of a smart System, Applications of smart material, role of smart materials in developing intelligent systems and adaptive structures.

UNIT II: PIEZO AND FERRO ELECTRIC MATERIALS (8 hours)

Piezo electric effect and inverse piezoelectric effect, Piezo electric materials, Structure of Quartz crystal, piezoelectric oscillator, Magnetostriction, Magnetostriction oscillator, piezo-electric sensors, applications of Piezo-electric materials.Characteristics and properties of ferroelectric materials, Curie-Weiss law, applications of Ferro electric materials.

UNIT III: PYRO AND THERMO-ELECTRIC MATERIALS (6 hours)

Pyroelectricity: pyro electric effect, pyro electric materials, pyro-electric detector.

Thermoelectricity: thermoelectric effect, Seebeck effect, Peltier effect, thermocouple, Principle and working of thermoelectric generator and Thermoelectric cooler,applications of thermoelectric materials

UNIT IV: SHAPE MEMORY MATERIALS (8 hours)

Introduction to shape memory alloys (SMA)- Shape Memory Effect (SME), Austenite, Martensite phases, Properties and characteristics SMAs, one-way and two-way shape memory effects, Properties of Ni-Ti shape memory alloy, Cu-based shape memory alloys, and their applications, Applications of SMAs.

Learning Resources:

1. Mukesh V. Gandhi, Brian S Smart Materials and Structures, Thompson, Springer, May- 1992
2. D. Patranabis, Sensors and Transducers, PHI Learning Pvt. Ltd., 2022
3. Nachiketa Tiwari,Bishakh Bhattacharya, Smart Material, Adaptive Structures& Intelligent Mechanical Systems

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VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
DEPARTMENT OF PHYSICS
Open elective Course
FUNDAMENTALS OF THIN FILM TECHNOLOGY AND APPLICATIONS

L : T : P	Credits	CIE Marks	SEE Marks	SEE Duration	Course Code
02: 0: 0	03	40	60	3 hours	U24OE510PH

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	1
CO3	3	3	-	-	-	-	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1

Course Objectives	Course Outcomes	BTL
Students are able to	***The students acquire the ability to***	
1. Learn the fundamental atomistic mechanisms.	1. State fundamental definitions of thin film technology.	1
2. Narrate thin film deposition techniques.	2. Describe thin film deposition techniques.	2
3. Acquire knowledge on thin film devices.	3. Illustrate thin film devices and their use.	3
4. Appreciate applications of thin films	4. Use thin films coatings in industrial applications	3

UNIT-I: THIN FILM GROWTH

Classification of films- formation of thin films- Condensation and nucleation, growth and coalescence of islands, -nucleation theories: capillarity and atomistic models, sticking coefficient, adhesion, substrate effect, film thickness effect.

UNIT-II: DEPOSITION TECHNIQUES

Thin film deposition techniques-spin coating,simple thermal evaporation- Chemical vapor deposition technique-Advantages and disadvantages of Chemical Vapor deposition (CVD), Physical vapour deposition electron beam evaporation, RF sputtering, Ion beam sputtering, Laser ablation, molecular beam epitaxy (MBE).

UNIT-III: THIN FILM MATERIAL CHARACTERIZATION TECHNIQUES

Characterization techniques: X-Ray Diffraction (XRD), Thickness measurement techniques, working principles of Scanning Electron Microscopy (SEM), working of Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM).

UNIT-IV: PROPERTIES OF THIN FILMS

Electrical conduction in continuous and discontinuous metallic thin films. Transport and optical properties of metallic, semiconducting, and dielectric films.

UNIT-V: THIN FILM DEVICES AND APPLICATIONS

Anti-reflection coatings, fabrication ofthin film gas and temperature sensors, Thin film solar cells, Quantum dot solar cells, Applications of thin films in electronics, medical, defense, automobiles.

Learning resources:

1. Kasturi Chopra Thin Film Device Applications, Mac Graw Hill, New York, 2012
2. A. Goswami, thin film fundamentals,New Age International, 2006
3. NPTEL: Fundamentals of Material Processing - Part 2, IIT Kanpur Prof. Shashank Shekhar, Prof. Jitesh J Thakkar

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VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
Ibrahimbagh, Hyderabad-500 031, Telangana State

DEPARTMENT OF PHYSICS
Open elective Course
FUNDAMENTALS OF VACUUM TECHNOLOGY AND APPLICATIONS

L : T : P	Credits	CIE		SEE		Course Code
		Marks	ExamDuration	Marks	Exam Duration	
03 :0 :0	03	40	90 min	60	3hours	**U24OE520PH**

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	1
CO3	3	3	-	-	-	-	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1

Course objectives	***Course outcomes***
Students will be able to learn	***At the end of the course students will be***
1. Learn basics definitions of vacuum technology. 2. Acquire principles of vacuum pump parameters. 3. Gain insight of vacuum production methods 4. Learn measurement of vacuum 5. Known various applications of vacuum.	1. Define various vacuum ranges and terms related to vacuum technology. 2. List out vacuum pump parameters. 3. Narrate working of various types of vacuum pumps. 4. Explain working of different vacuum measuring devices. 5. List applications of vacuum in various fields.

UNIT-I: FUNDAMENTALS OF VACUUM

Vacuum Nomenclature and Definitions, units of vacuum, Vacuum ranges, Types of flow: turbulent flow, viscous or laminar flow, molecular flow, Knudsen flow, out gassing, Mean free path of the molecules, adsorption, desorption, evaporation theory-rate of evaporation, Hertz- Knudsen equation, types of evaporation.

UNIT-II: VACUUM TERMINOLOGY

Methods of production of vacuum, vacuum pump function basics, throughput, pumping speed, conductance, evacuation rate, fore vacuum and high-vacuum pumping, Pump Choice, valve less, valved pumping system, Positive Displacement Vacuum Pumps, Momentum Transfer Vacuum Pumps, Entrapment Pumps, traps and baffles. Function of the oil in oil-sealed vacuum pumps. Effects of condensable vapours on mechanical pump performance, Water vapour tolerance of a pump, Back-streaming

UNIT-III: VACUUM PUMPS

Systems construction and working of vacuum pumps: Roots vacuum pumps, Rotary vane pump, multistage rotary pumps, diffusion pump, Turbomolecular pumps, cryo-pump, ion getter pumps

UNIT-IV: VACUUM MEASUREMENT

Overview of gauges, direct reading and indirect reading gauges, classification of pressure gauge, Vacuum gauges: thermocouple gauge, Pirani gauge, cold cathode and hot cathode ionization gauge, Penning gauge, leak detection, Leak detection methods-leak rate.

UNIT-V: VACUUM APPLICATIONS

Deposition of thin films, Vacuum technology in the semiconductor industry, Vacuum technology in metallurgical processes, Vacuum technology in the chemical industry,

SUGGESTED BOOKS:

1. Dorothy M. Hoffman and Bawa Singh, Handbook of Vacuum Science and Technology, Academic Press, 1998
2. M. N. Avadhanulu and P.G. Kshirsagar, Textbook of Engineering Physics, Revised Edition, S.Chand, 2015
3. John F. O'HanlonA User's Guide to Vacuum Technology, Jhon Willey and sons, 2006

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Ibrahimbagh, Hyderabad-500 031, Telangana State
DEPARTMENT OF PHYSICS
Open elective Course
INTRODUCTION TO NANOTECHNOLOGY

L : T : P	Credits	CIE		SEE		Course Code
		Marks	Exam Duration	Marks	Exam Duration	
03 :0 :0	03	40	90 min	60	3hours	**U24OE610PH**

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	1
CO3	3	3	-	-	-	-	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	1
CO5	2	-	-	-	-	-	-	-	-	-	-	1

Course objectives	Course outcomes	BTL
Students will be able to learn	At the end of the course students will be	
1. Learn bulk, thin and nano structures. 2. Acquire knowledge on properties of nano materials. 3. Appreciate fabrication techniques of nano materials. 4. Learn nanomaterial characterization techniques.	1. Distinguish bulk, thin and nano materials from the point of view of size effects. 2. List various properties of nano materials. 3. Narrate various nanomaterial preparation techniques. 4. Describe characterization techniques of nano materials. 5. Write various applications of CNTs&nano structures.	2 2 2 3 2

UNIT-I:INTRODUCTION TO NANOSCIENCE

The distinction between bulk, thin films and nano materials-surface to volume ratio, change of electronic structure, density of states of nano materials, quantum confinement-quantum size effect, Quantum wells, Quantum wires, Quantum dots.

UNIT-II: PROPERTIES OF NANO MATERIALS

Electrical properties: conductivity, ballistic transport, Magnetic properties: soft and permanent magnetic nano materials, Giant Magneto Resistance (GMR), chemical properties, optical properties and thermal properties.

UNIT-III: NANOMATERIALS PREPARATION TECHNIQUES

Bottom-up and Top-down approaches. Preparation techniques Bottom-up methods: Physical Vapor Deposition, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, top-down methods: ball milling, Nanolithography.

UNIT-IV: NANO MATERIAL CHARACTERIZATION TECHNIQUES

Characterization techniques: X-Ray Diffraction (XRD), working principles of Scanning Electron Microscopy (SEM), working of Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Emission Microscope (FEM).

UNIT-V: CARBON NANO MATERIALS AND APPLICATIONS

Graphene, Elementary ideas on Carbon nanotubes, types of CNTs-single wall (SWCNT) and multiwall carbon nanotubes (MWCNT), properties and characteristics of SWCNTS and MWCNTS. Applications of nano materials in cosmetic sector, food, agricultural, engineering, automotive Industry, environment, medical applications, textiles, paints, energy and space Applications.

Learning Resources:

1. K.K. Chattopadhyay and A.N. Benerjee, Introduction to Nanoscience and Nanotechnology, PHI, 2019.
2. Nanomaterials and their Properties, IIT-Kanpur, NPTEL Course

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