DEPARTMENT OF PHYSICS

(B. TECH: VII Sem.)
(OPEN ELECTIVE)

PHOE401: NANOSCEICE AND TECHNOLOGY

L	T	P	Credits	Total contact hours
3	0	0	3	36

Pre-requisite: **PHIC101**

Brief Description about the course: This course includes the fundamentals of nanoscience and nanotechnology and their various synthesis, characterization techniques and potentials applications in different fields.

Course Content:

UNIT I (9 Hours)

Baiscs of Nano-Science and Technology: Basic concepts of Nanoscience: Quantum dot, Potential barrier, Background of Nanotechnology, types of Nanotechnology and nano-machines, top down and bottom up techniques, atomic manipulation, self-assembly monolayers, Time and length scale in structures, Dimensionality and size dependent phenomena, Surface to volume ratio, Fraction of surface atoms, Properties at nanoscale (electronic, magnetic, optical and mechanical).

UNIT II (10 Hours)

Synthesis methods of Nanomaterials: Introduction to Nanomaterials, Synthesis of nanomaterials: Sol-gels techniques, Co-precipitation and Hydrothermal method, Lithography: Photolithography, Electron beam lithography, Focused Ion Beam Lithography (FIB); Dip-Pen Nanolithography, Template Synthesis; Self Assembly and Bio/Chemical Methods, Chemical Vapor Deposition(CVD).

UNIT-III (10 Hours)

Characterization Techniques for Nanomaterials: Structural Characterization: X-Ray Diffraction (XRD), Surface Characterization: Scanning Electron Microscopy (SEM), High Resolution Transmission Electron Microscope (HRTEM), Scanning Probe Microscope (STM, AFM, MFM), Raman Spectrometry.

MECHANICAL ENGINEERING DEPARTMENT
PIOE425: SIX SIGMA CONCEPTS AND METHODOLOGY

Pre-requisite: Nil

L	T	P	Credits	Total contact hours
3	0	0	3	40

Brief Description about the course

Six Sigma is a best in class process improvement strategy that focuses on reducing process variation in business operations. It aims to achieve operational excellence by minimizing defects and waste in the system. This course can provide the general procedure and framework to understand and implement the six sigma in any organization.

UNIT-I

Quality concepts, evolution of continuous improvement, concept of six sigma, need for six sigma, process yield, statistical rationale of six sigma, belt system, teams, leadership in six sigma, resources for Six Sigma, roles and responsibilities of six sigma professionals. **(8 hrs)**

UNIT-II

Six Sigma Strategy: Six sigma strategic planning, define measure analyze improve control (DMAIC), design for six sigma (DFSS), selection of six sigma toolset, enablers of six sigma, obstacles of six sigma. **(10 hrs)**

UNIT-III

Six Sigma Project Implementation: Implementation framework, Define: project identification, project selection, problem definition, voice of customer, project critical to quality, improvement opportunity, process mapping, Measure: six sigma metrics, critical process assessment, measure metrics, Analyze: source of variations, analyzing root causes, Improve: six sigma improvement, implementation planning, innovate solution, selecting a solution, piloting the solution, improvement evaluation, lean process improvement, Control: need of control and monitoring in six sigma project, out of control action plan. **(14 hrs)**

UNIT-IV

Six Sigma for Operational Excellence: combining lean and six sigma methodologies, sustainable six sigma, integration with industry 4.0, tangible gains of six sigma, impact on organization sustainability, six sigma case studies: manufacturing sector, healthcare, higher education, supply chain management. **(8 hrs)**

NOTE:

The focus of concluding lectures should be to emphasize the value addition of the subject and also on how it impacts the environment. Further, the faculty may suggest possible sustainable solutions/emerging technologies/innovations towards sustainability in the subject domain.

Text Books / Reference

5. An introduction to six sigma and process improvement by james r. evans & william m. lindsay, cengage learning
6. Six sigma handbook by thomas pyzdek, paul a. keller, mc graw hill
7. Six sigma the breakthrough management strategy revolutionizing the world's top corporations
8. Six sigma for business excellence: approach tools and applications by hemant urdhwareshe, pearson

Course Outcomes

CO 1: Understand the basics of six sigma and role of teams in six sigma execution
CO 2: Interpret the six sigma implementation strategy for manufacturing and service sector
CO 3: Apply six sigma DMAIC process to reduce process variations
CO 4: Relate the sustainable and smart process improvement practices with conventional strategies

Course Code	**:**	**ITOE 403**
Course Title	**:**	**Computer Networks**
Number of Credits and L/T/P scheme	**:**	**3 & 3 0 0**
Prerequisites (Course code)	**:**	
Course Category	**:**	**OE**

Course Learning Objectives:

1. Understand computer network basic, different models used for study of computer networks, ability to identify different designs, understanding of the issues surrounding wired and wireless Networks.
2. Design, calculate, and apply subnet masks to fulfil networking requirements and building the skills of routing mechanisms.
3. Analyse the features and operations of various application layer protocols such as Http, DNS, SMTP and FTP.
4. Analyse the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
5. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Course Content:

Unit 1: Introduction

History and development of computer networks, Network Functions, Network Topology, Network Services, Switching Approaches, Transmission media and systems, OSI Reference Model, Overview of TCP/IP architecture,

Unit 2: Physical, MAC and Data Link Layer

Different types of transmission media, errors in transmission: attenuation, noise, multiplexing and signalling techniques, Encoding (NRZ, NRZI, Manchester, 4B/5B, etc). Aloha, CSMA, CSMA/CD, CSMA/CA protocols, Ethernet, including Gigabit Ethernet and WiFi (802.11), Token Ring, Bluetooth and Zigbee. Error detection, Sliding Window, Stop and Wait protocols, ARQ, Sliding Window Protocols, HDLC, PPP protocols.

Unit 3: Network layer:

Internet Protocol, IPv6, ARP, DHCP, ICMP, Routing algorithms: Distance vector, Link state, Metrics, Inter-domain routing. Subnetting, Classless addressing, Network Address Translation, IPv4 to IPv6 Translation strategies, Packet network topology, Datagrams and Virtual Circuits, Structure of Switch/Router, Connectionless and Virtual Circuit packet Switching, Traffic management and QoS – FIFO, Priority Queues, Fair Queuing, MPLS.

Unit 4: Transport and Application layer:

UDP, TCP. Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions, etc. Client Server Model, HTTP, DNS, SMTP, FTP, and TFTP.

Text Books:

1. Behrouz A. Forouzan: Data Communications and Networks, Fifth Edition, McGraw Hill, 2017.
2. Leon Garcia and IndraWidjaja: Communication Networks – Fundamental Concepts and Key Architectures, Second Edition TMH.
3. A.S. Tanenbaum: Computer Networks, Sixth Edition, Pearson Education, 2022.
4. William Stallings: Data and Computer Communications 10/e, Pearson Education.

Course Outcomes:

At the end of the course student will be able to……

1. Understand computer network basic, different models used for study of computer networks, ability to identify different designs, understanding of the issues surrounding wired and wireless Networks.
2. Design, calculate, and apply subnet masks to fulfil networking requirements and building the skills of routing mechanisms.
3. Analyse the features and operations of various application layer protocols such as Http, DNS, SMTP and FTP.
4. Analyse the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
5. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES
B. Tech (Open Elective Course)
Course Title: Human Resource Management

Course Category: OE | **Internal: 50 Marks**
Course Code: HSOE 401 | **Theory: 50 Marks**
Credits: 3 (L-3) | **Total: 100 Marks**
Semester: 7th | **Time: 3hrs**

Course Objectives

This course aims at increasing acquaintance of the students with HR concepts in an attempt to raise students' level of understanding with respect to people dynamics in modern organizations.

UNIT I

Human Resource Management- Concept, Scope and Functions of HRM; Evolution of HRM: Craft System, Scientific Era, Human Relation Movement, Strategic Human Resource Management.

Unit II

Developing and Retaining Talent - training & development- Nature, Its Importance as source of competitive Advantage, Inputs in Training and Development; Training Needs Identification; Training Process: Deriving Instructional Objectives, Designing, Methods of Training and Development. Performance Appraisal: Its Process, Methods and Its Relevance.

Unit III

Workplace Spirituality and Human Resource Management, Workforce Diversity: Reasons & Strategies, Leadership- Leader v/s manager- Leadership styles, Concepts, Theories and Styles Trait, Behavioral and situational Transactional and Transformational Leaderships, Spiritual leadership.

Unit IV

Transactional Analysis: Life Positions, Johari Window, Analysis of transactions, Understanding emotions and feelings. Stress: reasons and effects, identifying stress, the four A's of stress management, techniques, Approaches, Thinking and Problem Solving Skills, Green Human Resource Management & Sustainability.

Course Outcomes

After the completion of the course students will be able to gain the knowledge and skills that are required to effectively contribute to dynamic organizations. Students will be able to evaluate HRM related social, cultural, ethical and environmental responsibilities and issues in a global context.

Suggested Readings

- Robbins, S. P. (2004). Organizational Behavior. Pearson Education.
- Luthans, F. (2002). Organizational Behavior. McGraw-Hill International Edition.
- Pareek, Udai. (2004). Understanding Organizational Behavior. Oxford University Press.
- Kolb, D. (1991) Organizational Behavior: An Experiential Approach. 5th ed. Englewood Cliffs, New Jersey, Prentice Hall Inc.,
- Moore, MD, (1988) Inside Organizations: Understanding the Human Dimensions London, Sage
- Clifford T Morgan, Richard A King, John R Weiz, John Schopler (2009) Introduction to Psychology, Tata McGraw Hill
- R.K.Sahu (2010), Group Dynamics & Team Building, Excel Books

DEPARTMENT OF HUMANITIES &SOCIAL SCIENCES
B. Tech (Open Elective Course)
Course Title: Recent Trends in Economic Development

Course Category: OE | **Internal: 50 Marks**
Course Code: HSOE 402 | **Theory: 50 Marks**
Credits: 3 (L-3) | **Total: 100 Marks**
Semester: 7th | **Time: 3hrs**

Course Objectives

1. To enable the students to understand the context of development that how some countries have been able to address the poverty issues and some are not.
2. To familiarize the students with the possible means of realization of development goals of the countries.

Instructions for Examiner

The number of questions to be set will be five, one from each unit. The examinees will be required to attempt all five questions. All questions shall carry equal marks.

UNIT I: Concept of Economic Development and Growth

Economic Development: meaning, characteristics, determinants and strategies, International agendas of development: Millennium development goals (MDGs) and sustainable development goals (SDGs). Economic growth, recent debate of economic growth and development.

UNIT II: Agriculture and Economic Development

Role of agriculture in economic development in India, technology and agriculture: mechanization, varietal developments, cold storage and supply chain management.

UNIT III: Recent Developments Industrial

Role of industry in economic development, Trends and patterns of industrialization in India, new economic policy: national manufacturing policy, Make in India and Startups in India. Role of World Bank, International Monetary Fund, NITI Aayog, Structural Adjustment Program, Financial Reforms, Recent Tax Reforms.

Course Outcomes

The students will learn that why there are development differences across countries in the world. They will come to know the new paradigms of development mainly MDGs and SI3Gs. The paper will help the students to understand the possible means likewise agriculture, industries, institutions and finance for economic development.

Suggested Readings

1. Development Economics: SubrataGhatak Longman 1978
2. Agriculture and Economic Development: SubrataGhatak and Ken Ingersent, Select Book Service, Syndicate New Delhi
3. Indian Economy: AN Agrawal New Age India Publishers
4. Indian Economy: Ruder Datt& KPM Sundram, S Chand company Pvt Ltd

ELECTRICAL ENGINEERING DEPARTMENT

EEOE402 ELECTRICAL VEHICLE TECHNOLOGY

Pre-requisite: EEPC101, EEPC201, EEPC210

L	T	P	Credits	Total contact hours
3	0	0	3	42

Brief Description about the course: This course contains, introduction to Electrical Vehicles, EV Subsystems. Illustrate the various electric drive configurations and their architectures suitable for electric vehicles and Vehicle Dynamics. Various types of electric machines used in electric vehicles and variousenergy management strategies employed in electric vehicles.

Course Content

Unit – I **(7)**

Introduction to EV: Importance and need for electric vehicles (EV), history and evolution of automobile systems, technology and grid infrastructure side barriers in EV adoption, socio-economic barriers.Classification of EVs, types of hybrids and their operating modes, hybridization ratio.BEVs and their key components, FCEVs and their key components, solar EV, EV versus ICE, emissions due to the electrical grid.

Unit – II **(10)**

Vehicle Dynamics: Vehicle dynamics, vehicle load forces, aerodynamic drag, rolling resistance, climbing resistance.Estimation of BEV range and effect of auxiliary loads on range, downgrade force and regeneration, rated speed.Gradeability, vehicle acceleration, traction motor characteristics, simple drive cycle for vehicle comparisons.Downgrade force and regeneration, simple drive cycle.

Unit - III **(12)**

Power Electronic Converters and Electrical Machines in EV: Power electronics circuits used for control and distribution of electric power in DC-DC, AC-DC, DC-AC converters used for EV. Fundamental of Drives and Control of EV with DC motor, Induction Motor, Permanent Magnet Motor, Switched Reluctance Motor, BLDC motor, Design and Sizing of Traction Motors.

Unit – IV **(13)**

Energy Storage Devices and Management in EV: Overview of battery chemistries, EV battery and its required characteristics, cell, modules & pack. Battery terminologies: C-Rate, SOC, DOD, rated voltage, specific energy, specific power, cycle life, self-discharge. BOL, EOL. Charging characteristics of typical Lithium ion battery used in EVs. Hydrogen fuel cell based energy storage for EV, balance of plant (BOP), fuel cell polarization curve and power curve, fuel cell and plant efficiencies, sizing the fuel cell plant. Super-capacitor based energy storage and it's importance in BEV. EV charging: EV charging modes, DC fast charger - Operation, types, limitations. SAE J1772 connector, AC Level 1, 2 & 3 charging, Bharat AC-01 charger. EV charging standards: DC fast charging - CHAdeMO, CCS-combo 1, CCS-combo 2, GB/T, Bharat DC-02, GB/T charger, supercharger.

References/Textbooks:

1. John G. Hayes and G. AbasGoodarzi, "Electric Powertrain- Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles" John Wiley & Sons Ltd, 2018
2. Iqbal Husain, Electric and Hybrid Vehicles – Design Fundamentals, 2 ed., CRC Press, 2016.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, 2 ed., Wiley, 2012.
4. MehrdadEhsani, YiminGao, Sebastien E. Gay, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles – Fundamentals, Theory, and Design, CRC Press, 2005.

Course Outcomes

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

CO 1: Interpret the importance of electric vehicles, barriers in their adoption, and their Impact on power system.

CO 2: Illustrate the various electric drive configurations and their architectures suitable for electric vehicles and Vehicle Dynamics

CO 3: Discuss the various types of electric machines used in electric vehicles and various energy management strategies employed in electric vehicles

CO 4: Describe the different energy storage devices, battery charging-discharging Characteristics, and various AC and DC charging standards.

ELECTRICAL ENGINEERING DEPARTMENT

EEOE404 DIGITAL CONTROL SYSTEMS

Pre-requisite: EEPC101, EEPC204, EEPC208

L	T	P	Credits	Total contact hours
3	0	0	3	42

Brief Description: With the implementation of microprocessors, programmable logic devices and DSP chips as controllers in modern systemscorresponding knowledge of digital control systems is also required. This course provides asystematic approach for the vital theories required for appreciating the past and present status ofcontrol system

Course Contents:

Unit-I **(12)**

Introduction and signal processing: Introduction to digital control systemAnOverview of the Classical Approach to Analog ControllerDesign., Advantages of digital control, Configuration of the Basic Digital Control Scheme, Principles of Signal Conversion, Discrete-Time Signals,

Sample-and-hold systems: The Sampling operation, The Hold operation, Practical Sample-and-Hold Circuit, the sampling theorem, SampledSpectra and Aliasing, reconstruction of Analog Signals, Practical Aspects of the Choice of Sampling Rate, Principles ofDiscretization

Time-domain models for discrete-time systems, Transfer Function Models, Stability on the z-Plane andthe Jury Stability Criterion.

Unit-II **(10)**

Design of digital control: z-Plane Specifications of Control System Design, DigitalCompensator Design using Frequency Response Plots, Digital Compensator Design using Root Locus Plots, z-Plane Synthesis

Unit-III **(10)**

Control system analysis using state variable methods: State variable representation, conversion of state variablemodels to transfer functions, conversion of state variablemodels to transfer functions to canonical state variable models, Eigen values and eigen vectors, Concept of Controllability andObservability;

Unit-IV **(10)**

Case studies: Implementation of Digital Controllers, Tunable PID Controllers, Digital Temperature Control System, Digital Position Control System, Stepping Motors and Their Control, Programmable Logic Controllers

References/Textbooks:

1. M. Gopal, "Digital Control and State Variable Methods", McGraw Hill Education
2. Hemchandra Madhusudan Shertukde, "Digital Control Applications Illustrated with MATLAB" 2015, CRC Press
3. B. C. Kuo, "Digital Control Systems", Oxford University Press-New Delhi
4. Landau Landau, Zito Landau, "Digital Control Systems: Design, Identification and Implementation", Springer-Verlag
5. V. I. George, C.P. Kurian, " Digital Control Systems", Cengage Learning 6. K. Ogata, "Modern Control Engineering", Prentice Hall publication.

Course outcomes:

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

CO1 Learn the fundamentals of digital control systems and signal processing.

CO2 Knowledge to design digital controllers and asses their design through the constraint specifications.

CO3 Model and analyze digital system in state space

CO4 Learn the applications of digital control for various engineering problems.

ECOE-401 SENSORS

Pre-requisites:

L	T	P	Credits	Total contact hours
3	0	0	3	40

Brief Description:

In recent years, technological advances have resulted in the rapid development of a new and exciting research direction – the interdisciplinary use of sensors for data collection, systems analysis, and monitoring. These highly calibrated sensors require precision engineering techniques that play an important role in analyzing and integrating large datasets. Sensor networks in particular represent a very active area of research, including work on problems such as sensor network localization and network design. Application areas for sensors and sensor networks include environmental monitoring, military surveillance, computational neuroscience, seismic detection, and a great deal more. The fundamental problems of utilizing the collected data for efficient system operation and decision making encompasses multiple research areas, including applied mathematics, optimization, signal/image processing, as well as emerging areas that require interdisciplinary techniques from several fields of research.

Course Contents:

UNIT-I 10hrs.

Introduction to Sensors, Definition and types of sensors, Sensor characteristics: sensitivity, accuracy, resolution, range, and linearity

Transducers: conversion of physical quantities to electrical signals, Passive and active sensors, Analog and digital sensors, Classification of Sensors based on measurement principles: Temperature sensors, Pressure sensors, Proximity sensors, Motion sensors, Force and load sensors, Humidity sensors, Light sensors, Gas sensors, Chemical sensors, Biosensors

UNIT-II 10hrs.

Sensor Signal Conditioning, Signal conditioning techniques: amplification, filtering, and linearization, Noise reduction and interference rejection, Calibration and sensor characterization, Sensor Interfaces and Data Acquisition, Analog-to-digital conversion, Serial and parallel interfaces, Microcontrollers and microprocessors for sensor integration, Data acquisition systems and software

UNIT-III 10hrs.

Sensor Applications in Different Engineering Streams, Sensors in mechanical engineering: Accelerometers, Strain gauges, Position and displacement sensors, Vibration sensors, Flow sensors

Sensors in electrical engineering: Current and voltage sensors, Magnetic field sensors, Hall effect sensors, Power sensors, Radiation sensors

Sensors in civil engineering: Structural health monitoring sensors, Geotechnical sensors, Environmental sensors

Sensors in biomedical engineering: ECG and EEG sensors, Blood pressure sensors, Oxygen sensors, Glucose sensors, Prosthetic sensors

UNIT-IV 10hrs.

Sensor Integration and IoT Applications, Wireless sensor networks, Internet of Things (IoT) and sensor integration, Sensor fusion and data integration techniques

Emerging Sensor Technologies and Trends, Nanosensors, MEMS sensors, Wearable sensors, Energy harvesting sensors, Sensor networks for smart cities

Application to various sustainable technologies, case studies from the Indian knowledge system.

Reference books:

5. Sensors and Actuators, D. Patranabis, 2nd Ed., PHI, 2013.
6. Make sensors: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media, 2014.
7. Sensors handbook- Sabrie soloman, 2nd Ed. TMH, 2009
8. Handbook of Modern Sensors, J. Fraden, Fourth Edition, Springer
9. Instrument transducers, H. K. P. Neubert, OUP
10. Measurement systems: application & design, E. A. Doebelin, Mc Graw Hill

ECOE-402 FSM CONTROLLER DESIGN

Pre-requisites:ECPC22, Computer Organization and Architecture, Familiarity with a hardware description language

L	T	P	Credits	Total contact hours
3	0	0	3	36

Course Code	**:**	**CSOE 403**
Course Title	**:**	**Computer Networks**
Number of Credits and L/T/P scheme	**:**	**3 & 3 0 0**
Prerequisites (Course code)	**:**	
Course Category	**:**	**OE**

Course Learning Objectives:

1. Understand computer network basic, different models used for study of computer networks, ability to identify different designs, understanding of the issues surrounding wired and wireless Networks.
2. Design, calculate, and apply subnet masks to fulfil networking requirements and building the skills of routing mechanisms.
3. Analyse the features and operations of various application layer protocols such as Http, DNS, SMTP and FTP.
4. Analyse the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
5. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Course Content:

Unit 1: Introduction

History and development of computer networks, Network Functions, Network Topology, Network Services, Switching Approaches, Transmission media and systems, OSI Reference Model, Overview of TCP/IP architecture,

Unit 2: Physical, MAC and Data Link Layer

Different types of transmission media, errors in transmission: attenuation, noise, multiplexing and signalling techniques, Encoding (NRZ, NRZI, Manchester, 4B/5B, etc). Aloha, CSMA, CSMA/CD, CSMA/CA protocols, Ethernet, including Gigabit Ethernet and WiFi (802.11), Token Ring, Bluetooth and Zigbee. Error detection, Sliding Window, Stop and Wait protocols, ARQ, Sliding Window Protocols, HDLC, PPP protocols.

Unit 3: Network layer:

Internet Protocol, IPv6, ARP, DHCP, ICMP, Routing algorithms: Distance vector, Link state, Metrics, Inter-domain routing. Subnetting, Classless addressing, Network Address Translation, IPv4 to IPv6 Translation strategies, Packet network topology, Datagrams and Virtual Circuits, Structure of Switch/Router, Connectionless and Virtual Circuit packet Switching, Traffic management and QoS – FIFO, Priority Queues, Fair Queuing, MPLS.

Unit 4: Transport and Application layer:

UDP, TCP. Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions, etc. Client Server Model, HTTP, DNS, SMTP, FTP, and TFTP.

Text Books:

1. Behrouz A. Forouzan: Data Communications and Networks, Fifth Edition, McGraw Hill, 2017.
2. Leon Garcia and IndraWidjaja: Communication Networks – Fundamental Concepts and Key Architectures, Second Edition TMH.
3. A.S. Tanenbaum: Computer Networks, Sixth Edition, Pearson Education, 2022.
4. William Stallings: Data and Computer Communications 10/e, Pearson Education.

Course Outcomes:

At the end of the course student will be able to……

1. Understand computer network basic, different models used for study of computer networks, ability to identify different designs, understanding of the issues surrounding wired and wireless Networks.
2. Design, calculate, and apply subnet masks to fulfil networking requirements and building the skills of routing mechanisms.
3. Analyse the features and operations of various application layer protocols such as Http, DNS, SMTP and FTP.
4. Analyse the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
5. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

CEOE402 Ground Water Engineering

Pre-requisite: None

L	T	P/D	Credits	Total contact hours
3	0	0	3	3

Brief description of the course: The course is divided into four units, with Unit I covering aquifer properties, groundwater flow equations, exploration techniques, and determination of hydraulic properties. Unit II focuses on tube well design, construction, working, pumping equipment, and hydraulic testing. Unit III explores artificial recharge methods, Ghyben-Herzberg relation, and control of saltwater intrusion. Finally, Unit IV/V addresses urban water demand management, rainwater harvesting, groundwater modelling, and integrated water resources management and governance.

Course Content:

Unit-I (9 hrs)

Properties of Aquifers, Formation constants, compressibility of aquifers, Equation of motion for steady and unsteady ground water flow in isotropic homogeneous aquifers, Dupit's assumptions. Unconfined flow with a recharge, tiled train problem. Ground water exploration and methods of investigations. Effect of boundaries, interference of water, leaky aquifers, Thiem's equilibrium formula for unconfined and confined aquifers and determination of hydraulic properties of aquifers. Non equilibrium formula for aquifer (unsteady radial flows).

Unit-II (7 hrs)

Tube wells, optimum capacity, silting of tube well, design of tube wells in different aquifers, tube well types, parts, bore hole, strains, its types, well pipe, casing pipe, blind pipe. Construction and working of tube wells, site selection, drilling operation, cable tool method, hydraulic method, Rotary Method and drilling fluids, well screen assembly installation, verticality and alignment of tube wells, gravel packing, development of tube wells, sickness, corrosion and failure of tube wells, Pumping equipment and hydraulic testing of pumps.

Unit-III (11 hrs)

Artificial recharge of ground water, considerations and methods, recharge techniques induced infiltration, water spreading, flooding, basins, ditching, modification of natural channels, irrigation, recharge pits, shafts and recharge wells

Ghyben-Herzberg Relation between fresh and saline water shape and structure of fresh water and salt water interface, upcoming saline water, fresh water and salt water relations on oceanic islands Occurrence of saline water intrusion, Control of salt water intrusion, Recognition of sea water in the ground water.

Unit-IV (9 hrs)

Urban Water Demand Management: Investigate and develop sustainable strategies for managing water demand in urban areas, including efficient water use practices, conservation measures, and public awareness campaigns.

Rainwater Harvesting and Storm Water Management: Study the implementation of rainwater harvesting systems and sustainable storm water management techniques to recharge groundwater and reduce runoff in urban environments.

Groundwater Modelling and Simulation: Develop numerical models and simulation tools to assess the impact of urbanization on groundwater resources, evaluate different management scenarios, and optimize sustainable groundwater allocation strategies.

Integrated Water Resources Management & Policy and Governance

Note: The focus of concluding lectures should be to emphasize the value addition of the subject and also on how it impacts the environment. Further, the faculty may suggest possible sustainable solutions/emerging technologies/innovations towards sustainability in the subject domain.

Text Books/Reference:

1. Ground water Hydrology, D. K. Todd, John Wiley & Sons Inc. New York.
2. Groundwater, H.M. Raghunath, Wiley Eastern Ltd., N. Delhi
3. Karamouz, M, Ahmadi, A, and Akhbari, M, Groundwater Hydrology: Engineering, Planning and Management, CRC Press
4. Ground Water Hydrology, V.C. Aggarwal, PHI Learning Private Limited New Delhi
5. Davis, S.N., and De Weist, R.J.M., Hydrogeology, John Wiley & Sons, New York
6. Domenico, Concepts and Models in Groundwater Hydrology, McGraw Hill Inc. New York.

Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: Course imparts aquifer knowledge, flow equations, exploration, and data analysis for informed groundwater resource management.

CO2: Study consist of a comprehensive knowledge guides tube well design, construction, operation, and maintenance, improving efficiency, longevity, and performance.

CO3: Study outcomes on artificial groundwater recharge, Ghyben-Herzberg relation, and saltwater intrusion improve groundwater management, freshwater-saltwater dynamics understanding, and sustainable water resource management strategies.

CO4: Learning outcomes contribute to sustainable water management, urban water systems understanding, and policies promoting efficient water use and integrated water resources management.

CEOE404 Theory of Elasticity and Plasticity

Pre-requisite: None

L	T	P/D	Credits	Total contact hours
3	0	0	3	3

Brief description of the course: This course is a general introduction to the theory of elasticity. This is the single most important branch of solid mechanics. It encompasses the mechanical behavior of an enormous variety of engineering and natural materials and provides a template for the formulation of more advanced models of complex material behavior, such as plasticity, growth and thermos-mechanics. This course will cover: the basic concept of elasticity, its relationship to work and energy, the concepts of frame invariance and material symmetry, stress and strain relationship, Airy's stress function and its use in analysis of 2D problems as well as covers the plastic behaviour and application of failure theories to brittle and ductile materials.

Course content:

UNIT 1: (06)

Basic concepts of deformation of bodies – deformation gradient- Tensor notations of stress and strain in 3D field - Traction - Engineering and Cauchy stress and Green- Lagrange Strains - Cauchy form of equilibrium equation - Transformation of stress and strain in a 3D field - Equilibrium equations in 2D and 3D Cartesian coordinates

UNIT 2: (10)

Concept of Orthogonal Transformation of axes and Problems, Determination of Stress invariants Compatibility equations - Stresses: Principal, Octahedral, Hydrostatic and deviatoric - Derivation of Constitutive law - reduction to isotropic and uniaxial case.

Concept of Strain at a point, Determination of Normal and Shear Strain, Generalized Hooke's Law and problems on interrelationship between stress and Strain in three dimensions.

UNIT 3: (08)

Formulation of a stress analysis problem using the necessary and sufficient conditions in three dimensions and modifying the same to identify the unknowns in plane cases, Derivation of Airy's Stress function using the boundary conditions, equilibrium equations, compatibility conditions. Plane stress and plane strain problems - 2D problems in Cartesian coordinates as applied to beam bending using Airy's stress function and examples - Problems in 2D

UNIT 4: (06)

Torsion of non-circular sections - St. Venant's theory – Torsion of elliptical sections - Torsion of triangular sections - Prandtl's membrane analogy - Torsion of rolled profiles - Torsion of thin walled tubes

UNIT 5: (06)

Plasticity – Introduction - Reasons of plasticity - slip lines - Plastic stress-strain relations - Flow rules (associated and non associated) - Different hardening rules - Yield criteria for ductile and brittle materials - Graphical representation of yield criteria.

Note: The focus of concluding lectures should be to emphasize the value addition of the subject and also on how it impacts the environment. Further, the faculty may suggest possible sustainable solutions/emerging technologies/innovations towards sustainability in the subject domain.

Text Books/Reference:

1. Srinath, L.S., Advanced Mechanics of Solids, Tata McGraw Hill, 2010
2. Schmidt, R.J. and Boresi, A.P., Advanced Mechanics of Materials, Wiley, 2002
3. Hibbeler, R.C., Mechanics of Materials, Pearson, 2016
4. Timoshenko, S.P. and Gere, J.M. Mechanics of Materials, Tata McGraw Hill, 1992
5. Rees, D.W.A., Basic Engineering Plasticity, Butterworth-Heinemann, 2006
6. Sadhu Singh, Applied Stress Analysis, 4th Edition, Khanna Publishers, New Delhi.
7. J.W. Dally and W. F. Riley, Experimental Stress Analysis, 3rd Edition, Mc Gram Hill.

Course Outcomes:

On completion of the course, the students will be able to

1. Relate various stress and strain measures and perform transformation between different bases.
2. Determine principal, hydrostatic and octahedral stresses for given stress state.
3. Obtain the solution to classical problems using the Airy stress function approach.
4. Understand the behaviour of non-circular and open sections in torsion.
5. Gain a basic introduction to the plastic behaviour in materials and application of failure theories of brittle and ductile materials.

B. Tech. 7th Semester

Course Code	**:**	**CHOE401**			
Course Title	**:**	**Metals and Alloys**			
Number of credits	**:**	**L**	**T**	**P**	**Total**
		3	**0**	**0**	**3**
Prerequisites (Course code)	**:**	**Enrolling students must have studied one Chemistry Paper in B. Tech. First Year**			
Course Type	**:**	**OE**			

Course Learning Objectives:

- To enable the students to acquire knowledge of the importance and significance of metals and alloys for engineering applications.
- To bring adaptability to new developments in engineering chemistry and a knowledge of contemporary issues relevant to engineering.
- To make them apply the knowledge of fundamental chemistry for identification, solution and analysis of complex engineering problems that meet the specified needs with appropriate consideration for the industrial applications.

Course Content:

Unit 1: Introduction to Metals and Alloys

Historical development, modern and major use of metals, mineral deposits, agglomeration (pelletizing, sintering), metal extraction and refining (pyrometallurgy, hydrometallurgy, electrometallurgy), methods to enhance mechanical properties in metals (alloying, cold working, heat treatment), purpose of alloying, classification of alloys according to their use, ferrous alloys, non-ferrous alloys, bonding theory for metals and alloys, phase rule, chemistry of precious metals, environmental issues. **(12L)**

Unit 2: Metal Alloys

Preparation, properties, applications, alloy steels, primary-metal alloys (copper, lead, zinc, tin, nickel), light-metal alloys (beryllium, magnesium, aluminum, titanium), other alloy systems, their applications. **(12L)**

Unit 3: Alloys with Apecial Properties

Dental alloys, surgical implants, low-expansion alloys, spring alloys, magnetic recording alloys, nuclear reactor alloys, magnetic alloys, superalloys (high temperature alloys), their applications. **(8L)**

Unit 4: Characterization of Alloys

Strengthening and toughening of alloys, mechanical properties (tension, compression, hardness, bending, torsion-shear, impact, creep and stress rupture, fatigue, fracture, etc.), characterization of steel and copper alloys, characterization of thin layer and coatings, characterization of materials used in medical treatment, welding-joining and industrial applications. **(8L)**

Reference Books:

1. Bonding Theory for Metals and Alloys, Frederick E. Wang, Elsevier, 2005.
2. Metals and Alloys: Industrial Applications, Mark Anthony Benvenuto, De Gruyter, 2016.
3. Chemistry of Precious Metals, S. A. Cotton, Blackie Academic & Professional, Chapman & Hall, 1997.
4. Mechanical Properties and Working of Metals and Alloys, Amit Bhaduri, Springer Nature, 2018.
5. Characterization of Metals and Alloys, Ramiro Pérez Campos, Antonio Contreras Cuevas, Rodrigo A. Esparza Muñoz, Springer International Publishing, 2017.
6. Modern Physical Metallurgy and Materials Engineering, Sixth Edition, R. E. Smallman, R. J. Bishop, Reed Educational and Professional Publishing Ltd 1995, 1999.
7. The Extraction and Refining of Metals, Colin Bodsworth, CRC Press, Inc., 1994.
8. Mineral Processing and Extractive Metallurgy, 100 Years of Innovation, Corby G. Anderson, Robert C. Dunne, John L. Uhrie, Society for Mining, Metallurgy & Exploration Inc., 2014.
9. Modern Physical Metallurgy, Eighth Edition, R. E. Smallman, A. H. W. Ngan, Elsevier Ltd., 2014.
10. Recovery and Refining of Precious Metals, C. W. Ammen, Springer Science Business Media New York, 1984.

Course Outcomes:

Upon successful completion of this curriculum students will be able to:

CO-1	Gain the basic knowledge of metals and alloys and their applications in day to day life.
CO-2	Understand the importance of alloys in various industrial applications.
CO-3	Learn the fundamental principles of metallurgy.
CO-4	Apreciate the mechanical properties of various alloys and the characterization techniques.

UNIT-IV (7 Hours)

Potential Applications: Applications of Nanomaterials: Data storage, Water purification, Photocatalytic degradation, Targeted drug delivery, Hyperthermia, Solar energy conversion and catalysis, Molecular electronics and nanoelectronics, Nanomedicine and Nanobiotechnology: Nanotoxicology challenges, Cosmetics, Building construction, Heat transfer etc.

Course Outcomes:

At the end of the course students will be able to:

CO1: Engineer the properties of materials at the nanoscale.

CO2: Synthesize and characterize the nanomaterials of different shapes and sizes.

CO3: Design and develop the various devices at the nanoscale.

Text Books/Reference Books:

1. Pradeep T., "**A Textbook of Nanoscience and Nanotechnology**", Tata McGraw Hill Education Pvt. Ltd., 2012.
2. Hari Singh Nalwa, "**Nanostructured Materials and Nanotechnology**", Academic Press, 2002.
3. Nabok A., "**Organic and Inorganic Nanostructures**", Artech House, 2005.
4. Dupas C., Houdy P., Lahmani M., "Nanoscience: Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.

DEPARTMENT OF PHYSICS

(B. TECH: VII Sem.)
(OPEN ELECTIVE)

PHOE402: PHYSICS OF ENERGY HARVESTING TECHNOLOGIES

L	T	P	Credits	Total contact hours
3	0	0	3	36

Pre-requisite: **PHIC101**

Brief Description about the course: This course discus about the various energy harvesting approaches, basic physics behind it and their hybrid approaches to design various emerging energy harvesting systems.

Course Content

UNIT-I (9 Hours)

Introduction to energy harvesting, Available energy, Experimental characterization techniques, Wind energy, Applications.

Photovoltaic energy harvesting: Background physics, Solar cell design and strategies for optimizing figure of merit, Various types of solar cells, Future directions.

UNIT-II (8 Hours)

Thermoelectric energy harvesting: Background physics, Semiconductors and thermoelectrics, Bulk thermoelectric materials performance, Strategies for optimizing figure of merit (ZT), Thermoelectric modules, Future directions.

UNIT-III (9 Hours)

Piezoelectric energy harvesting: Background physics, Piezoelectric harvester design, Modeling of piezoelectric harvesters, Strategies for optimizing figure of merit, Future directions

Magnetostrictive energy harvesting: Background physics, Magnetostrictive harvester design, Modeling of magnetostrictive harvesters, Strategies for optimizing figure of merit, Future directions.

UNIT-IV (10 Hours)

Hybrid and emerging energy harvesting approaches: Solar-thermal energy harvesting, energy for garbage, emerging nanotechnology based approaches of energy harvesting and applications.

Other energy harvesting approaches: Bio-inspired energy harvesting approaches, Dielectric elastomer based harvesters, Electrostatic energy harvesters, Electrets based harvesters and applications in sustainable technologies, Waste to energy.

Course Outcomes:

At the end of the course students will be able to:

CO1: Apply the ideas of physics for various energy harvesting approaches.

CO2: Analyze practical problems on various energy harvesting techniques.

CO3: Design and develop the energy harvesting systems.

Text Books/Reference Books

1. D. M. Rowe (Ed.), **"Thermoelectrics Handbook- Macro to Nano"**, CRC Press, 2005
2. Antonio Luque and Steven Hegedus, **"Handbook of Photovoltaic science and engineering"**, Wiley, 2010
3. T. J. Kazmierski and S. Beeby, **"Energy Harvesting Systems: Principles, Modeling and Applications"**, Springer-Verlag, 2011
4. S. Priya, D. J. Inman (Eds.), **"Energy Harvesting Technologies"**, Springer, 2009