Evaluation Reforms NEP 2020

2nd Year Bachelor of Engineering

OPEN ELECTIVE-1 (Sem.-4) SYLLABUS

Shroff S R Rotary Institute of Chemical Technology,

Ankleshwar

EFFECTIVE FROM A.Y. 2026-2027

Open Elective - I (Semester – IV)

(Open Electives)

Sr. No.	Course Code	Course	Offered by (Department)
1	BMEOE441	Basics of Maintenance Engineering	Mechanical Engineering
2	BEVOE441	Industrial Wastewater Treatment	Environmental Science & Technology
3	BCHOE441	Introduction to Chemical Industry	Chemical Engineering
4	BITOE441	IT for Sustainability	Information Technology
5	BCTOE441	Materials Engineering	Chemical Technology (All Programs)
6	BEEOE441	Fundamentals of Renewable Energy Technologies	Electrical Engineering
7	BCOOE441	Emerging Technologies	Computer Engineering

UPL University of Sustainable Technology
Shroff S. R. Rotary Institute of Chemical Technology
B.E. Semester IV
Basics of Maintenance Engineering (BMEOE441)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	0	2	2	50	50	0	0	100

COURSE OVERVIEW:

This course introduces the fundamentals of maintenance engineering with emphasis on reliability, maintainability and modern maintenance practices such as TPM. It covers maintenance planning, scheduling, lubrication and human factors affecting maintenance performance. The course develops the ability to analyze failures, improve equipment effectiveness and apply systematic maintenance strategies in industrial systems, ensuring enhanced safety, reliability and productivity.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs
	SECTION-A		
1	**Fundamentals of Maintenance Engineering**: Definition, objectives and scope of maintenance engineering, Role and significance of maintenance in industrial and process plants, Evolution of, maintenance from reactive to proactive approaches, Classification of maintenance, Basic maintenance functions, Maintenance organization structure and its importance	1	5
2	**Reliability and Maintainability of Engineering Systems:** Concept and definition of reliability and maintainability, Importance in industrial systems, Failure concepts and classification of failures, Bath tub curve, Reliability terms and measure such as Mean Time Between Failures (MTBF), Mean Time To Failure (MTTF) and Mean Time To Repair (MTTR, Maintainability concept, Factors affecting maintainability, Reliability and maintainability improvement techniques	2	5
3	**Total Productive Maintenance (TPM):** Concept and objectives of TPM, Evolution and need of TPM in industries, Principles and key features of TPM, TPM pillars, Roles of operators and maintenance personnel, Concept of Overall Equipment Effectiveness (OEE), Benefits and limitations of TPM, Implementation steps of TPM in industries.	3	5
	SECTION-B		
4	**Maintenance Planning and Scheduling:** Introduction , Strategic Planning in Maintenance, Medium Range Planning, Short Range Planning , Maintenance Scheduling, Elements of	4	5

	Sound Scheduling, Maintenance Job Priority System, Scheduling Techniques, Scheduling Using Computers		
5	**Introduction: Friction, Wear and Lubrication:** Concepts of friction and wear, types and mechanisms of wear, Purpose of lubrication and lubrication regimes (boundary, mixed, hydrodynamic). Characteristics of lubricants: viscosity, viscosity index, oxidation stability, flash point. Classification of lubricants and types of lubricating oils, Applications of lubricants in industrial machinery, Lubricant testing and test methods, Lubricant storage and handling practices, Safety and health hazards, Environmental regulations related to lubricant use and disposal.	5	5
6	**Human Errors in Maintenance:** Concept of human error and its role in maintenance activities, Types of errors such as slips, lapses, mistakes, and violations, Common causes such as lack of training, fatigue, poor communication, time pressure and inadequate supervision, Impact on safety, reliability, productivity and equipment performance, human reliability concept, Methods for minimizing errors including training and skill development, standard operating procedures (SOPs), use of checklists, proper documentation, ergonomic work design, supervision, and safety awareness.	6	5

LIST OF PRACTICALS/TUTORIALS: N/A

TEXT BOOKS:

1. S.K. Srivastava, Maintenance Engineering: Principles, Practices and Management, S. Chand & Company Ltd., New Delhi.
2. R.C. Mishra & K. Pathak – Maintenance Engineering and Management (PHI Learning).

REFERENCE BOOKS:

1. B.S. Dhillon – Engineering Maintenance: A Modern Approach, CRC Press / Taylor & Francis.
2. R.K. Mobley (Ed.) – Maintenance Engineering Handbook, McGraw-Hill.
3. Mohammad Ben-Daya, Uday Kumar & D.N.P. Murthy – Handbook of Maintenance Management and Engineering, Springer
4. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.
5. Hand Book of Reliability Engineering & Management: W. Grant Ireson and Clyde F McGraw Hill.
6. Maintenance Planning & Control: Anthony Kelley – East West Press.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112105232

COURSE OUTCOMES:

CO1	**Describe** basic concepts, types and functions of maintenance engineering.
CO2	**Explain** reliability, maintainability and types of failures in engineering systems.
CO3	**Apply** TPM principles and evaluate equipment effectiveness using OEE for industrial systems.
CO4	**Analyze** maintenance planning, scheduling techniques and job prioritization for effective resource utilization.

CO5	**Assess** friction, wear mechanisms and lubrication practices to enhance performance and reduce equipment failure.
CO6	**Design** strategies to minimize human errors and improve safety, reliability and maintenance performance.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Industrial Wastewater Treatment (BEVOE441)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	0	2	2	50	50	00	00	100

COURSE OVERVIEW:

- This course provides a comprehensive understanding of the generation, characteristics, treatment, and management of industrial wastewater.
- The course equips students with the knowledge and skills required to design, analyse, and implement effective industrial wastewater treatment systems, ensuring environmental protection and sustainable industrial development.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs (30)
	SECTION-A		
1	**Industrial wastewater:** Industrial wastewater characteristics, Effects on environment, Stream standards, Effluent standards for discharge into surface water, public sewers, onto land for irrigation, Scenario in India, Regulatory requirements for industrial wastewater, Volume reduction, and Strength reduction methods, Waste minimization strategies.	1	05
2	**Physical and Chemical Treatment process:** Design of preliminary and primary treatment operations: screens, grit chambers, skimming tank, primary and secondary sedimentation tanks. Coagulation and flocculation, neutralization, precipitation (heavy metals removal), oxidation and reduction processes, disinfection methods, removal of nitrogen and phosphorus, boiler water and cooling water treatment methods.	2	05
3	**Biological Treatment Processes**: Types, Attached Growth Processes: Trickling Filters (Standard Rate, High Rate), Rotating Biological Contactors, Suspended Growth Processes. **Advanced Treatment Technologies**: Membrane processes, Adsorption, Ion exchange, Advanced oxidation processes, treatment for strong industrial waste: Incineration, Evaporation: Natural & forced evaporation	3	05
	SECTION-B		
4	**Sludge Treatment and Disposal:** Sludge Thickening, Aerobic and Anaerobic Sludge Digestion Processes, Design of Digester Tank, Sludge Dewatering, Ultimate Disposal, Sludge Drying Beds, Other Methods of Sludge Treatment	4	04
5	**Pollution Control in Industries:** Manufacturing process, Identification & characterization of sources of wastewater, treatment	5	05

	of wastewater including recycling & reuse concepts in textile industry, pharmaceutical industry, dairy industry, sugar industry, fertilizer industry, tannery, distillery, pulp & paper industry, petrochemical industry, dye & dye intermediate.		
6	**Reuse of industrial wastewater**: Quality requirements for reuse, Zero effluent discharge systems, Individual and common effluent treatment plants: technical and financial aspects.	6	06

TEXT BOOKS:

1. Industrial Waste Treatment by Nelson Leonard Nemerow, Butterworth-Heinemann, 2007
2. Industrial Waste Treatment by A.D Patwardhan

REFERENCE BOOKS:

1. Wastewater Treatment – Concepts and Design Approach, by G L Karia and R A Christian, Prentice Hall of India,2006
2. Environmental Engineering by Gerard Kiely, McGraw Hill Education (India) Pvt Ltd, 2013
3. Environmental Engineering – A Design Approach by A. P. Sincero and G A Sincero, Prentice Hall of India,2014
4. Environmental Pollution and Control in Chemical Process Industries by S.C. Bhatia

ONLINE RESOURCES:

- https://nptel.ac.in/

COURSE OUTCOMES:

After Learning this course, Students will be able to:

CO 1	**Identify** the characteristics of industrial wastewaters
CO 2	**Design** and evaluate physical and chemical treatment units
CO 3	**Assess** and design biological treatment systems
CO 4	**Design** and analyze sludge treatment and disposal systems
CO 5	**Compare** and recommend treatment strategies for specific industries
CO 6	**Evaluate** the feasibility of industrial wastewater reuse, design Zero Liquid Discharge (ZLD) systems

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Introduction to Chemical Industry (BCHOE441)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	0	2	2	50	50	00	00	100

COURSE OVERVIEW:

The chemical industry plays a vital role in producing materials and products essential for modern society. This course provides a broad overview of the structure and functioning of the chemical industry for students from various engineering disciplines. It introduces key concepts such as raw materials and feedstocks, basic process operations and major sectors including inorganic chemicals, petrochemicals, polymers, fertilizers, and pharmaceuticals. Students will gain an understanding of how chemical industries operate, their environmental and sustainability considerations, and the role of engineers in modern chemical manufacturing systems.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs (30)
	SECTION-A		
1	**Overview & Fundamentals of Chemical Industry:** Introduction to chemical industry, Scope and role of engineers in chemical industry, Classification of chemical industries, Raw materials & feedstock - fossil, bio-based, mineral; supply chains, Plant layout & process flow diagrams (BFD, PFD).	1	3
2	**Core Process Concepts:** Unit operations and unit processes, Fundamental principles and concepts in Stoichiometry, fluid flow operations, Mechanical operations, Heat exchange equipment, Reactor types, Separation processes, Process control, and Process safety.	2	8
3	**Inorganic Chemical Industries:** Chloro-alkali industry, Sulfuric acid manufacturing, Nitrogen & ammonia industry, Cement & glass industries.	3	4
	SECTION-B		
4	**Organic & Petrochemical Industries:** Petroleum refining processes, Petrochemical building blocks like ethylene, propylene, Polymer industry; polymerization types & processing of PE, PP, PVC, PET, Dyes, pigments & surfactants, Pharmaceutical industry.	4	6
5	**Agrochemical, Food & Specialty Chemicals:** Fertilizer industry - NPK, urea, DAP, Pesticide & herbicide industry, Food & flavour chemicals, fermentation, Paints, coatings & adhesives - binder/pigment/solvent system.	5	4

6	**Environment, Sustainability & Industry Trends:** Industrial pollution & ETP - air, water, solid waste; CPCB norms Renewable & bio-based chemicals - bioethanol, biodiesel, circular economy, Carbon footprint & life cycle assessment, , Indian chemical industry clusters, Digitalization & Industry 4.0 - IoT, digital twin, AI in process optimization, Career pathways & emerging technologies.	6	5

TEXT BOOKS:

1. Shreve, R. N., and Austin, G. T., *Shreve's Chemical Process Industries*, 5th Edition, McGraw-Hill International Edition, New York, 1984.

REFERENCE BOOKS:

1. Ghosal, S. K., Sanyal, S. K., & Dutta, S., Introduction to Chemical Engineering, Tata McGraw-Hill, New Delhi, 1998.
2. Dryden, C. E.; Rao, M. G.; Sittig, M. (Eds.), Dryden's Outlines of Chemical Technology (For the 21st Century), 3rd Edition, Affiliated East-West Press, New Delhi, 1997 / 2016.

ONLINE RESOURCES:

- https://nptel.ac.in/courses/103107081

COURSE OUTCOMES

CO1	**Understand** the structure, classification, and role of the chemical industry and its raw material supply chains.
CO2	**Explain** basic chemical engineering concepts including unit operations and unit processes.
CO3	**Describe** major inorganic chemical industries and their industrial significance.
CO4	**Identify** key processes and products in organic, petrochemical, polymer, and pharmaceutical industries.
CO5	**Discuss** the role and applications of agrochemical, food, and specialty chemical industries.
CO6	**Evaluate** environmental issues, sustainability practices, and emerging trends in the chemical industry.

UPL University of Sustainable Technology

Shroff S R Rotary Institute of Chemical Technology

B.E. Semester IV

IT for Sustainability (BITOE441)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	0	2	2	50	50	0	0	100

PREREQUSITE:

Students should have a basic understanding of computer fundamentals, including hardware, software, and operating systems, along with familiarity with internet technologies and digital tools. Basic knowledge of programming concepts, data handling, and databases is recommended. Additionally, an introductory awareness of environmental studies and sustainability concepts, along with logical reasoning and problem-solving skills, will help students effectively understand and apply Information Technology for sustainable development.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (30)
	SECTION-A		
1	**Introduction to Sustainability & Environment:** Definition, scope, and importance of sustainability ,Concept of sustainable development(SDGs), Multidisciplinary nature of environmental studies, Ecosystem: structure, functions, energy flow, food chain & food web,Role of humans in environmental degradation and protection	1	4
2	**Natural Resources & Sustainable Management:** Types of natural resources(Renewable & non-renewable, Water, forest, mineral, food, and energy resources), Resource depletion and conservation techniques, Sustainable resource management practices, Role of individuals in conservation	2	5
3	**Environmental Issues & Climate Change:** Environmental pollution (air, water, soil, noise),Global warming and greenhouse effect, Climate change and its impacts, Waste management and recycling, Disaster management and environmental risks	3	6
	SECTION-B		
4	**Role of Information Technology in Sustainability:** Green computing and energy-efficient systems, Role of IT in environmental monitoring (IoT, sensors), GIS (Geographic Information Systems) and Remote Sensing, Big Data and AI in environmental analysis, Smart cities and sustainable technologies	4	4
5	**Sustainable IT Practices & E-Waste Management:** Green IT infrastructure (low energy computing, cloud optimization),	5	5

	Sustainable software engineering practices ,E-waste(sources, impacts, and management using IT), Recycling and circular economy concepts , Corporate sustainability & ESG practices		
6	**Case Studies & Applications :** IT-Enabled Environmental Laws and Digital Policy Frameworks Ethical Computing and Corporate Social Responsibility in IT, Role of IT in Governance, NGOs, and Citizen Participation **,** Information Technology for Sustainable Development Goals (SDGs) Green Technologies and Emerging IT Careers in Sustainability	**6**	**4**

TEXT BOOKS:

1. Mohammad Dastbaz, Colin Pattinson, Babak Akhgar, Green Information Technology: A Sustainable Approach, Morgan Kaufmann.
2. San Murugesan, G. R. Gangadharan, Harnessing Green IT: Principles and Practices, Wiley.

REFERENCE BOOKS:

1. Mike Halsey, The Green IT Guide: Ten Steps Toward Sustainable and Carbon-Neutral IT Infrastructure, 1st Edition, Apress.
2. Jorge Marx Gómez, Susanne Strahringer, Frank Teuteberg, Green Computing & Sustainability, 1st Edition, dpunkt Publishers.

ONLINE RESOURCES:

1. https://www.unesco.org/en/en/green-digital-transformation
2. https://www.perlego.com/book/4913299/green-computing-for-sustainable-development-pdf
3. https://www.unesco.org/en/sustainable-development/education/greening-future/curriculum
4. https://openlearning.unesco.org/courses/course-v1%3AUNESCO%2BED-003_ENG%2B2025_T1_ENG

COURSE OUTCOMES:

CO1	**Understand** the concepts of sustainability, environmental systems, and their relevance to Information Technology.
CO2	**Analyze** the impact of IT systems on natural resources and apply sustainable practices for resource management.
CO3	**Identify** environmental issues and evaluate how IT tools (AI, IoT, Data Analytics) can be used to address them.
CO4	**Apply** principles of green computing and sustainable software development to minimize environmental impact.
CO5	**Examine** environmental policies, ethics, and social responsibilities in the context of Information Technology.
CO6	**Explore** Sustainable Development Goals (SDGs) and emerging green technologies to develop sustainable IT-based solutions and career pathways.

UPL University of Sustainable Technology
Shroff S R Rotary Institute of Chemical Technology
B.E. Semester IV
Materials Engineering (BCTOE441)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		E	M	I	V	Total
2	0	0	2	02	50	50	0	0	100

COURSE OVERVIEW: This course introduces the fundamental principles of structure– property–processing–performance relationships in engineering materials, based on Foundations of Materials Science and Engineering. It covers atomic structure, bonding, crystal systems, defects, and diffusion, followed by phase diagrams and transformations. Students learn the mechanical behaviour of materials, major classes of materials (metals, ceramics, polymers, composites), and key aspects of corrosion and degradation, with emphasis on applications in chemical industries.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs. (30)
	SECTION-A		
1	**Unit 1: Introduction & Atomic Structure** • Classification of materials (metals, ceramics, polymers, composites) • Structure–property–processing relationship • Atomic structure and periodic table • Interatomic bonding: ionic, covalent, metallic, van der Waals	1	5
2	**Unit 2: Crystal Structure and Imperfections** • Crystal systems and unit cells • FCC, BCC, HCP structures • Atomic packing factor, density • Miller indices (planes & directions) • Imperfections: point, line (dislocations), surface defects • Slip systems and plastic deformation basics	2	5
3	**Unit 3: Diffusion and Phase Diagrams** • Diffusion mechanisms (vacancy, interstitial) • Fick's First and Second Laws • Temperature dependence of diffusion • Phase diagrams: unary and binary systems • Isomorphous and eutectic systems • Lever rule	3	5

	SECTION-B		
4	**Unit 4: Mechanical Properties and Deformation** • Stress–strain behavior • Elastic and plastic deformation • Hardness, toughness, ductility • Strengthening mechanisms • Creep, fatigue, fracture	3,4	5
5	**Unit 5: Materials: Metals, Ceramics, Polymers, Composites** • Ferrous and non-ferrous alloys • Ceramics and glasses • Polymers: thermoplastics, thermosets, elastomers • Composite materials • Structure–property–application relationships	4,5	5
6	**Unit 6: Corrosion, Degradation and Applications** • Electrochemical corrosion • Types of corrosion (galvanic, pitting, etc.) • Oxidation and degradation • Prevention techniques • Materials selection in chemical industries	5,6	5

TEXT BOOKS:

1. Materials Science and Engineering - Callister W.D.
2. The Science and Engineering of Materials - Askeland & Phule
3. Introduction to Materials Science - Shackelford

ONLINE RESOURCES:

NPTEL	Video lectures, notes, assignments
MIT Open Courseware	Lecture notes, assignments, exams
edX/MITx	Online courses (MOOCs)
Youtube Channel	Video lectures
Nano Hub	Simulations, tools, tutorials

COURSE OUTCOMES:

CO1	Explain the fundamentals of atomic structure, bonding, and classification of engineering materials.
CO2	Describe crystal structures, defects, and diffusion mechanisms, and relate them to material behavior.
CO3	Interpret phase diagrams and phase transformations for analyzing material processing and stability.
CO4	Analyze mechanical properties and deformation mechanisms of materials under different loading conditions.
CO5	Evaluate corrosion, degradation, and failure mechanisms in engineering materials and suggest preventive measures.
CO6	Select appropriate materials for engineering applications based on structure– property relationships and service requirements.

UPL University of Sustainable Technology

Shroff S R Rotary Institute of Chemical Technology

B.E. Semester IV

Fundamentals of Renewable Energy Technologies (BEEOE441) [OE-1]

Teaching and Examination Scheme:

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	0	2	2	50	50	0	0	100

COURSE OVERVIEW: This course provides a comprehensive introduction to renewable energy technologies, focusing on the principles, characteristics, and applications of various energy sources such as solar, wind, biomass, and hydro. It emphasizes the role of sustainable energy systems in addressing global energy demands, environmental concerns, and energy security. The course also covers basic system design, integration, and emerging trends in renewable energy to equip learners with the knowledge required for modern energy solutions.

COURSE CONTENT

Sr. No.	Topics	COs	Hrs (30)
	SECTION-A		
1	**Scenario of Renewable Energy and Distributed Energy Systems:** Need for renewable energy, advantages and limitations, global and Indian energy scenario, comparison between renewable and non-renewable energy sources, and environmental and sustainability aspects. Concept of distributed energy systems, need for hybrid use of renewable sources, importance of energy storage, and basic idea of standalone and grid-connected systems.	1	4
2	**Solar Energy:** Solar radiation basics, measurement methods and instruments. Conversion of solar energy into electrical energy using photovoltaic effect, working principle and types of solar cells, and basic configurations. Applications such as solar power plants and street lighting. Conversion of solar energy into thermal energy, types of solar collectors and their applications, including solar cookers and water heating systems.	2	6
3	**Bio Energy:** Biomass as a renewable energy source, basic conversion technologies, biomass gasification, and types of gasifiers. Biogas production and types of biogas plants, along with advantages, limitations, and applications of bioenergy.	3	5
	SECTION-B		
4	**Wind Energy:** Basic principles of wind energy, power in wind, working of wind turbines, and energy conversion. Components and classification of	4	4

	wind energy systems, advantages and limitations, and applications such as electricity generation and wind pumps.		
5	**Ocean Thermal Energy:** Introduction to ocean thermal energy, working principle of Ocean Thermal Energy Conversion (OTEC), resource and site requirements. Open and closed cycle systems, advantages and limitations, and applications.	5	6
6	**Geothermal, Wave Energy:** Geothermal energy resources, methods of harnessing geothermal energy, advantages, limitations, and applications. Basics of wave energy, wave motion, wave energy conversion devices, and their advantages, limitations, and applications.	6	5

TEXT BOOKS:

1. *Renewable Energy Resources*, G.N. Tiwari and M.K. Ghosal, Narosa Publishing House.
2. *Non-Conventional Energy Sources*, G.D. Ray, Khanna Publications.
3. *Renewable Energy Resources*, John Twidell and Tony Weir, Taylor & Francis.

REFERENCE BOOKS:

1. Solar Energy: Principles of Thermal Collection and Storage, S.P. Sukhatme and J.K. Nayak, Tata McGraw-Hill, New Delhi.
2. Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
3. *Renewable Energy*, Godfrey Boyle, Oxford University Press.
4. *Handbook* of Renewable Energy Technology, Ahmed and Zobaa, R.C. Bansal, World Scientific, Singapore.

ONLINE RESOURCES:

1. NPTEL Solar Energy Engineering Course: https://nptel.ac.in/courses/121106014
2. NPTEL: *Non-Conventional Energy Resources* https://nptel.ac.in/courses/108105058

COURSE OUTCOMES

After the completion of the course the student should be able to:

CO1	Explain the need, scope, and comparative aspects of renewable and conventional energy systems, including distributed energy concepts.
CO2	Describe solar energy systems, including photovoltaic and thermal technologies, and their applications.
CO3	Examine biomass energy conversion processes and summarize their applications.
CO4	Analyse the operation and performance of wind energy conversion systems.
CO5	Evaluate ocean thermal energy systems based on their working principles and applications.
CO6	Differentiate geothermal and wave energy systems and assess their potential for energy generation.

UPL University of Sustainable Technology

Shroff S R Rotary Institute of Chemical Technology

B.E. Semester IV

Emerging Technologies (BCOOE441)

Teaching Scheme (Hrs./week)				Credit	Examination Scheme				
L	T	P	Total		SEE	CCE	I/TW	V	Total
2	0	0	2	2	50	50	0	0	100

PREREQUSITE:

Students should have a basic understanding of computer fundamentals including hardware, software, and operating systems, along with introductory knowledge of programming concepts in languages such as C, Python, or Java. Familiarity with basic data handling, databases, and computer networks is recommended. Additionally, students should possess fundamental mathematical and logical reasoning skills, including basic statistics and problem-solving abilities, to effectively understand and apply concepts in emerging technologies.

COURSE CONTENT:

Sr. No.	Topics	COs	Hrs (30)
	SECTION-A		
1	**Introduction to Emerging Technologies:** Definition and characteristics of emerging technologies, Evolution of technology and digital transformation, Role of emerging technologies in Industry 4.0, Impact on society, economy, and education, Overview of key technologies (AI, IoT, Blockchain, Cloud, etc.)	1	4
2	**Artificial Intelligence & Machine Learning:** Introduction to Artificial Intelligence (AI) , Types of AI (Narrow, General, Super AI), Basics of Machine Learning (Supervised, Unsupervised, Reinforcement Learning), Applications of AI & ML (healthcare, education, business), Ethical issues and challenges in AI.	2	5
3	**Internet of Things (IoT) & Smart Systems:** Introduction to IoT and architecture, Sensors, actuators, and communication protocols, IoT applications: Smart homes, smart cities, healthcare, Edge computing and real-time data processing, Security and privacy issues in IoT.	3	6
	SECTION-B		
4	**Cloud Computing & Big Data:** Introduction to Cloud Computing (IaaS, PaaS, SaaS), Cloud service providers and deployment models, Basics of Big Data (Volume, Velocity, Variety), Data analytics and data-driven decision making, Applications in business, healthcare and government.	4	6
5	**Blockchain & Cyber security:**	5	5

	Introduction to Blockchain technology, Cryptography basics and distributed ledger, Applications of Blockchain (crypto currency, supply chain, banking), Fundamentals of Cyber security, Threats, vulnerabilities and security measures.		
6	**Emerging Trends, Innovation & Future Technologies:** Robotics and Automation, Augmented Reality (AR) & Virtual Reality (VR), 3D Printing and Digital Manufacturing, Quantum Computing basics, Green technologies and sustainable IT, Future careers in emerging technologies.	**6**	**4**

TEXT BOOKS:

1. Errol S. van Engelen, Emerging Technologies, Business Expert Press.
2. Kutub Thakur, Al-Sakib Khan Pathan, Sadia Ismat, Emerging ICT Technologies and Cybersecurity: From AI and ML to Other Futuristic Technologies, Springer.

REFERENCE BOOKS:

1. Jonathan Follett, Designing for Emerging Technologies: UX for Genomics, Robotics, and the Internet of Things, O'Reilly Media.
2. Jennifer Koerber, Michael Sauers, Emerging Technologies: A Primer for Librarians, Bloomsbury Publishing.

ONLINE RESOURCES:

1. https://alison.com/course/emerging-technologies-in-information-systems
2. https://www.coursera.org/learn/iot-wireless-cloud-computing
3. https://www.simplilearn.com/learn-iot-basics-skillup
4. https://www.mygreatlearning.com/academy/learn-for-free/courses/ai-and-big-data-in-iot

COURSE OUTCOMES:

CO1	**Understand** the fundamentals and significance of emerging technologies in the context of digital transformation and Industry 4.0.
CO2	**Explain** the concepts of Artificial Intelligence, Machine Learning, and their real-world applications.
CO3	**Analyze** the architecture and applications of Internet of Things (IoT) and smart systems.
CO4	**Apply** knowledge of Cloud Computing and Big Data technologies for data-driven solutions.
CO5	**Evaluate** Blockchain technology and Cybersecurity principles to ensure secure digital systems.
CO6	**Explore** advanced technologies such as AR/VR, robotics, and quantum computing, and identify future career opportunities in emerging technology domains.