G.S. Mandal's
MAHARASHTRA INSTITUTE OF TECHNOLOGY
CHHATRAPATI SAMBHAJINAGAR
(An Autonomous Institute)
Accredited with "Grade A" by NAAC
(Formerly Known as College of Applied Science)
Approved by All India Council for Technical Education (AICTE), New Delhi
Permanently Affiliated to Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar
DTE Code -2113

Ref: MIT/B. Tech./Acad/OE/2023/03 Date: 18-01-2024

Notice

Registration for Open Electives III for Third Year B. Tech Classes

All the students of Third Year B. Tech (All Branches) are hereby informed that students has to select one of the course as per the curriculum as Open Elective course either offered by the department or from other departments in Semester VI of Academic Year 2023-24 Part – II. It is mandatory to enroll for the open elective course. The list of such courses offered by various departments is as follows:

Sr. No	Program	Course Code	Course
1	Agricultural Engineering	AED391	Fundamentals of Bioenergy
2	Civil Engineering	CED391	Solid Waste Management
3	Computer Science and Engineering	CSE391	RHCSA (RedHat Certified System Administration) – **Change in Course Name is under consideration**
4	Computer Science and Engineering	CSE392	Digital Marketing
5	Electronics and Computer Engineering	ECE391	Data Science
6	Electronics and Computer Engineering	ECE392	Control Systems
7	Electrical Engineering	EED391	Special Purpose Electric Machines
8	Emerging Science and Technology	AID391	Business Intelligence
9	Mechanical Engineering	MED391	Industry 4.0
10	Mechanical Engineering	MED392	Operations Research
11	Plastic and Polymer Engineering	PPE391	Waste Management and Circular Economy

The **syllabi of the courses** are attached for ready reference. The students are hereby instructed to meticulously check the syllabus before selecting the Open Electives. Important points to be noted by students are mentioned below:

1. Allocation of Open Elective-III shall be purely based on first come first served basis.
2. No changes in the preferences shall be entertained once the students have opted for their Open Elective choices.

3. A maximum 50 % quota of Open Elective shall be allocated to students of the host department. The remaining 50 % shall be allocated to the students from other departments.
4. The open elective class will be formed if the minimum 15 students enroll for the course.
5. Students shall be allocated the Open Elective as per the preference given and the number of available seats for the respective Open Elective course.
6. If the student does not complete the registration process, the courses shall be allocated as per availability and no student will be entertained for any queries related to the same.
7. Students must do online registration for Open Elective on the provided link or by scanning the QR Code as given below. The link for registration will be available on **19/01/2024 between 10.00 AM to 5.00 PM.**

   http://tinyurl.com/TYOEIII2324PII

Dean Academics

Maharashtra Institute of Technology, Aurangabad * An Autonomous Institute * MIT

Director
Director
Maharashtra Institute of Technology,
Aurangabad
(An Autonomous Institute)

Copy to:

- Dean (Examinations and Evaluations) for information and n.a.
- Registrar/ Deans, for information and n.a.
- HODs for information and Circulation to students through class coordinators

NH-211, MIT Campus, Satara Village Road, Chhatrapati Sambhajinagar 431 010 (M.S.); India. Phone (Director): (0240) 2375111,(Office) 2375365,2375355; Fax:(0240)2376618 ,Email:director.mitt@mit.asia; Website:https://www.mit.asia

Faculty of Science & Technology Syllabus of T. Y. B.Tech. Agricultural Engineering (Semester VI)	
Course Code: AED391 Course: Open Elective-III Fundamentals of Bioenergy **Teaching Scheme:** Theory: 3 Hrs./week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15Marks Teacher Assessment: 10 Marks Continuous Internal Evaluation: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs.
Prerequisite	Basic knowledge of Bioenergy sources and biomass utilization
Objectives	1. Understand bioenergy technologies, processes, reactions and energy conversion rates for Anaerobic Digestion, gasification, pyrolysis (fast, intermediate and slow) and combustion 2. Know what constitutes a suitable feedstock for bioenergy applications
Unit-I	**Introduction to bioenergy** Introduction, Unit of Energy and Introduction of Bioenergy, How Biomass Formed on the Earth, Basic Biomass Technology (Resources and Production) Biomass Production: Wastelands, classification and their use through energy plantation, selection of species, methods of field preparation and transplanting. **(6 Hrs)**
Unit-II	**Bioethanol**- Biofuels: Introduction, Ethanol production process, Biodiesel production process, Environmental Benefits, Bio-oil: Pyrolysis or Destructive distillation. **(6 Hrs)**
Unit-III	**Biogas**- Biogas: Introduction, process description, Constituents of biogas, main features of biogas plant, Classification & Popular designs, Applications, factors considered for selection of biogas plant, advantages, disadvantages. **(6 Hrs)**

Unit-IV	**Biodiesel-** Biodiesel production processes, Biodiesel characterization, Biodiesel feedstocks, Environmental permitting and safety considerations for biodiesel production. **(6 Hrs)**				
Unit-V	**Thermo Chemical Processes:** Basic concepts in gasification and pyrolysis, chemistry of gasification, Gasification Types – Updraft Gasifier, downdraft, cross draft, applications, difference. **(6 Hrs)**				
Unit-VI	**Biomass utilization:** Biomass densification technique (briquetting, pelletization, and cubing), environmental aspect of bio-energy, waste to energy conversion. **(6 Hrs)**				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1	Introduction to Bioenergy (Energy and the Environment)	Vaughn C. Nelson, Kenneth L. Starcher	CRC Press	1st
	2	Bioenergy: Biomass to Biofuels	Anju Dahiya	Elsevier Science	2nd
	3	Bioenergy: Principles and Applications	Yebo Li and Samir Kumar Khanal	Wiley	2nd

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Syllabus of T. Y. B.Tech. Civil Engineering (Semester VI)

Course Code: CED391 Course: Open Elective-III Solid Waste Management **Teaching Scheme:** Theory: 3 Hrs./week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 10 Marks Continuous Internal Evaluation: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs.

Prerequisite	Environmental Science
Objectives	To get introduced to the generation, collection and management of the various types of solid waste and different waste management techniques.
Unit-I	**Introduction to Solid Waste Management (SWM):** Need and Objectives, Waste Management Hierarchy, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, types, Composition, Quantities, Physical, chemical and biological properties. **(6 Hrs.)**
Unit-II	**Generation of solid waste: Factors affecting. Storage and collection:** General considerations for waste storage at source, Types of collection Systems, Transfer station: Meaning, Necessity, Transportation of solid waste: Means and Methods, Routing of vehicles. **(6 Hrs.)**
Unit-III	**Segregation and Material Recovery** Objectives, Stages of segregation, sorting operations, Guidelines for sorting for materials recovery, E waste management, Biomedical waste management**.** **(6 Hrs.)**
Unit-IV	**Waste processing: processing technologies** Composting, thermal conversion technologies incineration, treatment of biomedical wastes. Energy recovery from solid waste: Parameters affecting energy recovery, Bio-methanation, Fundamentals of thermal processing,

<table>
<tr><td></td><td colspan="5">Pyrolysis, Incineration, Advantages and disadvantages of various technological options. (6 Hrs.)</td></tr>
<tr><td>Unit-V</td><td colspan="5">Disposal: Landfills and its introduction, Definition, Essential components, Site selection, Land filling methods, Leachate analysis and landfill gas management, treatment & disposal, Determination of capacity of landfill disposal site. (6 Hrs.)</td></tr>
<tr><td>Unit-VI</td><td colspan="5">Hazardous waste management (HWM): Types of hazardous waste (such as nuclear, biomedical and industrial waste), problems and issues related to HWM, Need for HWM, Legislations on management and handling of HW, Hazardous Characteristics, reduction of wastes at source, Recycling and reuse, labelling and handling of hazardous wastes, incineration, solidification & stabilization of hazardous waste. (6 Hrs.)</td></tr>
<tr><td rowspan="5">References</td><td>Sr. No.</td><td>Title</td><td>Author</td><td>Publication</td><td>Edition</td></tr>
<tr><td>1</td><td>Integrated Solid Waste Management</td><td>Hilary Theisen and Samuel A, Vigil</td><td>McGraw-Hill, New York</td><td>1993</td></tr>
<tr><td>2</td><td>CPHEEO, Manual on Municipal Solid waste management,</td><td>Central Public Health and Environmental Engineering Organization</td><td>Government of India</td><td>2000</td></tr>
<tr><td>3</td><td>Environmental Resources Management, Hazardous waste Management</td><td>Michael D. LaGrega, Philip L Buckingham Jeffrey C. E vans</td><td>Mc-Graw Hill International edition</td><td>2001</td></tr>
<tr><td>4</td><td>Solid waste Engineering</td><td>Vesilind P.A., Worrell W and Reinhart</td><td>Thomson Learning Inc., Singapore</td><td>2002</td></tr>
</table>

	5	Hazardous Waste Management	Charles A. Wentz	McGraw Hill International Edition,New York	2nd

(Faculty of Science & Technology)

Syllabus of T. Y. B. Tech. Computer Science and Engineering (Semester VI)

Course Code: CSE391 Course: Open Elective-III RHCSA (RedHat Certified System Administration) **Teaching Scheme:** Theory: 3 Hrs./week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs.

Prerequisites	This course has prerequisites like previous system administration experience on other operating systems is beneficial. Fundamental knowledge of Operating System.
Objectives	1. Develop a strong understanding of the command-line interface (CLI) and become proficient in using essential command-line tools and utilities for system administration tasks. 2. Understanding fundamental system administration tasks, such as managing file systems, users, and groups. 3. Ability to Install, update, and remove software packages using package management tools and service management. 4. Ability to identify and resolve common system issues, perform system analysis, and troubleshoot problems related to hardware, software. 5. Ability to configure and troubleshoot network interfaces and handling system security. 6. Ability to manage storage devices and file systems and utilize containerization tools like Podman.

Unit-I	**Introduction to Red Hat Enterprise Linux (RHEL, Filesystem and File Permissions** Overview of RHEL and its features. Installation and deployment of RHEL, Filesystem hierarchy standard (FHS), Managing files and directories. **(6 Hrs.)**
Unit-II	**User and Group Administration** Permissions and ownership User andgroup management, Password policies and authentication methods, User and group quotas user and group-level security measures, such as password policies and file permissions, to maintain system integrity. **(6 Hrs.)**
Unit-III	**Package Management, System Initialization** Package installation, removal, and verification Managing software repositories, Dependency resolution and package querying, Boot process and run levels Managing services and daemons, Systemd and SysVinit. **(7 Hrs.)**
Unit-IV	**System Maintenance, Troubleshooting and System Recovery** System updates and patching, Kernel management, Managing log files and system monitoring, System troubleshooting methodologies, Rescue and recovery techniques, Boot loader configuration and troubleshooting. **(7 Hrs.)**
Unit-V	**Network Configuration** Network interfaces and configurations, IP addressing and routing**,** DNS configuration. configuring firewalls, securing SSH access, and implementing SELinux policies to protect the system from unauthorized access and potential threats. **(7 Hrs.)**
Unit-VI	**Storage Administration & Run containers** Disk partitioning and formatting**,** Logical Volume Manager (LVM)**,** Filesystem creation and mounting, Deploy Container, Manage Container Storage and Network Resources, Manage Containers as System Services. **(7 Hrs.)**

	Sr. No.	Title	Author	Publication	Edition
Textbooks / Reference Books	1.	Linux System Programming	Robert Love	O'Reilly, SPD	10th
	2.	UNIX Network Programming	W.R. Stevens	McGraw-Hill	5th
	3.	Linux Command Lineand Shell Scripting Bible	Richard Blum and Christine Bresnahan	McGraw Hill	6th
	4.	UNIX and Linux System Administration Handbook	Evi Nemeth, Garth Snyder, Trent R. Hein	Ben Whaley	3rd
	5.	RHCSA/RHCE Red Hat Linux Certification Study Guide	RedHat Student Guide	RedHat	9th

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Syllabus of T. Y. B. Tech. Computer Science and Engineering (Semester VI)

Course Code: CSE392 Course: Open Elective-III: Digital Marketing **Teaching Scheme:** Theory: 3 Hrs./week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs.

Prerequisites	Basic Understanding of Digital Marketing
Objectives	1. To understand the basic concept of digital marketing 2. To understand the concept of search engine optimization. 3. Implement Social Media Optimization 4. Discuss the concept of google advertising
Unit-I	**Digital Marketing Introduction** Concept of Digital Marketing, Use of Digital Marketing, Digital Marketing Platform, Digital Marketing Strategy, Types of Digital Marketing – Organic & Paid, Digital Marketing VS Traditional Marketing. How is it different from traditional marketing, ROI between Digital and traditional Marketing. **(7 Hrs.)**
Unit-II	**Search Engine Optimization (SEO)** Introduction of SEO, Search Engine working, SEO Tools Web position Analysis, Competition Analysis, Google Algorithms and Updates. **(6 Hrs.)**
Unit-III	**Social Media Optimization (SMO)** **Facebook** - Profile Creations, Creating groups and pages, Tips and Guides, Posts And promotions, Events Creations, Video Marketing, Promotional Techniques, Integration Techniques. **Twitter** -Set-up and usage Tips, Promoted Tweets, Video Marketing, Promotional Techniques, Integration

	Techniques, Analytics. **LinkedIn**-Profile Creations, Company Page Creations, Tips and Guides, LinkedIn posts LinkedIn promotions LinkedIn Groups, Video Marketing, Promotional Techniques, Integration Techniques, **Instagram** -Integration Techniques, Promotional Techniques. **(5 Hrs.)**
Unit-IV	**Introduction to SEM** Google AdWords, Search Advertising, Display Advertising, Mobile Advertising, Video Advertising, Shopping Advertising, Report generation, Google AdWords Express, Setup, Google Mapping Ads. **(6 Hrs.)**
Unit-V	**E-Commerce Management** Maintenance of an online product-listing website through product keyword research, product pricing, positive reviews, and customer retention. **(6 Hrs.)**
Unit-VI	**Email Marketing** How to create and send product-based emails in bulk, and ensure that all of the emails have a good open rate and conversion rate. **(6 Hrs.)**

Textbooks / Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Digital Marketing For Dummies	Ryan Deiss & Russ Henneberry	Tata McGraw Hill	6th
2.	Social Media Marketing All-in-one Dummies	Jan Immerman, Deborah Ng	Prentice Hall	3rd
3.	Digital Marketing	Seema Gupta	Tata McGraw Hill	1st

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Syllabus of Third Year B. Tech Electronics and Computer Engineering Semester-VI

Course Code: ECE391 Course: Data Science **Teaching Scheme:** Lectures: 3 Hrs./ Week Tutorial: - Hr./ Week	Credits: 3 – 0 – 0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 10 Marks Continuous Internal Evaluation: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Prerequisites	Programming Concepts, Data Structure, Basic Linear Algebra, Basic Probability and Statistics.
Objectives	The objectives of the course are. • Give an introduction to data science and its applications. • Understand use of statistics in data science • Use data science to analyze large and unstructured data with different tools
Course Outcomes	At the end of the course the student will be able to 1. Demonstrate the fundamental concepts and principles of data science. 2. Apply data preprocessing techniques to clean and prepare data for analysis. 3. Perform statistical analysis and interpret the results. 4. Implement and evaluate machine learning algorithms for data prediction and classification.
Unit-I	**Introduction to Data Science:** Overview of Data science and its terminologies, Applications of Data Science, Role of Data science in emerging technologies. Data types and Data sources, Data preprocessing techniques, Statistical concepts for Data Science. **(6 Hrs.)**
Unit-II	**Machine Learning for Data Science:** Introduction to machine learning algorithms, Supervised learning: linear regression, logistic regression, decision trees, and random forests, Unsupervised learning: clustering algorithms, dimensionality reduction, Feature generation and selection using Machine learning. **(6 Hrs.)**

Unit-III	**Data Visualization and Communication:** Principles of data visualization, Exploratory data analysis using visual techniques Tools and libraries for data visualization. Mining Social Networks: Social Networks graphs, clustering of graphs, direct discoveries of communities in graphs, analyze the portioning of graphs, the neighborhood properties of graphs. **(6 Hrs.)**
Unit-IV	**Big Data Analytics and cloud computing for Data Science:** Introduction to big data and its challenges, Distributed computing frameworks: Hadoop and Spark, Big data processing and analysis. Cloud concept and computing for data science. **(6 Hrs.)**
Unit-V	**Programming Languages and libraries for Data Science:** Python for Data Science, Python libraries for data science. R programming language for Data science. Implementation examples in Python and R language. **(6 Hrs.)**
Unit-VI	**Ethical Considerations in Data Science**: Privacy, security, and ethical considerations in data science, Bias, fairness, and interpretability in machine learning algorithms, Legal and regulatory aspects of data science. **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Python for Data Analysis	Wes McKinney	O'Reilly Media	2nd
2.	The Elements of Statistical Learning	Trevor Hastie, Robert Tibshirani, Jerome Friedman	Springer	2nd
3.	Data Science for Business	Foster Provost, Tom Fawcett	O'Reilly Media	1st
4.	Hands-On Machine Learning with Scikit-Learn and TensorFlow	Aurélien Géron	O'Reilly Media	2nd
5.	Doing Data Science: Straight Talk from The Frontline	Cathy O 'Neiland Rachel Schut	O'Reilly Media, Inc	3rd

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Syllabus of Third Year B. Tech Electronics and Computer Engineering Semester-VI

Course Code: ECE392 Course: Control Systems **Teaching Scheme:** Lectures: 3 Hrs./ Week Tutorial: - Hr./ Week	Credits: 3 – 0 – 0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 10 Marks Continuous Internal Evaluation: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Prerequisites	Linear algebra and calculus
Objectives	The objectives of the course are • The objective of this course is to introduce students to the fundamental concepts and principles of control systems. • Students will develop an understanding of the analysis and design of control systems, including time-domain and frequency-domain techniques.
Course Outcomes	At the end of the course the student will be able to 1. Understand the basic concepts and terminology of control systems. 2. Analyze linear time-invariant (LTI) systems using Laplace transforms and transfer functions. 3. Design and analyze feedback control systems using time-domain techniques. 4. Analyze control system stability using Routh-Hurwitz and Nyquist criteria.
Unit-I	**Introduction to Control Systems** Definition and classification of control systems, Feedback and feedforward control, Open-loop System, closed-loop control and their examples. Distinguish between open and close system. Laplace transforms. **(6 Hrs.)**
Unit-II	**Mathematical Modeling of Dynamic Systems** Differential equations and transfer functions, Advantages, Disadvantages and Properties of Transfer function, transfer function representation, Block diagrams and signal flow graphs, State-space representation. **(6 Hrs.)**

Unit-III	**Time-Domain Analysis** Time response analysis, Step response analysis. Time constant and system behavior. Transient and steady-state response, Second-order system characteristics: Step response analysis. Natural frequency and damping ratio. Undamped, underdamped, critically damped, and overdamped systems Performance specifications: Rise time, settling time, peak time, and peak overshoot. Steady-state error and error constants. Introduction to error analysis. **(6 Hrs.)**
Unit-IV	**Stability Analysis:** Definition of stability, Stability conditions based on the Routh array, Application of the Routh-Hurwitz criterion to analyze system stability. Nyquist stability criterion, Application of stability criteria to determine system stability. **(6 Hrs.)**
Unit-V	**Frequency-Domain Analysis:** Frequency response analysis, Relationship between time-domain and frequency-domain representations, Bode plots, Nyquist stability criterion, Stability margins, gain margin and phase margin. **(6 Hrs.)**
Unit-VI	**Controller Design:** Sensors and actuators, Sampling and discrete-time control systems, Proportional-Integral-Derivative (PID) controllers, Frequency response design (lead, lag, and lead-lag compensation), Digital controllers and hardware implementation. **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Modern Control Engineering	Katsuhiko Ogata	--	--
2.	Control Systems Engineering	Norman S. Nise	--	--
3.	Feedback Control of Dynamic Systems	Gene F. Franklin, J. David Powell, and Abbas Emami-Naeini	--	--
4.	Automatic Control Systems	Benjamin C. Kuo and Farid Golnaraghi	--	--

Science & Technology

Syllabus of S. Y. B.Tech. (Electrical Engineering) (Semester III)

Course Code: EED391 Course: Open Elective-III Special Purpose Electric Machines **Teaching Scheme:** Theory: 3 Hrs. / week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs.

Prerequisite	Basic electrical Engineering, magnetic circuit, conventional electrical machines
Objectives	1. To understand different types of motors for particular application 2. To examine behaviour of machines for specific applications 3. To compare different machines 4. To develop knowledge in regards of control and use of machines
Unit-I	**Induction Generators** Construction, operating principle, types, operating characteristics, Applications. **(6 Hrs.)**
Unit-II	**Doubly fed induction Machines** Construction, operating principle, types, operating characteristics, Applications to grid connected wind and mini/micro hydel systems. **(6 Hrs.)**
Unit-III	**Switched Reluctance Motor**: Construction, operating performance, control and applications. **Variable reluctance stepper motor:** Construction, operating performance, control and applications. **(6 Hrs.)**
Unit-IV	**Linear Machines:** Linear Induction Machines and Linear Synchronous Machines: Construction, operation, performance, control and applications. **(6 Hrs.)**
Unit-V	**BLDC Machine** Construction, magnetic materials used, types of motors, control and applications. Recent developments in BLDC motors. **(6 Hrs.)**

Unit-VI	**Permanent Magnet Machines:** Construction, magnetic materials used, types of motors e.g. PMDC and PM Synchronous Machine, control, and applications. Recent developments in electrical machines. **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1	Switched Reluctance motor drives'	R.Krishnan,	CRC press, 2001	1st Edition
2	Permanent magnet and Brushless DC motors'	T.Kenjo and S.Nagamori	Clarendon press. London, 1988	1st Edition
3	Special Electrical Machines	Simmi P Burman	S.K. Kataria& Sons	2nd Edition
4	Permanent Magnet Synchronous and Brushless DC Motor Drives	R. Krishnan.	New Delhi, Prentice, Hall of India, 2009	2nd Edition
5	Special Electrical Machines	Venkataratnam	Taylor and Francis, 2009	1st Edition

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Syllabus of T. Y. B. Tech. (AIDS) Semester VI

Course Code: AID391 Course: Business Intelligence **Teaching Scheme:** Theory: 03 Hrs./week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous In-semester Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs.

Prerequisites	No Prerequisites
Objectives	1. Student should learn fundamental concepts of Business Intelligence. 2. To learn analytics framework to support decision making in business intelligence.
Unit-I	**Understanding Business Intelligence** The Challenge of Decision Making, What Is Business Intelligence?, The Business Intelligence Value Proposition, The Combination of Business and Technology **(6 Hrs.)**
Unit-II	**Business Intelligence Technology Counterparts** Data Warehousing: What Is a Data Warehouse?, Data Marts and Analytical Data, Organization of the Data Warehouse Enterprise Resource Planning: Distributing the Enterprise, First ERP, then Business Intelligence, The Current State of Affairs Customer Relationship Management: CRM, ERP, and Business Intelligence Customer Decisions, Decisions About Customers, Business Intelligence and Financial Information **(6 Hrs.)**
Unit-III	**The Spectrum of Business Intelligence** Enterprise and Departmental Business Intelligence, Strategic and Tactical Business Intelligence, Power and Usability in Business Intelligence, Finding the Right Spot on the Continuum, Business Intelligence: Art or Science? **(6 Hrs.)**

Unit-IV	**Business Intelligence User Interfaces** Querying and Reporting, Reporting and Querying Toolkits, Basic Approaches: Building Ad-Hoc Queries, Building On-Demand Self-Service Reports, Enhancing and Modifying, Data Access: Pull-Oriented Data Access, Push-Oriented Data Access, Dashboards: EIS Is the Engine, Metric System and KPIs, Business Intelligence Dashboards **(6 Hrs.)**
Unit-V	**On-Line Analytical Processing (OLAP)** OLAP:OLAP and OLTP, Operational Data Stores, Variations in Data and Approach, OLAP Applications and Functionality, Multi-Dimensions: Thinking in More Than Two Dimensions, What Are the Possibilities?, Drilling and Pivoting, OLAP Architecture: Cubism, Tools, ROLAP, MOLAP, HOLAP, Data Mining **(6 Hrs.)**
Unit-VI	**Visualization, Guided Analysis and** Visualization: The Basics, Unconstrained Views, Guided Analysis: The Business Intelligence Two-Step, How to Guide the Guides, Handling Unstructured Data **(6 Hrs.)**

Textbooks / Reference Books

Sr. No.	Title	Author	Publication	Edition
1	Decision Support and Business Intelligence Systems	Efraim Turban, Ramesh Sharda, Jay Aronson, David King	Pearson Education, 2009.	9th
2	The Savy Manager's Guide Getting Onboard with Emerging IT,	David Loshin, Business Intelligence	Morgan Kaufmann Publishers.	2009

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Syllabus of T. Y. B. Tech. Mechanical Engineering (Semester VI)

Course Code: MED391	Mid Semester Examination-I: 15 Marks
Course: Open Elective-III Industry 4.0	Mid Semester Examination-II: 15 Marks
Teaching Scheme:	Continuous Internal Evaluation: 10 Marks
Theory: 3 Hrs./week	Teacher Assessment: 10 Marks
Credits: 3-0-0	End Semester Examination: 50 Marks
	End Semester Examination (Duration): 2 Hrs.

Course Objectives	1. To make students aware of the structure and role of Industry 4.0, in current evolving industrial environment. 2. To give learners overview of Industry 4.0 technologies and their integration.
Unit I	**Introduction-** Four industrial revolutions, Digital transformation of Industry and the fourth industrial revolution, Scope of Industry 4.0, Automation pyramid and Industry 4.0, Principles of Industry 4.0. **(6 Hrs.)**
Unit II	**Internet of Things (IoT)–** Concept of IoT, IoT Architecture – Sensing layer, Network layer, Data processing layer, Application layer, Applications of IoT – for automobiles, homes, etc. Internet of Service (IoS), Internet of Energy (IoE). **(6 Hrs.)**
Unit III	**Technologies in Industry 4.0 (1)-** Augmented reality and Virtual Reality, 3D Printing, Collaborative robots, Smart material handling, Smart sensors, Concept of smart products. **(6 Hrs.)**
Unit IV	**Technologies in Industry 4.0 (2)-** Machine learning, Introduction to Cyber Physical Systems (CPS), Components of Cyber Physical Systems, Digital twins, Machine vision, Smart factory, Artificial intelligence. **(6 Hrs.)**
Unit V	**Data in Industry 4.0-** Big Data, Data Mining, Data Analytics, Cloud computing, Data – anew resource of organization, Data analysis for optimal decision making, Digitalization of the entire value chain. **(6 Hrs.)**
Unit VI	**Applications of Industry 4.0-** Industry 4.0 in Manufacturing – Predictive maintenance, Real-time supply-chain optimization, Digital performance management, Smart energy consumption, Challenges in implementing Industry 4.0. **(6 Hrs.)**

	Sr. No.	Title	Author	Publication	Edition
Textbook/ Reference Books	1	Industry 4.0 - the Industrial Internet of Things	Industry 4.0_ the Industrial Internet of Things	Industry 4.0_ the Industrial Internet of Things	-
	2	Industry 4.0-Managing The Digital Transformation	Alp Ustundag, Emre Cevikcan	Springer	1st
	3	Automated Manufacturing System	Hugh Jack	Lulu.com	7th
	4	Industry 4.0- Opportunities Behind The Challenge	Dr. Mirjana Stankovic, Ravi Gupta and Dr. Juan E. Figueroa	UNIDO General Conference 2017	-
	5	Handbook of Ind. Automation	Richard L. Shell Ernest L. Hall	CRC Press	1st

Faculty of Science & Technology
Syllabus of T. Y. B. Tech. Mechanical Engineering (Semester VI)

Course Code: MED392 Course: OE-III Operations Research **Teaching Scheme:** Theory: 3 Hrs/week Credits: 3-0-0	Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continues Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs

Objectives	1. To familiarize the students with formal quantitative approach to problem solving 2. To formulate real life engineering problems 3. To solve engineering problems using various Operations Research Techniques
Unit-I	**Introduction to Operations Research :** Basics definition, scope, objectives, phases, models, applications and limitations of Operations Research. **(2 Hrs.)**
Unit-II	**Linear Programming Problem :** Formulation of LPP, Graphical solution of LPP, Simplex Method, Artificial variables, Big-M method, two-phase method, degeneracy and unbound solutions. **(8 Hrs.)**
Unit-III	**Transportation Model :** Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test – the stepping stone method or MODI method. Degeneracy in Transportation Problem. **(8 Hrs.)**
Unit-IV	**Assignment Problem:** Hungarian Method to solve Assignment Problem, Travelling Salesman as an Extension of Assignment Problem. **(4 Hrs.)**
Unit-V	**Queuing model and Sequencing model :** Queuing Systems And Structures, Notation Parameters, Single Server and Multi Server Models, Poisson Input, Exponential Service, Constant Rate Service, Infinite Population

	Sequencing Model: Introduction, n jobs through two machines, n jobs through three machines, two jobs through m machines and n jobs through m machines. **(6 Hrs.)**				
Unit-VI	**Network Models:** Fulkerson's rule, concept and types of floats, float calculations, CPM and PERT, Crashing cost and crashing Network. **(8 Hrs.)**				
Text Book/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Operations Research	Taha H.A.	Prentice Hall Of India.	Ninth Edition
	2.	Introduction to Operations Research	Frederick S. Hillier and Gerald J. Lieberman	Tata McGraw-Hill	Seventh Edition
	3.	Operations Research	P.K. Gupta, D.S Hira	S. Chand & Co.	Fourth Edition
	4.	Operations Research	Man Mohan, P. K. Gupta, Kanti Swarup	S. Chand & Co.	12^{th} Edition
	5.	Operations Research Principles and Practice	Ravindran, Phillips and Solberg	Mc. WSE Willey	Second Edition
	6.	Operations Research: Applications and Algorithms	Wayne L. Winston, Jeffrey B. Goldberg	Thomson Brooks	Fourth edition
	7.	Operations Research: Theory, Methods and Applications	S. D. Sharma, Himanshu Sharma	Kedar Nath Ram Nath	Fourth Edition
	8.	PERT and CPM: Principles and Applications	L. S. Srinath	East-West Press Private Limited,	Third Edition
	9.	Project Planning and Control with PERT & CPM	Dr. B.C. Punmia & K.K. Khandelwal	Firewall Media	Fourth Edition

Faculty of Science & Technology

Syllabus of T. Y. B. Tech. Plastic and Polymer Engineering (Semester VI)

Course Code: PPE391 Course: Open Elective III: Waste Management and Circular Economy **Teaching Scheme:** Theory: 3 Hrs./week	Credits: 03 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Continuous Internal Evaluation: 10 Marks Teacher Assessment: 10 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 2 Hrs.

Prerequisite	Plastic materials, processing, rheology, basics of polymer technology and designing
Objectives	• It aims to provide students with a comprehensive understanding of sustainable practices and the principles of the circular economy within the context of polymer engineering. • Students will explore various strategies, technologies, and policies for achieving sustainability, reducing environmental impact, and promoting circularity in the polymer industry. • The course will emphasize the importance of integrating sustainable principles in the design, production, and disposal of polymer materials.
Unit-I	**Topic Title: Introduction to Waste Management and Circular Economy** Definition and significance of sustainability in polymers, basics of waste management, principles and goals of the circular economy, environmental, social, and economic dimensions of waste management, life cycle thinking and assessment in plastics **(4 Hrs.)**
Unit-II	**Topic Title: Waste generation, composition, and management** Sources and types of plastic and polymer waste, composition analysis and characterization of waste, quantification and assessment of waste generation, waste management and treatment methods: MSWM processing and plastics waste management comprising of waste hierarchy i.e., prevention, minimization, reuse, recycling, energy recovery, and disposal. **(8 Hrs.)**

Unit-III	**Topic Title: Sustainable Polymer Processing** Energy-efficient processing techniques, clean and green manufacturing practices, waste reduction and recycling in polymer processing, sustainable additives and processing aids **(6 Hrs.)**
Unit-IV	**Topic Title: Sustainable Waste Management and Disposal** Waste characterization and classification in polymers, mechanical recycling, waste-to-energy conversion technologies, biological treatment methods for polymer waste, hazardous waste management and regulations, sustainable landfilling and waste disposal practices **(6 Hrs.)**
Unit-V	**Topic Title: Circular Economy Strategies** Design for recycling and upcycling principles, closed-loop supply chains and reverse logistics, extended producer responsibility and product stewardship, circular economy business models and initiatives, case studies on successful implementation of circular economy strategies **(6 Hrs.)**
Unit-VI	**Topic Title: Policy and Regulatory Framework for Sustainability** International and national policies promoting sustainability in polymers, Environmental regulations and standards for the polymer industry, corporate social responsibility and sustainability reporting, challenges, and opportunities in implementing sustainable practices, future trends and emerging technologies in sustainable polymer engineering **(6 Hrs.)**

Textbooks / Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Waste Management and the Circular Economy in Selected OECD Countries	OECD	OECD Publishing	1st Edition, 2019
2.	Plastics and Sustainability: Towards a Peaceful Coexistence	Michael Tolinski	Wiley	1st Edition 2011

	between Bio-based and Fossil Fuel-based Plastics			
3.	Plastics and Sustainability: Towards a Deeper Understanding of the Environmental Role of Plastics in Today's World	Conor P Carlin	Wiley-Scrivener	1st Edition 2021
4.	Strategic Management for the Plastics Industry: Dealing with Globalization and Sustainability	Jones, Roger F.	CRC Press	1st Edition 2013
5.	Plastics in the Circular Economy	Vincent Voet, Jager, Rudy and Folkersma	De Gruyter	1st Edition 2023
6.	A Practical Guide to Plastics Sustainability: Concept, Solutions, and Implementation	Michel Biron	William Andrew Publishers	1st Edition, 2020
7.	Circular Economy and Waste Valorisation: Theory and Practice from an International Perspective	Jingzheng Ren, Long Zhang	Springer	1st Edition, 2022