DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Engg./B.Tech./70/2022

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies & recommended by the Dean, Faculty of Science & Technology, **the Academic Council at its meeting held on 01 November 2021 has accepted revised following syllabus of Bachelor of Technology Third Year (Vth & VIth semester) in accordance with Choice Based Credit & Grading System as per guidelines of AICTE** as appended herewith.

Sr.No.	Syllabi as per CBC & GS
[1]	B.Tech. [Civil Engineering],
[2]	B.Tech. [Mechanical Engineering],
[3]	B.Tech. [Plastic and Polymer Engineering],
[4]	B.Tech. [Electronics and Telecommunication Engineering],
[5]	B.Tech. [Electrical Engineering],
[6]	B.Tech. [Computer Science & Engineering].
[7]	B.Tech.[Agricultural Engineering]

This is effective from the Academic Year 2021-22 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2022/ 6330-38
Date:- 07.01.2022.

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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1] The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.

2] The Section Officer,[Engg.Unit] Examination Branch,Dr.BAMU,A'bad.
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7] The Record Keeper, Dr.BAMU,A'bad.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad-431004

Revised Syllabus of Third Year (TY) Bachelor of Technology

Mechanical Engineering

(V & VI Semester)

Under Choice Based Credit System (CBCS)

Under Faculty of Science and Technology

(Effective from 2021-22 and onwards)

FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus Structure w.e.f. 2021-2022 (Choice Based Credit System)

TY B. Tech. (Mechanical Engineering)

Semester-V

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks							Credits			
		Theory	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	TH	TW/PR	TUT	Total
MED301	Design of Machine Elements-I	3	-	-	15	15	10	60	-	-	100	3	-	-	3
MED302	Materials & Metallurgy	3	-	-	15	15	10	60	-	-	100	3	-	-	3
BSH303	Managerial Economics, Finance & Costing	3	-	-	15	15	10	60	-	-	100	3	-	-	3
MED341-MED343	Professional Elective Courses-II	3	-	-	15	15	10	60	-	-	100	3	-	-	3
	Open Elective-I	3	-	-	15	15	10	60	-	-	100	3	-	-	3
MED321	Lab: Design of Machine Elements-I	-	-	2	-	-	-	-	-	25	25	-	1	-	1
MED322	Lab: Materials & Metallurgy	-	-	2	-	-	-	-	-	25	25	-	1	-	1
MED323-MED325	Lab: Professional Elective Courses-II	-	-	2	-	-	-	-	25	-	25	-	1	-	1
MED326	Minor Project	-	-	2	-	-	-	-	25	-	25	-	1	-	1
MED327	Lab: Development of Software Skills-I	-	-	2	-	-	-	-	-	25	25	-	1	-	1
MED328	Lab: Experiential/ Problem base learning	-	-	2	-	-	-	-	25	-	25	-	1	-	1
		15	12	-	75	75	50	300	75	75	650	15	6	-	21

Semester-VI

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks							Credits			
		Theory	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	TH	TW/PR	TUT	Total
MED351	Design of Machine Elements II	3	-	-	15	15	10	60	-	-	100	3	-	-	3
MED352	Theory of Machines	3	-	-	15	15	10	60	-	-	100	3	-	-	3
MED353	Heat Transfer	3	-	-	15	15	10	60	-	-	100	3	-	-	3
MED391-MED393	Professional Elective Course-III	3	-	-	15	15	10	60	-	-	100	3	-	-	3
	Open Elective-II	3	-	-	15	15	10	60	-	-	100	3	-	-	3
MED371	Lab: Design of Machine Elements II	-	-	2	-	-	-	-	-	25	25	-	1	-	1
MED372	Lab: Theory of Machines	-	-	2	-	-	-	-	-	25	25	-	1	-	1
MED373	Lab: Heat Transfer	-	-	2	-	-	-	-	-	25	25	-	1	-	1
MED374	Major Project-I	-	-	4	-	-	-	-		50	50	-	2	-	2
MED375	Lab: Development of Software Skills-II	-	-	2	-	-	-	-	25	-	25	-	1	-	1
	Mandatory Non-credit Course (Audit Course)	2													
		17	12	-	75	75	50	300	25	125	650	15	6	-	21

MSE- Mid Semester Exam, ESE- End Semester Examination, TH-Theory, OR- Oral, TA-Teacher Assessment, TW- Term Work, PR- Practical, Tut- Tutorial

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II

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Professional Elective Courses-II (Semester-V)

Group A	Group B	Group C
MED341: Internal Combustion Engines	MED342: Mechatronics	MED343: CAD/CAM/CAE
MED323: Lab: Internal Combustion Engines	MED324: Lab: Mechatronics	MED325: Lab: CAD/CAM/CAE

Professional Elective Courses-III (Semester-VI)

Group A	Group B	Group C	Group D
MED391: Automobile Engineering	MED392: Reliability Engineering	MED393: Automation in Manufacturing	MED394: Fundamental of Automobile Design

List of Open Elective-I (Semester V)

Sr. No.	Offered by Department	Name of Course	Course Code
1.	Agricultural Engineering	Statistical Methods in Engineering	AED331
2.	Civil Engineering	Environmental Impact Assessment	CED331
3.	Computer Science and Engineering	Artificial Intelligence and its Applications	CSE331
4.	Electrical Engineering	Special Purpose Machines	EED331
5.	Electronics and Telecommunications Engineering	Electronic Product Design	ETC331
6.	Mechanical Engineering	Operations Research	MED331
7.	Plastic and Polymer Engineering	Introduction to Nanotechnology	PPE331

List of Open Elective-II (Semester VI)

Sr. No.	Offered by Department	Name of Course	Course Code
1.	Agricultural Engineering	Fundamentals of Bioenergy	AED381
2.	Civil Engineering	Solid Waste Management	CED381
3.	Computer Science and Engineering	Information & Cyber Security	CSE381
4.	Electrical Engineering	Electrical Materials	EED381
5.	Electronics and Telecommunications Engineering	Internet of Things	ETC381
6.	Mechanical Engineering	Industry 4.0	MED381
7.	Plastic and Polymer Engineering	Polymer Recycling and Waste Management	PPE381

Mandatory Non-Credit Course (Audit Course) (Semester VI)

Sr. No.	Offered by Department	Course	Course code
1.	First Year	German Language	BSH807
2.	First Year	Japanese Language	BSH808
3.	Civil Engineering	Professional Ethics and Constitution of India	CED801
4.	Computer Science and Engineering	Green Computing	CSE801
5.	Electronics and Telecommunications Engineering	Smart Cities	ETC801
6.	Mechanical Engineering	Research Methodology	MED801
7.	Plastic and Polymer Engineering	Industrial Safety and Management	PPE801

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III

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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech (Mechanical Engineering) Semester V

Course Code: MED301 Course Title: Design of Machine Elements-I **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	• Knowledge and understanding of strength of materials
Objectives	1. Understand the meaning of machine design and design process. 2. Predict effectively and accurately the reasons of failure and then correlate it to the theoretical knowledge. 3. Developing the capability of analyse and select the various criteria of design. 4. Developing the creativity for designing the various components such as shaft, keys, pins, levers, couplings, cotter joint & knuckle joint etc. 5. Developing the creativity for designing the various types of fasteners including riveted joints and welded joints at various loading conditions.
Unit I	**Fundamentals of Design of Machine Elements:** **A]** Design Classification, Phases of Design, Design considerations, Selection of Materials & BIS designations of materials **B]** Design C clamp & frames, Application of theories of failure. **(6 Hrs)**
Unit II	**Design against static loading:** **A]** Design of Cotter Joint, Knuckle joint. **B]** Design of rigid and flexible couplings and Keys **(6 Hrs)**
Unit III	**Design of Screw & Fasteners:** Design of bolted and threaded joints, power screws and introduction to re-circulating ball screw. **(6 Hrs)**
Unit IV	**Design against Fluctuating load:** **A]** Stress concentration, fatigue failure, S-N diagram, endurance limit, notch sensitivity. **B]** Goodman diagram, Soderberg diagram, Gerber diagram and Modified Goodman diagram, Fatigue design under combined stress **(6 Hrs)**
Unit V	**Design of Spring:** Introduction of Springs, Design of helical spring, Design of leaf spring **(6 Hrs)**
Unit VI	**Design of Riveted & Welded Joints:** **A]** Rivet Joint: Types, failure of rivet joint, design of rivet joint including eccentrically loaded joint. **B]** Welded Joint: Types, failure, Design of Welded joint including bending and eccentric loading. **(6 Hrs)**

Textbook/ Reference Books

Sr.No.	Title	Author	Publication	Edition
1.	Design of Machine Elements	J. E. Shigley	TMH Publication	10th
2.	Design of Machine Elements	M. F. Spotts	Prentice Hall	8th
3.	Machine Design	V. B. Bhandari	TMH Publication	4th
4.	Machine Design	Khurmi & Gupta	Eurasia Publishing House	25th
5.	Machine Design	U. C. Jindal	Pearson Publication	1st

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech (Mechanical Engineering) Semester V	
Course Code: MED302 Course: Materials and Metallurgy **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Prerequisite	• Fundamental knowledge about chemistry and mechanical properties
Objectives	1. Introduce students to the field of materials science and materials testing 2. To understand various types of phase diagrams and their applications. 3. To study different types of Alloys and Materials. 4. To understand principle of various Heat Treatments. 5. To study latest materials in manufacturing.
Unit I	**Crystallography** Overview of material classification. System of crystal lattices, Space lattice, Unit cell, Average number of atoms in unit cell, Coordination number, Packing efficiency, Crystallographic planes, and directions. Crystal Imperfections: Line defect, Point defect and Surface defect. **(5 Hrs)**
Unit II	**Phase Diagrams** Phases in metals and solid solutions, Solidification and cooling curves of pure metals and alloys, Hume-Rothery rules, Phase rule, Allotropy. Construction and interpretation of binary phase diagram, Lever rule, Types of equilibrium diagrams in metals and alloys. Iron-Carbon equilibrium diagram: Phases in Fe-C diagram, Invariant reactions, and Critical temperatures. **(6 Hrs)**
Unit III	**Steels and Cast Irons** Microstructures of Plain carbon steels, structure properties co-relationship of Plain carbon steels. Effect of alloying elements on structure of steels and on the critical temperatures. Effect of common alloying elements on plain carbon steels. Properties and uses of High-speed steels, Stainless steels, and Tool steels. Types of Cast irons: White, Grey, Malleable and Nodular etc., Chilled and Mottled Cast iron, Properties, and application of Cast irons. **(7 Hrs)**
Unit IV	**Heat Treatment of Steels** Transformation products of Austenite and their characteristics, Time Temperature Transformation diagrams, Continuous cooling transformation diagrams, Critical cooling rate. Heat Treatment of steels: Annealing, Normalizing, Hardening, Retained austenite and its effect, Tempering, Cryogenic treatment, Austempering, Martempering, Patenting and Ausforming of steels. Case hardening: Carburizing, Nitriding, Carbonitriding, Flame and Induction hardening of steels. **(8 Hrs)**
Unit V	**Non-ferrous metals and High-performance alloys** Properties and uses of important non-ferrous metals like Copper, Aluminum, Tin. Study of important non-ferrous alloys: Brasses, Bronzes, Aluminum alloys, Zirconium alloys, Bearing materials. Super alloys: properties and applications. **(5 Hrs)**

Unit VI	**Advances in Materials** Smart materials: types and properties. Shape memory alloys. Composites: types, properties, and applications. Nanomaterials: concept of nanotechnology, types, properties, and nanocomposites. **(5 Hrs)**				
Textbook/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Materials Science and Metallurgy for Engineers	V. D. Kodgire and S. V. Kodgire	Everest Publishing House	31st
	2.	Introduction to Physical Metallurgy	Sydney H. Avner	Tata McGraw Hill	2nd
	3.	Engineering Metallurgy	R. Higgins	Tata McGraw Hill	6th
	4.	Fundamentals of Material Science and Engineering: An Integrated Approach	William D. Callister Jr., David G. Rethwisch	John Wiley and Sons Inc.	6th
	5.	Nanostructures and Nanomaterials: Synthesis, Properties and Applications	Guozhong Cao	World Scientific	2nd

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (All) Semester V	
Course Code: BSH303 Course: Managerial Economics, Finance and Costing **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Prerequisite	• Basic knowledge of concepts of economics.
Objectives	On the completion of this course, the learner will be able to 1. Correlate various micro and macro-economic variables and solve numerical problems 2. Analyse, interpret the financial statements, and decide upon the health of a firm. 3. Appreciate and illustrate Economic/Industrial/Trade policies and their implications and Role played by various financial institutions/banks. 4. Apply costing and accounting and costing practices in solving real life problems
Unit I	**Managerial Economics Part-I:** Introduction- Economics, basic concepts - utility, wealth, welfare, price, markets, and opportunity cost. Micro - and macro- economics, economics of growth and development. **(4 Hrs)**
Unit II	**Managerial Economics Part-II:** Demand and supply analysis: Law and elasticity of demand and supply. Demand function. Market structure - competition, monopoly, oligopoly and imperfect competition. Market imperfections and state interventions. Role of government; monetary, fiscal and trade policies, BOP, industrial policy; instruments of government policy; taxation, incentives, budget. Theory of firm: Production and Cost analysis for short run and long run. Cost-Output Relationship: Cost Function, Cost-Output relationships in Short Run and Long Run. Revenue Analysis and Pricing Policies. **(8 Hrs)**
Unit III	**Finance Part-I:** Introduction, Basic business function, sources of finance and their relative importance. Long and short term finance. Fund allocation, alternative uses of finance. Time value of money. Analysis of financial statements –Ratio analysis using balance sheet, profit and loss account. Capital budgeting decisions- type, nature and evaluation criteria: NPV, IRR, Payback. **(6 Hrs)**
Unit IV	**Finance Part-II:** Working capital management. Financial markets; money markets, bill market, discount houses, call loan market, etc., Capital markets; mutual funds, stock markets, industrial banks, world bank, UTI, IDBI, ICICI, SEBI and state finance corporations. **(6 Hrs)**
Unit V	**Costing Part-I:** Cost classification: Cost ascertainment; allocation, apportionment, absorption of overheads and non-production cost; overhead analysis, absorption methods, general considerations. Job costing; factory job costing, contract cost. Unit costing; output and operating cost, simple process costing, normal and abnormal losses in process, waste, scrap, bye-and joint products. Marginal costs and breakdown charges. **(6 Hrs)**
Unit VI	**Costing Part-II:** Cost planning and control, standard cost and budgetary control, setting standards, variance analysis. Cost reduction; tools, techniques and productivity.

	Depreciation; causes and significance, methods of providing for depreciation, book values, taxes and depreciation. (6 Hrs)

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1	Economics	Paul Samuelson and William Nordhaus	Tata McGraw Hill.	2005
2	Financial Management	Prasanna Chandra	McGraw Hill.	10th
3	Cost Accounting	Jawaharlal	Tata McGraw Hill (TMH).	3rd
4	Finance Sense - Text and Cases	Prasanna Chandra	Tata McGraw Hill	4th
5	Managerial Economics	Varshney and Maheshwari	Sultan Chand and Sons, New Delhi	22nd
6	Indian Economy	Ruddar Datt and Sundaram	S.Chand Publication	72nd
7	Financial institutions and markets	L.M. Bhole and Jitendra Mahakud	McGraw Hill Education.	6th
8	Managerial Economics	Paul Keat, Philip Young and Sreejata Banerjee	Pearson Publication	7th

Web Resources:	1	www.nptel.ac.in

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V	
Course Code: MED341 Course: Professional Elective Course -II (Internal Combustion Engines) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Prerequisite	• Fundamental knowledge of Mechanical Engineering, Engineering Thermodynamics and Applied Thermodynamics
Objectives	1. To make the students understand and analyze the fundamentals and working of Internal Combustion Engines. 2. To make the students familiar with the engine fuel and air supply system, fuel injection system, ignition system, engine lubrication and cooling system. 3. To make the students understand the combustion phenomenon of SI and CI engines, exhaust emission and its control. 4. To make the students familiar with alternative fuels and recent trends in IC engines
Unit I	**Introduction to I C Engine:** Review of IC Engine terminologies, actual valve timing diagram, various losses in actual working, dissociation, specific heats, Selection of Engine. Carburetion & Fuel Injection: Introduction, Properties of Air- fuel mixture, Air fuel mixture requirements for steady state and transient conditions. Simple carburetor, complete carburetor. Theory of simple carburetor (approximate & exact analysis), Numerical. Design of Carburetor. Ideal requirements of carburetor. Air craft carburetor. Introduction to petrol injection system. Requirements of injection system, types of injection system. Bosch fuel pump, Fuel injectors, types of Nozzle, Electronic fuel injection system. **(07 Hrs)**
Unit II	**Combustion and Ignition in S.I. & C.I. Engines:** Introduction, Combustion in S.I. Engines, Ignition limits, stages of combustion, effect of engine variables on ignition lag & flame propagation, normal & abnormal combustion, effect of detonation & its control, combustion chamber design for SI Engine. Principle Octane rating, HUCR, Combustion in C.I. Engines: Stages of combustion, delay period, diesel knock & its control, cetane rating, Air-fuel ratio, Design of combustion chamber for CI Engine. **(06 Hrs)**
Unit III	**Ignition in S.I. & C.I. Engines: Ignition System:** Ignition System Requirements, Battery & Magneto Ignition Systems, Comparison. Electronic Ignition system, Spark Advance & Retard System. **Engine Lubrication and Cooling:** Lubrication of engine components, Lubrication system – wet sump and dry sump, crankcase ventilation, Types of cooling systems – liquid and air cooled, comparison of liquid and air-cooled systems. **(05 Hrs)**
Unit IV	**Measurement, Testing and Performance:** Introduction, Performance parameter and their measurement- Morse Test, BP, FP., Heat balance sheet, performance characteristics of S.I. & C.I. Engines, Performance maps, numerical. **(07 Hrs)**
Unit V	**Supercharging and Turbocharging:** Introduction, Objectives and principles of supercharging, Methods of supercharging, Supercharging limits, Modifications for

	supercharging, Advantages and Limitations. **Recent trends in IC Engines:** Direct injection systems, Variable valve timing system, MPFi (Multi point fuel injection), CRDi (Common Rail Direct Injection), VTEC (Variable Valve Timing & Lift Electronic Control) Engines, Valvetronic system. **Alternative fuels:** Need of Alternative fuel, Biodiesel, Ethanol, Blending of Biodiesel, Blending of Ethanol, Hydrogen, Compressed Natural Gas (CNG), LPG. **(06 Hrs)**
Unit VI	**Emission and their control:** Exhaust emissions coming out of IC engine; HC, CO, CO_2, NOx, SOx, Soot, Smoke and other particulate emissions, effect on human health and environment, Causes of formation. Pollutant measurements & abetment. Engine Air pollution due to IC engine, Euro I to VI norms, Exhaust gas treatment: Catalytic converter, Exhaust Gas Recirculation. **(05 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Internal Combustion Engines & Air pollution,	Edward Obert	Harper & Row Publications	2nd
2.	Introduction to Internal Combustion Engines	Richard Stone	SAE International	3rd
3.	Internal Combustion Engines Fundamentals	John B Heywood	McGraw- Hill, Inc.	2nd
4.	Internal Combustion Engines	Mathur & Sharma	Dhanpat Rai & Co	4th
5.	Internal Combustion Engines	Dr. V. Ganesan	Tata McGraw-Hill	4th
6.	Internal Combustion Engines	Dr. V.M. Domkundwar	Dhanpat Rai & Co	4th
7.	R.K. Rajput	Thermal Engineering	Laxmi Publications	10th
8.	Fundamentals of I.C. Engines	H N Gupta	Prentice Hall, India	2nd
9.	Engineering fundamentals of Internal combustion Engines	Willard W Pulkrabek	Prentice Hall, India	2nd

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V

Course Code: MED342 Course: Professional Elective Course -II (Mechatronics) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	• Basic knowledge of transducers • Knowledge of fundamental concepts of electronics and electric systems
Objectives	1. To enable students aware of mechatronics systems and its components. 2. To give students knowledge about industrial automation and SCADA systems.
Unit I	**Introduction:** Introduction and Mechatronics system, Components of Mechatronics system - mechanical system (sensor/actuators) signal conditioning (amplifier- filters), Controllers (PLC), Graphical Display, Role of each component in working of the system, Need of signal conditioning, Data acquisition, Micro controllers. **(6 Hrs)**
Unit II	**Sensors:** Definition and Classification, Principle, construction and working of - Linear displacement and Rotational Displacement sensors, Force measurement, Temperature measurement, Proximity sensors, Vision sensor. **(6 Hrs)**
Unit III	**Actuators:** Electrical Machines - Induction motors, Stepper & Servo motors, Hydraulic & Pneumatic actuation, Electromechanical Actuators - Solenoids, Piezoelectric actuators. **(6 Hrs)**
Unit IV	**Programmable Logic Controller (PLC):** Introduction, PLC capabilities, PLC block diagram, Input/output modules, PLC addressing, PLC programing - Ladder Diagrams, Analog Input/output **(6 Hrs)**
Unit V	**Mechatronics System Design:** Case study, Definition of problem, Design of Mechatronics system - Selection of sensor, Selection of actuator, Selection of a PLC. **(6 Hrs)**
Unit VI	**Supervisory Control And Data Acquisition (SCADA):** Analog to digital conversion (ADC), Control and monitoring, SCADA architecture, Industrial Human Machine Interfaces (HMI), I/O Linking in SCADA. **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Introduction to mechatronics & Measurement system.	David G. Alicator Michal B. Histand	McGraw Hill	4th
2.	Programmable Logic Controller	W. Bolton	Newnes	6th
3.	Automated Manufacturing System	Hugh Jack	Lulu.com	7th
4.	Pneumatic Actuation System	Igor L. Krivts	Taylor &	1st

			German V. Krejnin	Francis	
	5.	Handbook of Ind. Automation	Richard L. Shell Ernest L. Hall	CRC Press	1st

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V	
Course Code: MED343 Course: Professional Elective Course -II (CAD/CAM/CAE) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Prerequisite	• Knowledge of Engineering Graphics and Machine Drawing
Objectives	1.To understand concepts of CAD/CAM/CAE and its applications. 2.To study different modeling techniques and transformations in CAD. 3.To learn fundamentals of CAE by analysis of components 4.To learn CNC part programming. 5.To study Group Technology & Flexible Manufacturing Systems 6.To explore different Rapid prototyping technologies.
Unit I	**Introduction:** What is CAD, CAM, CAE?, Role of CAD/CAM/CAE in Product cycle, Applications of CAD/CAM/CAE, Introduction to CIMS. Software configuration of graphics system **(4 Hrs)**
Unit II	**Techniques for Geometric Modeling & Transformation:** **Geometric Modeling** : Wire Frame Modeling, Solid Modeling: Constructive solid geometry (CSG), Boundary Representation (B-Rep), Surface Modeling: parametric representation of line, circle, ellipse & parabola, Parametric representation of Bezier curves, Cubic Spline curve, B-Spline curve. **Transformation:** 2D & 3D Transformations (Translation, Rotation, Scaling, Mirror and Shear), Concatenations, Matrix representation, application of transformation. **(8 Hrs)**
Unit III	**Computer Aided Engineering:** Fundamentals of computer aided engineering, Concept of stress strain curve, Types of analysis, Steps in FEA: Pre-processing, Solution, Post-processing, Discretization and types of elements (1D, 2D, 3D), Free and Mapped meshing, One example of basic element analysis on 1D or 2D. **(6 Hrs)**
Unit IV	**NC/CNC Technology and Robotics:** **NC/CNC Technology:** NC/CNC machine tool components, Co- ordinate systems, Fixed and floating zero concept, Concept of CNC and DNC machine tools, Manual part programming (G-codes, M-codes). **Robotics:** Physical configuration of Robot, types of robots, Robot programming methods. **(6 Hrs)**
Unit V	**Group technology and Flexible manufacturing systems:** Group technology, Parts classification & coding system, Applications of group technology, Types of Automation- Fixed, Flexible and Programmable, Flexible manufacturing system, Components of FMS, Types of FMS. **(6 Hrs)**

Unit VI	**Rapid Prototyping and Tooling:** Introduction to Rapid Prototyping, Applications of RP, RP Processes: Process overviews, STL file Generation, 3D printing technologies - SLA, FDM, SLS, SLM, EBM, DLP. Prototype properties: Material properties, color, dimensional accuracy, stability, surface finish, machinability, environmental resistance, operational properties. **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	CAD/CAM	M.P. Grower and E. W. Zimmer	Prentice hall of India.	1st
2.	CAD/CAM Principles & Applications	P. N. Rao	McGraw Hill.	3rd
3.	CAD/CAM	Zeid Ibrahim R. Sivasubramanian	Tata McGraw Hill.	1st
4.	CAD/CAM/CIM	P. Radhakrishnan S. Subramaninan V. Raju	New Edge publications	4th

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of T. Y. B. Tech. (All) Semester V

Course Code: AED 331 Course: Open Elective Course-I (Statistical Methods in Engineering) **Teaching Scheme:** Theory: 03 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 10 Marks End Semester Examination: 60 Marks End Semester Examination (Duration):03 Hrs

Prerequisite	Basics of Statistics and Probability Distribution
Objectives	1. To introduce different techniques involved in statistical analysis 2. To learn and practice various statistical methods for data analysis
Unit-I	**Sampling Distribution**: Population and Sample, Sampling Distribution, Standard Error Sampling Distribution of Means, Sampling Distribution of Variance, Sampling Distribution of Proportions **(6 Hrs)**
Unit-II	**Theory of Estimation**: Estimation Theory, Point Estimation – Basic Concept & Notion, Interval Estimation – Interval Estimation for Large Samples, Confidence Limits for Mean, Proportion, Standard Deviation, Difference of Means, Difference of Proportions **(6 Hrs)**
Unit-III	**Testing of Hypothesis**: Statistical Hypothesis, Tests of Significance, Null Hypothesis, Alternative Hypothesis, Types of Errors in Testing of Hypothesis, Level of Significance, Critical Region, One-Tailed and Two-Tailed Tests, Critical Values and Critical Region, P-value of Test Statistic, Procedure for testing of hypothesis **(6 Hrs)**
Unit-IV	**Large Sample Tests**: Sampling of Attributes – Test for Single Proportion, Test of Significance for Difference of Proportions, Sampling of Variables - Test of Significance for a Single Mean **(6 Hrs)**
Unit-V	**Non- Parametric Tests:** Parametric Tests and Non-Parametric Tests, Sign Test, Wilcoxon Signed-Rank Test, Mann-Whitney Test **(6 Hrs)**
Unit-VI	**Analysis of Variance (ANOVA):** Introduction, Analysis of Variance, Assumptions for ANOVA test, One-Way Classification **(6 Hrs)**

Text Book/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Statistics for Engineers and Scientists	William Navidi	McGraw	4th Edition
2.	Probability & Statistics for Engineers & Scientists	Walpole, Myers, Myers Ye	Prentice Hall	9th Edition
3.	Fundamentals of Statistics	S.C. Gupta	Himalaya Publishing House	7th Edition
4.	Statistical Methods	S. P. Gupta	Sultan Chand & Sons	1st Edition

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (All) Semester V	
Course Code: CED331 Course: Open Elective-I (Environmental Impact Assessment) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	• Environmental Engineering
Objectives	1. Student would overview the concepts, methods, issues and various forms and stages of EIA process. 2. Student will be able to examine the development of EIA in India and highlight the diversity of approach and impact of the EIA process.
Unit I	**Introduction and Evolution of EIA:** Introduction to Environmental Impact Assessment, Origin of EIA, Stages in EIA, thorough discussion of steps in EIA. Establishments of Procedure: Legislative Option, Project Screening for EIA, Public Participation in EIA process. **(6 Hrs)**
Unit II	**Impact assessment:** Background information, IA methods, environmental impact assessment methodology, documentation and selection process, environmental indices and indicators for describing affected environment, Life cycle assessment. **(6 Hrs)**
Unit III	**Air and noise environment:** Prediction and assessment of impact for air and noise environment, Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations. **(6 Hrs)**
Unit IV	**Water and soil environment:** Prediction and assessment of impact for water and soil environment, Basic information of water quality (Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations. **(6 Hrs)**
Unit V	**Decision Methods for Evaluation of Alternative:** Public participation in environmental decision making, Regulatory requirements, environmental impact assessment process, objectives of public participation, verbal communication in EIA studies. **(6 Hrs)**
Unit VI	**Environmental Impact Assessment Report:** Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan; post environmental monitoring. Latest EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, Procedure for public hearing, post environmental monitoring, Procedure for obtaining Environmental clearance for construction projects. **(6 Hrs)**

	Sr. No.	Title	Author	Publication	Edition
Textbook/ Reference Books	1.	Environmental Impact Assessment	Canter R.L.,	Mc Graw Hill Int.	2nd
	2.	Environmental Impact Assessment Theory and Practice	Peter Watten (Eds.)	Unwin Hyman	1st
	3.	Environmental Impact Assessment	R.R. Barthwell	New Age International Publishers	1st
	4.	Environmental Impact Analysis Handbook	John G. Rau and David C. Wooten	McGraw Hill Book Company	1st

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (All) Semester V

Course Code: CSE331 Course: Open Elective-I (Artificial Intelligence and its Applications) **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 End Semester Examination: 60 Marks End Semester Examination (Duration):3 Hrs

Prerequisite	Data Structures and Algorithms
Objectives	1. To introduce different techniques involved defining and simulating an intelligence. 2. To learn and practice various Artificial Intelligence methods, algorithms, and knowledge representation schemes.
Unit I	**Introduction:** Artificial Intelligence, AI Problems and AI techniques, solving problems by searching, Problem formulation. Application of AI techniques in different branches of engineering, Basic Sciences, Medical Science and equipment, Economy and Finance (6 Hrs.)
Unit II	**Searching techniques in AI:** DFS, BFS, Uniform cost search, Depth Limited Search, Iterative Deepening, Bidirectional search, Comparing Different Techniques. (6 Hrs.)
Unit III	**Heuristic functions:** Hill Climbing, Simulated Annealing, Best First Search, A*, IDA*, SMA*, Crypto-Arithmetic Problem. (6 Hrs.)
Unit IV	**Agents and Environments:** Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent. A Knowledge Based Agent, Environment, Types of Environments WUMPUS WORLD Environment, **Case Study: Automated Taxi, Vacuum Cleaner** (6 Hrs.)
Unit V	**Expert Systems:** Concept of an Expert System. Characteristics of an Expert System, Components of expert System, Concept of Knowledge Base, Components of Knowledge base, Knowledge Representation methods. **Case Study: DENDRAL, MYCIN, PXDES, CaDeT** (6 Hrs)
Unit VI	**Propositional Logic:** Introduction, First Order Predicate Logic, Forward and Backward Chaining, Resolution., Introduction to PROLOG and LISP (6 Hrs.)

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Pearson Education	2nd
2.	Artificial Intelligence	Elaine Rich, Kevin Knight, Shivashankar B Nair	McGraw Hill	3rd
3.	Artificial Intelligence	Elaine Rich, Kevin Knight	Tata McGraw Hill	2nd

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (All) Semester V	
Course Code: EED331 Course: Open Elective -I (Special Purpose Machines) **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 End Semester Examination: 60 Marks End Semester Examination (Duration):3 Hrs

Prerequisite	• They should have basic knowledge about all basic laws and construction / working principle of DC and AC motors and generators,
Objectives	1. To differentiate between generalized machines and control machines. 2. To understand principle and working of different control machines. 3. To be able to identify and implement control machines.
Unit I	**Hysteresis Motors:** Magnetic field production & nature of torque, Applications. **Reluctance Motors:** F. H. P. Reluctance motors, switched reluctance motors, Principle of working & operation, Applications. **(6 Hrs)**
Unit II	**Control Motors:** D C servomotors, transfer function of Armature and field-controlled motors their applications, Construction of F. H. P. Induction two-phase servomotors, production of torque, Torque-speed curves-characteristics & features-dynamic equations, Methods of control, Applications. Numerical on DC and AC servos. **(6 Hrs)**
Unit III	**Eddy Current Devices:** Construction & operation of eddy current couplings & dynamometers, merits & limitations. **(4 Hrs)**
Unit IV	**Tacho-Generators:** Basic requirements of tacho-generators, Ideal characteristics, classification. i) D.C. Tacho Generators: Output characteristics, Deviation from no load Characteristics, Dead-zone, Tooth ripples, Temperature effect, Accuracy class. ii) Induction Tacho-generators: Operating principle, Output characteristics, Equivalent circuit, Reasons for deviation from desired characteristics, Corrective means, Advantages. iii) A. C. Tacho-generators: Construction & operation, Output characteristics, non-linearities & tooth ripples, Advantages over other tacho-generators. Dynamic characteristics of techno-generators, Applications of tacho-generators. **(8 Hrs)**
Unit V	**Synchro & Synchro Transformers:** Different types of single phase & three-phase synchro, Differential synchro, Synchro-indicators, Their constructional features, Characteristics & applications, Synchro transformers principle, Characteristics error, applications of synchro transformers. **(6 Hrs)**

Unit VI	**Linear Motors:** Construction, Theory of operation of a linear induction motor, System with two-dimensional & three-dimensional field patterns, Performance of linear induction motors, Effect of variation in the air gap, Effect of width & thickness of the reaction plate, Thrust of linear induction motors, Applications. **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Electrical Machine and Power Electronics'	Bhimbhra P. S	Tata McGraw Hill Publication.	2nd
2.	'Modem control Engineering'	Ogata K.	Prentice Hall.	2nd
3.	Principles of Electrical Machines	V.K. Mehta	Chand Publication	2nd
4.	Electrical Machines	Ashfaq Hussain	Dhanpat rai	3rd
5.	Electrical Machines	Nagnath Kothari	TATA McGraw Hill.	5th
6.	Electrical Technologies	Edward Hughes Elbs	Pearson Education	2nd

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (All) Semester V

Course Code: ETC331 Course: Open Elective -I (Electronic Product Design) **Teaching Scheme:** Theory: 3Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 10 Marks End Semester Examination: 60 Marks End Semester Examination (Duration):3 Hrs

Prerequisite	• Students should be familiar with Circuit design and PCB design
Objectives	1. To understand the stages of product (hardware/ software) design and development. 2. To be acquainted with methods of PCB design and different tools used for PCB Design. 3. To understand the importance of testing in product design cycle. ` 4. To understand the processes and importance of documentation.
Unit I	**Introduction to Electronic product Design**: Product development basics, Product development stages, Redundancy, Ergonomics and Aesthetic Design consideration. **(6 Hrs)**
Unit II	**Packaging, Noise and Heat management:** Introduction to product packaging, Noise in electronic circuits, Grounding, Shielding, Enclosure Sizing ,Thermal management **(6 Hrs)**
Unit III	**Fundamentals of PCB and PCB Design:** Important terms related to PCB, Types of PCBs, PCB Design elements, PCB design Steps, Requirements of artwork, Layout rules, Grounding, Shielding, Design issues related to supply and ground conductors **(6 Hrs)**
Unit IV	**Software Design :** Waterfall model of software development, Phases of Software design, Goals of software design, Design of structured program, Testing and debugging of program **(6 Hrs)**
Unit V	**Product Testing:** Environmental Testing, Temperature testing Humidity testing, Various test on enclosures, EMI and EMC related testing, Importance of standards, Classification of standards, IEC standards. **(6 Hrs)**
Unit VI	**Product Documentation:** Need of documentation, Types of documentation, Manual, Types of manual, Study of one typical manual, Bill of Material-examples **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Electronic Product Design	R.G.Kaduskar	Wiley-India	2nd
2.	Integrated Circuits	K.R.Botkar	Khanna Publisher	10th
3.	Embedded System: A contemporary design Tool	James Peckol	Wiley	2nd

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (All) Semester V

Course Code: MED331 Course: Open Elective -I (Operations Research) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	• Fundamental knowledge and understanding of Engineering mathematics • Understanding of concepts of costing and management concepts
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 steppingstone method or MODI method. Degeneracy in Transportation Problem. Assignment Problem: Hungarian Method to solve Assignment Problem, Travelling Salesman as an Extension of Assignment Problem. **(8 Hrs)**
Unit IV	**Inventory Control, Replacement Analysis and Theory of Games:** Inventory Models: Economic Order Quantity Models, Quantity Discount Models, Stochastic Inventory Models, Multi Product Models, Inventory Control Models in Practice. Replacement Analysis: Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly. Theory of Games: Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance. **(6 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. **(6 Hrs)**

Textbook/	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**

Reference Books	1.	Operations Research	Taha H.A.	Prentice Hall Of India.	9th
	2.	Introduction to Operations Research	Frederick S. Hillier and Gerald J. Lieberman	Tata McGraw-Hill	7th
	3.	Operations Research	P.K. Gupta, D.S Hira	S. Chand & Co.	4th
	4.	Operations Research	Man Mohan, P. K. Gupta, Kanti Swarup	S. Chand & Co.	12th
	5.	Operations Research Principles and Practice	Ravindran, Phillips and Solberg	Mc. WSE Willey	2nd
	6.	Operations Research: Applications and Algorithms	Wayne L. Winston, Jeffrey B. Goldberg	Thomson Brooks	4th
	7.	Operations Research: Theory, Methods & Applications	S. D. Sharma, Himanshu Sharma	Kedar Nath Ram Nath	4th
	8.	PERT and CPM: Principles & Applications	L. S. Srinath	East-West Press Private Limited,	3rd
	9.	Project Planning & Control with PERT & CPM	Dr. B.C. Punmia & K.K. Khandelwal	Firewall Media	4th

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (All) Semester V	
Course Code: PPE331 Course: Open Elective-I: (Introduction to Nanotechnology) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Objectives	To study the introduction to nanomaterials and the factors affecting it. To study the types and synthesis methods of nanomaterials. To study the characterizations and properties of nanomaterials. To study the different applications of nanomaterials.
Unit I	**Introduction** Introduction to nanotechnology, conventional micro vs. nano-material properties, role of size in properties of nano-materials, length scale and surface to volume concept, and uniqueness of nanostructured materials; health hazards and handling of nanomaterials. **(4 Hrs)**
Unit II	**A) Synthesis** Bottom-up and top-down approach for nano materials synthesis, methods: ball milling, chemical vapor deposition, pressure vapor deposition, ultrasound assisted, minimulsion, microemulsion, nanoemulsion, hydrothermal, sol-gel, miscellaneous techniques. **(4 Hrs)** **B) Types of Nano-Materials** Natural and synthetic clays – Montmorillonite and layered double hydroxide (LDH); carbon nanofibers (CNFs), carbon nanotubes, graphene nanosheets, nanosilica, nanoaluminium oxide, nanotitanium oxide, nano-hybrids. **(4 Hrs)**
Unit III	**Properties of Nanomaterials in terms of Structure Property Relationship** Thermal properties, mechanical properties, gas barrier properties, flame retardant properties, electrical and electrochemical properties, electronic properties, optical properties, magnetic properties, biodegradable properties, antimicrobial properties, catalytic properties. **(6 Hrs)**
Unit IV	**Preparation of Polymer Nanocomposites** Solution intercalation, melt intercalation, roll milling, emulsion polymerization, in-situ polymerization. **(6 Hrs)**
Unit V	**Characterization of Nanomaterials and Nanocomposites** X-ray diffraction (XRD), dynamic light scattering (DLS), scanning electron microscopy (SEM), Transmission electron microscopy (TEM), energy dispersive X-ray spectroscopy (EDS), atomic force microscopy (AFM), small angle X-ray scattering (SAXS), differential scanning calorimetry (DSC), thermo gravimetric analysis (TGA). **(6 Hrs)**
Unit VI	**Application of Nanomaterials and Nanocomposites** Biomedical-drug delivery, bone replacement; sensors – gas sensor, metal adsorption and recovery, bio-molecule detectors; energy storage and conversion - super

	capacitors, solar cells, energy generators; electronics; self cleaning and self healing paints, nano-engineering of cement-based materials, agricultural nanotechnologies. **(6 Hrs)**				
Textbook/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Polymer Nanocomposites Processing, Characterization, and Applications	Joseph H. Koo	McGraw-Hill Nanoscience and Technology Series	1st
	2.	Encyclopaedia of Nanoscience and Nanotechnology	Hari singh Nalwa	American Scientific publishers	-
	3.	Chapter: Advanced Hybrid Nanostructures: Preparation, Properties and Applications, Book: Encyclopaedia of Nanoscience and Nanotechnology	Aniruddha Chatterjee et al	American Scientific Publishers	2018
	4.	Nanoparticle Technology Handbook	M Hosokawa, K Nogi, M Naito, T Yokoyama	Elsevier	-
	5.	The Science of Nanotechnology: An introductory text	Luanne Tilstra et al	Nova Science Publishers, Inc.	-
	6.	Polymer-Layered Silicate and Silica Nanocomposites	Y.C. Ke, P. Stroeve	Elsevier	2005
	7.	Nanotechnology in concrete – A review	Florence Sanchez, Konstantin Sobolev	Construction and Building Materials, Elsevier	24 (2010) 2060–2071
	8.	Agricultural Nanotechnologies: What are the current possibilities?	Claudia Parisi et al	Nano Today, Elsevier	2014

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech (Mechanical Engineering) Semester V	
Course Code: MED321 Course: Lab -Design of Machine Elements-I **Teaching Scheme:** Practical: 2 Hr./week	Credits: 0-0-1 Practical: 25 Marks
Course Content: The lab work consists of the assignments/experiments related to **A. Two full imperial sheets on following:** 1. Design and drawing sheet on any one of the following: Cotter joint, Knuckle joint, lever loaded safety valve or spring loaded safety valve 2. Design and drawing sheet on any one of the following: Rigid or flexible coupling, bolted or welded joints, including bending and eccentric loading, Power screw or screw jack, C-clamp **B. Assignments on following topics:** Design of Screw & Fasteners, Design against static loading, Fundamentals of design of machine Elements, Design against Fluctuating load, Design of Spring, Design of Riveted & Welded Joints **C. Case Study-I** Case study on the design of mechanical joint involving multiple machine components: It should expose the students to some aspects of joint design such as selection and configuration of the mechanical joint	

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V		
Course Code: MED322 Course: Lab-Materials and Metallurgy **Teaching Scheme:** Practical: 2 Hrs/week		Credits: 0-0-1 Practical: 25 Marks
Objectives	:	1. To understand the principal of optical microscopy. 2. To prepare specimen for metallography. 3. To study microstructures of steels, cast irons and non-ferrous materials. 4. To study heat treatment and changes in properties of metals. 5. To study mechanical properties like hardness, hardenability, strength, wear resistance, etc. of materials.
List of Practical/ Assignments	:	1. Measurement of Hardness by Rockwell Hardness Test. 2. Study of mechanical properties like tensile strength, impact strength and wear resistance of materials. 3. Study of Metallurgical Microscope. 4. Study and preparation of specimen for microscopic examination. 5. Observation of microstructure of various types of Plain carbon steels and Alloy steels. 6. Observation of microstructure of various types of Cast irons. 7. Observation of microstructure of the Non-ferrous alloys. 8. Study of changes in material properties and microstructures after Heat treatments like Annealing, Hardening, Tempering, Cryogenic Treatment, etc. 9. Study of Jominy end quench test to understand the concept of Hardenability. 10. Study of nanomaterials and nanocomposites.

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V		
Course Code: MED323 Course: Lab-Internal Combustion Engine **Teaching Scheme:** Practical: 2 Hrs/week		Credits: 0-0-1 Term Work: 25 Marks
Objective	:	1. To deal effectively with practical engineering situations, including analysis, selection and performance, and design of Internal Combustion Engines and the equipment's associated with it.
List of Practical/ Assignments	:	1. Trial on Diesel Engine with variable load & constant speed. 2. Trial on Diesel Engine with variable speed & constant load. 3. Trial on Petrol Engine with variable load & constant speed. 4. Trial on Petrol Engine with variable speed & constant load. 5. To draw the actual Valve Timing diagram for a given engine. 6. Dissembling & Assembling of the given Carburetor. 7. Morse Test. 8. Study of different types of fuel injection systems 9. Study of different types of carburetors. 10. Study of Cooling and Lubrication system. 11. Assignment on Exhaust Emission. 12. Study and demonstration on VTEC system.
(Any TEN practical to be performed from the given list)		

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V		
Course Code: MED324 Course: Lab-Mechatronics **Teaching Scheme:** Practical: 2 Hrs/week		Credits: 0-0-1 Term Work: 25 Marks
Objectives	:	1. To understand mechatronics system components. 2. To understand working of sensors, actuators, and PLCs.
List of Practical/ Assignments	:	1. Demonstration and study of mechatronics system and its components. 2. Demonstration and study of sensors and its wiring. 3. Demonstration and study of actuators and its wiring. 4. Demonstration of PLC and its components. 5. PLC programing for ON/OFF of a motor. 6. Demonstration and study of SCADA system. 7. Demonstration and study of Electro-pneumatic system. 8. Demonstration and study of Hydraulic system. 9. Demonstration and study of Industrial automation system. 10. Industrial visit for study of SCADA system.

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V		
Course Code: MED325 Course: Lab-CAD/CAM/CAE **Teaching Scheme:** Practical: 2 Hrs/week		Credits: 0-0-1 Term Work: 25 Marks
Objectives	:	1. Operate CAD packages to prepare solid model of components, assemble them to represent complex mechanical systems. 2. Introduction to CNC part programming. 3. Introduction to Rapid prototyping.
List of Practical/ Assignments	:	1. 2D Part modelling practice. 2. 3D Part modelling practice. 3. Component details and assembly in CAD. 4. Analysis of simple 2D/3D component. 5. Part programming on CNC lathe machine. 6. Part programming on CNC milling machine. 7. Part programming on CNC drilling machine 8. Part modelling on a RP machine. 9. A case study on computer integrated manufacturing. 10. Report on industrial visit.
(Any 10 number of practical to be performed from the given list)		

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (All) Semester V

Course Code: MED326 Course: - Minor Project **Teaching Scheme:** Practical: 2 Hrs/week	Credits:0-0-1 Term Work: 25 Marks

Objectives	:	1. To plan for various activities of the project and distribute the work amongst team members. 2. To develop the ability to define and design the problem and lead to its accomplishment with proper planning. 3. To understand the importance of document design by compiling Technical Report on the Minor Project work carried out. 4. To develop student 's abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Minor Project.
Guidelines	:	1. Students should select a problem which addresses some basic home, office or other real-life applications. 2. Projects which will address the social issues will be given due weightage. 3. It is desirable that the systems developed by the students have some novel features. 4. The batch size shall not exceed TWO students per batch. 5. The students have to select a suitable problem, design, prepare the drawings, produce the components, assemble and commission the project. 6. Institute may arrange demonstration with poster presentation of all minor projects developed by the students at the end of semester. 7. At the end of the semester, the students have to prepare and present 20-25 pages project report. 8. Final evaluation shall be based on continuous internal assessment followed by Viva-Voce.

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V	
Course Code: MED327 Course: Lab- Development of Software Skills-I **Teaching Scheme:** Practical: 2 Hrs/week	Credits: 0-0-1 Practical: 25 Marks

Course Content:

The lab work consists of the assignments/experiments related to Introduction to MATLAB Software

1. MATLAB window: Command window, Workspace, Command history, setting directory, Working with the MATLAB user interface
2. Basic commands, Assigning variables, Operations with variables
3. Data Types: Character and string, Arrays and vectors, Column vectors, Row vectors
4. Basic Mathematics: BODMAS Rules, Arithmetic operations, Operators and special characters, Mathematical and logical operators, Solving arithmetic equations
5. Operations on matrix: Crating rows and columns Matrix, Matrix operations, Finding transpose, determinant and inverse, Solving matrix
6. Plots: Plotting vector and matrix data, Plot labelling, curve labelling and editing, 2D plots: Basic Plotting Functions, Creating a Plot
7. MATLAB Programming for problem solving.

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester V

Course Code: MED328 Course: Experiential / Problem Based Learning **Teaching Scheme:** Practical: 2 Hrs/week	Credits: 0-0-1 Term Work: 25 Marks

Course Objectives:

On completion of the course, learner will be able to –

- To develop positive attitude, new skills, or new ways of thinking.
- To introduce independent and group learning by solving real world problem with the help of available resources.
- To be able to develop systematic approach in technical documentation.
- To select and utilize appropriate Software tools/Equipment/Problem solving tools to solve real life problems.

Guidelines:

The students plan, manage and complete a activity which addresses the stated problem.

1. The students must work in group to solve real life problem.
2. Open ended problems from course teachers can be considered from any course related to engineering field. (It can be domain specific/multidisciplinary but the emphasis on Mechanical Engineering)
3. A mentor to be assigned to 3-4 groups / one batch.
4. The steps to be followed for problem-based learning are as mentioned below:

Step 1: Explore the issue.
Gather necessary information; learn new concepts, principles, and skills about the proposed topic.
Step 2: State what is known.
Individual students and groups list what they already know about the scenario and list what areas they are lacking information.
Step 3: Define the issues.
Frame the problem in a context of what is already known and information the students expect to learn.
Step 4: Research the knowledge.
Find resources and information that will help create a compelling argument.
Step 5: Investigate solutions.
List possible actions and solutions to the problem, formulate and test potential hypotheses
Step 6: Present and support the chosen solution.
Clearly state and support your conclusion with relevant information and evidence.
Step 7: Review your performance.
Often forgotten, this is a crucial step in improving the problem-solving skills. Students must evaluate their performance and plan improvements for the next problem.

Recommended parameters for assessment, evaluation, and weightage:

1. Identification of the Problem (20%)
2. Documentation (Gathering requirements, design & modelling, implementation/execution, use of technology and final report, other documents). (30%)

3. Demonstration (Poster Presentation/Model Exhibition etc). (20%).
4. Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (10%)
5. Outcome (Participation in technical events / publication in national international conference journal/copyright/patent/prototype). (20%)

	Sr. No.	Title	Author
Reference Books/ Research Articles:	01	A new model of problem-based learning	Terry Barrett
	02	Research Methodology: Methods and Techniques	C. R. Kothari
Web Resources:		1. Problem-Based Learning: https://www.coursera.org/lecture/university-teaching/problem-based-learning-i-pbl-in-practice-SMXol 2. Problem-Based Learning: https://onlinecourses.swayam2.ac.in/ntr20_ed29/preview	

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech (Mechanical Engineering) Semester- VI

Course Code: MED351	Credits: 3-0-0
Course Title: Design of Machine Elements-II	Mid Semester Examination-I: 15 Marks
Teaching Scheme:	Mid Semester Examination-II: 15 Marks
Theory: 3 Hrs./week	Teacher Assessment: 10 Marks
Practical: 2 Hrs/week	End Semester Examination: 60 Marks
	End Semester Examination (Duration): 3 Hrs

Prerequisite	• Knowledge of SOM and DME-I
Objectives	1. Understand the procedure of gear design and gear trains. 2. Predict effectively and accurately the reasons of failure and then correlate it to the theoretical knowledge. 3. Developing the capability of analyze and select the various criteria of design. 4. Developing the creativity for designing the mechanical power transmission drive and its components. 5. Understand the basic concepts of finite element method, boundary element method, virtual prototyping, optimization methods
Unit I	**Design of Gear Drive:** Design considerations of gears, material selections, types of gear tooth failure .A] Design of Spur gears, Helical gears, Worm gears & bevel gears B] Introduction to Gear trains and types of gear trains. **(11Hrs)**
Unit II	**Design of Friction Clutch:** Introduction of friction clutch, design of single plate clutch, multi-plate clutch, cone clutch and centrifugal clutch. **(5 Hrs)**
Unit III	**Design of Belt Drives:** Introduction, types, materials of belt drives. A] Flat belt: Design of Open flat belt and Crossed flat belt. B] V-belt: Design of V-belt using standard catalogue. **(5 Hrs)**
Unit IV	**Design of Wire Rope & Chain Drive:** Introduction, types and material selection A] Design of wire rope. B] Design of simple chain drive. **(5 Hrs)**
Unit V	**Design of Bearings:** Introduction of bearings, Types of bearings A] Sliding Contact Bearing: Design of hydrodynamic & hydrostatic bearings. B] Rolling Contact Bearing: static and dynamic load capacities, bearing life, design for variable load and speed **(7 Hrs)**
Unit VI	**Advanced Techniques in Machine Design:** Introduction to Finite Element Method, Boundary Element Method, Virtual prototyping, Optimization methods. **(3 Hrs)**

Textbook/ Reference Books

Sr.No	Title	Author	Publication	Edition
1.	Design of Machine Elements	J. E. Shigley	TMH Publication	10th
2.	Design of Machine	M. F. Spotts	Prentice Hall	8th

			Elements			
		3.	Machine Design	V. B. Bhandari	TMH Publication	4th
		4.	Machine Design	Khurmi & Gupta	Eurasia Publishing House	25th
		5.	Machine Design	U. C. Jindal	Pearson Publication	1st

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester VI

Course Code: MED352 Course: Theory of Machines **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	• Engineering Drawing, Engineering Mechanics
Objectives	1. To understand classification and types of mechanisms. 2. To understand kinematics and dynamics of various machines. 3. To understand functions and types of various machine elements. 4. To understand balancing of various unbalanced forces in machines.
Unit I	**Mechanisms and Inversions**: Rigid body, Mechanism and Machine, Kinematic Link, Kinematic Pair and their Classification, Degrees of Freedom, Kinematic Chain, Linkage, Mechanism and Structure, Gruebler's Criterion for degrees of freedom, Inversions of Four Bar mechanism, Slider- Crank mechanism, Kinematic inversions, Double slider-crank mechanism. **(4 Hrs)**
Unit II	**Velocity Analysis**: Velocity analysis of mechanisms (having maximum six links) using relative velocity method and Instantaneous centre method, Kennedy's theorem, Determination of linear and angular velocities and their directions. **(6 Hrs)**
Unit III	**Acceleration analysis:** Acceleration analysis of mechanisms. Problems involving Coriolis's component of acceleration. Determination of linear and angular component of acceleration using graphical and analytical method. Klein's construction and Ritterhaus construction method for simple engine mechanisms. **(8 Hrs)**
Unit IV	**Classification of cams and followers**: Types of cams and followers, Terminology and definitions. Displacement diagrams of follower with Uniform velocity, simple harmonic motion, uniform acceleration and retardation and cycloidal motions. Construction of cam profile using these motions. Determination of velocity and acceleration. **(6 Hrs)**
Unit V	**Flywheel, Governors, Brakes and Dynamometer:** Turning moment diagram, fluctuation of energy in flywheel. Principle, working and types of governor like Watts, Porter, Proell and Hartnell governor. Functions and types of Brakes. Types of dynamometers. Absorption type dynamometers like Prony brake rope brake and transmission type dynamometer like belt transmission, epicyclic gear train and torsion dynamometer. **(6 Hrs)**
Unit VI	**Balancing:** Balancing of rotating masses acting in one or more planes. Static and dynamic balancing. Balancing of reciprocating engines. Primary and secondary forces and couples acting on single cylinder and double cylinder engines. Balancing of in line, radial, V-engine. **(6 Hrs)**

Textbook/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Theory of Machines	S. S. Ratan	Tata McGraw Hill	5th

	2.	Theory of Machines	T. Beven	Pearson Education India	3rd
	3.	Theory of Machines	P. L. Ballaney	Khanna Publications	3rd
	4.	Theory of Machines	Joseph E Shigley	John Uicker McGraw Hill	2nd
	5.	Textbook of Theory of Machines	R.K.Bansal	Laxmi publications	Revised 1st

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester VI	
Course Code: MED353 Course: Heat Transfer **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Prerequisite	• Fundamental knowledge of Thermodynamics and Physics • Basic understanding of Engineering Mathematics
Objectives	1. To study the fundamental principles and laws of heat transfer and to explore the implications of these principles for system behavior. 2. To study, analyze and design heat transfer systems through the application of these principles. 3. To develop the problem-solving skills essential to good engineering practice of heat transfer in real-world applications.
Unit I	**Introduction:** Introduction, Modes and laws of heat transfer, Mechanism of modes of heat transfer, Thermo-physical properties and their significance, Electrical Analogy, Derivation of generalized heat conduction equation in Cartesian, cylindrical and spherical co-ordinates with simplification of the same. **(4 Hrs)**
Unit II	**Steady state and Unsteady state heat conduction:** One dimensional steady state heat conduction: -Heat conduction through a plane wall, cylindrical wall and sphere, Heat conduction through a composite slab, cylinder and sphere, Effect of variable thermal conductivity, Critical radius of insulation, economic insulation, and thermal contact resistance, One dimensional steady state heat conduction with heat generation for plane wall, cylinder, sphere. Unsteady state heat conduction: -Development of unsteady state heat transfer equation for objects /system with negligible internal resistance, Biot and Fourier numbers, Lumped heat capacity method, Use of Heisler charts. **(8 Hrs)**
Unit III	**Extended Surfaces (Fins):** Need Types and Applications of Fins, Theory of simple pin-fin under steady state conduction without heat generation with different end conditions, Derivation of temperature distribution equations and heat transfer through fins of constant cross-sectional area, Effectiveness and efficiency of a fin, Application of fin theory for error estimation in temperature measurement. **(6 Hrs)**
Unit IV	**Convection heat transfer:** Introduction: -Local and average convective coefficient, Hydrodynamic and thermal boundary layer, Laminar and turbulent flow over a flat plate and through a duct, Friction factor, Drag and drag co-efficient. Free and Forced Convection: -Different dimensionless numbers and physical significance of these dimensionless numbers related to free and forced convection, Empirical correlations for free and forced convection for heat transfer in laminar and turbulent flow over a flat plate and through a duct, Condensation heat transfer, Nusselt theory, film wise and drop wise condensation, heat transfer in pool boiling phenomenon. **(6 Hrs)**

Unit V	**Radiation:** Fundamental concepts and definitions, Black body radiation, Planck's distribution law, Wien's displacement law, Stefan-Boltzmann law, Kirchhoff's law, Lambert's cosine law. Surface emission, radiative properties of a surface, grey, black, and real surface, Radiation shape factor, use of shape factor charts, Heat exchange between non-black bodies, heat exchange between two infinitely parallel planes and cylinders, Radiation shields, heat exchange by radiation between two finite black/gray surfaces, Irradiation, radiation potential, electrical network method of solving radiation problems. **(6 Hrs)**
Unit VI	**Heat Exchangers:** Heat exchangers classification, Overall heat transfer coefficient, Heat exchanger analysis, use of log mean temperature difference (LMTD) for parallel and counter flow heat exchangers, LMTD correction factor, fouling factor, The effectiveness-NTU method for parallel and counter flow heat exchangers. Design considerations of heat exchanger, compact heat exchangers. **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	A Textbook of Heat Transfer	S. P Sukhatme	University Press, Edition	4th
2.	Heat & Mass Transfer	Yunis A. Cengel & A.J. Gajar	Tata McGraw Hill	5th
3.	Heat & Mass Transfer	R. K. Rajput	S. Chand Publication	New 2008
4.	Heat Transfer	J. P. Holman	Tata McGraw Hill	10th
5.	Fundamentals of Engineering Heat & Mass Transfer	R.C. Sachdeva	Wiley Eastern Ltd. (I)	5th
6.	Heat & Mass Transfer	D.S.Kumar	Katson's Publication	Reprint 2013
7.	Fundamentals of Heat & Mass Transfer	Incropera and Dewitt	John Wiley and Sons	2018

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester VI	
Course Code: MED391 Course: Professional Elective Course -III (Automobile Engineering) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Prerequisite	• Fundamental knowledge of Thermodynamics and Theory of Machines • Basic understanding of I.C. engines and its components
Objectives	1. To study basics of principles of Automobile systems 2. To study working of various Automobile systems 3. To study modern trends in Automobiles
Unit I	**Introduction to Automobiles** Classification of Automobiles, Sub-systems of Automobiles. Chassis: Terminology, Forces acting on chassis during running, Frame: Functions, Construction and Types, Sub-frame, Materials and defects in chassis, Troubleshooting in chassis. Power unit: Functions, Construction, Multi-cylinder engines: Engine balance and firing order. **(4 Hrs)**
Unit II	**Fuel Feed Systems, Lubrication Systems and Cooling Systems for Power Unit** Fuel feed systems for petrol engines: Carburetion, Fuel pump, MPFI. Fuel feed systems for diesel engines: Fuel injection, Diesel injection system, CRDI. Cooling systems: Purpose and Types, Troubles and remedies of cooling systems. Lubrication systems: Functions, Properties and Types of Lubricants, Methods of lubrication: mist, splash, pressure, dry and wet, Troubleshooting for lubrication systems. **(8 Hrs)**
Unit III	**Transmission Systems** Transmission system: Functions and Components, Types of gear boxes: constant mesh, sliding mesh and synchromesh, Automatic transmission: epicyclic gear train and fluid flywheel, Clutches: functions and types, Propeller shaft, Universal joint, Sliding joint, Differential unit: functions, components and working, Troubleshooting in transmission system. **(7 Hrs)**
Unit IV	**Steering Systems and Wheels** Steering system: Functions of steering mechanism, Ackermann steering geometry, Steering gear box types, Types of front and rear axles, Power steering, Troubleshooting in steering system. Wheel geometry, Types of wheels: Disc, Wire, Light weight alloy wheels, Tyre: types, specifications, designation system. **(5 Hrs)**
Unit V	**Braking and Suspension Systems** Functions of Brakes, Types: Disc and Drum, Operation principle: mechanical, hydraulic, air, vacuum and electric / electromagnetic, Power brakes, Fault finding and maintenance of brakes. Objectives and Components of suspension system: Spring, shock absorber, Types of suspension systems, Difference between dependent and independent suspension for

	front and rear axles. **(6 Hrs)**
Unit VI	**Innovations on Automobiles** Anti-lock braking system (ABS), Regenerative braking, Traction control system (TCS), 4-wheel steering, 4-wheel drive (4WD), All wheel drive (AWD), Electronically controlled active suspension (ECAS) system, Safety restraint system (Air bags), Introduction to e-vehicles and hybrid vehicles. **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Automobile Engineering (Vol. I)	Kirpal Singh	Standard Publishers Distributors, Delhi	13th
2.	Automobile Engineering (Vol. II)	Kirpal Singh	Standard Publishers Distributors, Delhi	13th
3.	Automobile Engineering	R. B. Gupta	Satya Prakashan, New Delhi	7th
4.	A Textbook of Automobile Engineering	R. K. Rajput	Laxmi Publications	2nd
5.	Automotive Mechanics	W. H. Crouse	Tata McGraw-Hill, Inc.	10th

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester VI	
Course Code: MED392 Course: Professional Elective Course -III (Reliability Engineering) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Prerequisite	• Knowledge of probability theory and its applications • The ability to understand and anticipate the possible causes of failures, and knowledge of how to prevent them. • To have knowledge of the methods that can be used for analyzing designs and data.
Objectives	1. To present the fundamentals of reliability engineering. 2. To provide the students with the fundamental concepts and necessary knowledge related to systems reliability 3. To expose with the necessary engineering techniques used for Analyzing, Planning and controlling reliability systems
Unit I	**Introduction**: Reliability, availability and maintainability, Reliability concepts and patterns of failure, modes of failure, reliability assurance rules, product liability, importance of reliability. **(4 Hrs)**
Unit II	**Reliability of Systems:** series and parallel configuration, Combined series and parallel configuration, mixed configuration, K-out of n structure, analysis of complex systems-enumerations method, conditional probability method, delta star method for conditional probability analysis, Cut set & Tie set Method, nodes removal matrix method, system reliability analysis-block diagram method. **(8 Hrs)**
Unit III	**The Failure Distribution:** Failure data, reliability function, MTTF, Mean time Between Failure (MTBF), Failure rate and failure hazard rate, Bath tub curve, common distributions in failure mechanisms-exponential, Weibull, Normal, Log normal, Constant hazard rate model, increasing hazard rate models, decreasing hazard rate model, time dependent & stress-dependent hazard models. **(8 Hrs)**
Unit IV	**Reliability Design:** Design for reliability. Design process, assessment, Methodology, Reliability allocations, reliability improvements, selection of components to improve the systems reliability. **(4 Hrs)**
Unit V	**Reliability, availability & maintainability (RAM) Analysis:** Introduction to RAM failure mechanism, failure data analysis, reliability of repairable & non repairable system, system reliability by Monte Carlo simulation Techniques, reliability allocation or apportionment, reliability apportionment techniques-equal apportionment, AGREE, ARINC, feasibility of objectives apportionment, dynamic programming apportionment, minimum effort method, redundant systems. Reliability prediction based on exponential distribution, fault tree and success tree methods, events tree method, failure model, failure mechanism. **(8 Hrs)**

Unit VI	**Reliability Testing:** product testing, reliability life Testing, Burn- In testing, and accelerated life testing, Censored and uncensored field data, acceptance testing. **(4 Hrs)**				
Textbook/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	An Introduction to Reliability and Maintainability Engineering	Charles E. Ebeling	TMH Publication, New Delhi.	12th
	2.	Concept in Reliability in Engineering	L.S. Srinath	Affiliated East West Press.	4th
	3.	Reliability in Engineering Design	K.C.Kapur & L.R.Lumbersome	John Willey and sons	-
	4.	Reliability Base Design	S S Rao	TMH Publication, New Delhi.	1st
	5.	Reliability Analysis for Engineers	Roger D Leitch	Oxford University Press	-

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Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester VI

Course Code: MED393 Course: Professional Elective Course -III (Automation in Manufacturing) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	• Knowledge of various manufacturing processes
Objectives	1. To give an idea about various sectors of manufacturing where automation can be implemented. 2. To aware students about different technologies practiced in different sections of manufacturing.
Unit I	**Introduction:** Introduction to manufacturing automation, Types of Automation, Levels of Automation, Computer Aided Design, Computer Aided Manufacturing. Computer Aided Engineering. **(6 Hrs)**
Unit II	**NC/CNC Machines:** Introduction, Block diagram of CNC, Main Parts of CNC machines, Coordinate systems, Fixed and floating zero concept, Manual part programming (G-codes, M-codes). **(6 Hrs)**
Unit III	**Flexible Manufacturing Systems:** Flexible manufacturing system introduction, Types of flexibility in Manufacturing, Group technology and FMS, Components of FMS, Types of FMS. **(6 Hrs)**
Unit IV	**Industrial robots:** Introduction to robots, Physical configuration of Robot, types of robots – Articulated robot, SCARA robot, cylindrical robot, Delta robot, Cartesian robot, Robot programming methods - Teaching, Lead through, Offline robot programming. **(6 Hrs)**
Unit V	**3D Printing:** Introduction to 3D printing, Steps in 3D printing, 3D printing technologies - Stereolithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Digital Light Process (DLP), Multi Jet Fusion (MJF), PolyJet, Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM). **(6 Hrs)**
Unit VI	**Advanced Manufacturing Administrative Technologies:** Product cycle and product life cycle, Product Lifecycle Management, Phases of product lifecycle, ERP, Types of ERP Systems – On premise, Cloud based, Hybrid. **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Introduction to mechatronics & Measurement system.	David G. Alicator Michal B. Histand	McGraw Hill	4th
2.	Programmable Logic Controller	W. Bolton	Newnes	6th
3.	Automated Manufacturing System	Hugh Jack	Lulu.com	7th

	4.	Pneumatic Actuation System	Igor L. Krivts German V. Krejnin	Taylor & Francis	1st
	5.	Handbook of Ind. Automation	Richard L. Shell Ernest L. Hall	Marcel Dekker	1st

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Course Code: MED394 Course: Professional Elective Course -IV (Fundamental of Automobile Design) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	• Knowledge of basics of Machine design is essential
Objectives	1. To study basics of design of styling 2. To study basics of design of bonnet 3. To study sheet metal design, manufacturing cycles in Automobiles manufacturing
Unit I	Introduction to styling, Design, Design Examples, Industrial Design, applications. Typical Product Life Cycle, Automotive Design Process (Design Process for production release), Design Studio Process or Product Conceptualization process, case study, CAS Surfaces or Digital Clay Models, Class A Surfaces, Role of Class A Surface Engineer, Requirements for Class A Surface, Case Studies for Class A Surfaces, Step by Step Process for Bonnet Class A Surface Creation. Good Design & its examples **(6 Hrs)**
Unit II	Function of a bonnet, Inputs for the bonnet, Design procedure- Develop Hood Package Layout, Develop Typical Sections, Define Block Surfaces in 3D, Define Dynamic Clearance Surfaces in 3D, Define Hood Structural Members, CAE 1(Durability, crash), Panel Detail Design, Define Body Assembly Process, CAE 2(Durability, crash, Individual pane l level). Design Updating and Detailing Prototypes, Design Updating and Production Release **(6 Hrs)**
Unit III	Introduction to CAD, CAM & CAE: FEA, NVH, Dura, Crash, Occupant Safety, CFD, Implicit vs. Explicit Solvers, Degrees of Freedom, Stiffness matrix, Types of Solvers, Durability: Oil Canning on Hood, Scope of Work, NVH: Constrained Modal Analysis on Hood, Scope of Work, Loading, Boundary Conditions, Results & Conclusion, Crash: Vehicle Crashworthiness, Energy Management, Biomechanics, Head Impact Analysis on Hood, Importance of Failure Criteria **(6 Hrs)**
Unit IV	Introduction to Sheet metal design and manufacturing cycle, Simultaneous Engineering (SE) feasibility study, Auto body and its parts, Important constituents of an automobile, different types of Sheet metal processes, Types of draw dies, Draw Model development, forming simulations, Material properties Forming Limit Curve (FLD), Preprocessing, Post Processing, Sheet Metal Formability – Simulation **(5 Hrs)**
Unit V	Die design: Requirements, Sheet metal parts and their operation like Cutting, Non-cutting etc., Presses, Various elements used in die design., Function of each element explained with pictures, Different types of dies, **(6 Hrs)**
Unit VI	Fixture design: Requirements, definition, operation and elements of fixture design, Different types of welding processes used for fixture, Body Coordinates 3- 2-1 principle, need for Fixture, Describe Design Consideration. Specification of product using GD&T in the Fixture design. List the Fixture Elements. Describe typical operations in Sheet metal Fixture using Manual/Pneumatic/Hydraulic fixture, typical Unit Design for Sheet metal parts (Rest/Clamp/location/Slide/Dump units/base), types

	of Fixture (Spot welding/Arc welding/Inspection Fixture/Gauges) **(7 Hrs)**				
Textbook/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Fundamentals of Modern Manufacturing: Materials, Processes, and Systems	Mikell P. Groover	John Wiley & Sons Ltd.	4th
	2.	Jig and Fixture Design	Edward G. Hoff man	Delmar, Cengage Learning	5th
	3.	H-Point_The Fundamentals of Car Design & Packaging	Stacey Macey, Stuart Macey, Ralph Gilles, Freeman Thomas, Gordon Murray, Geoff Wardle	Design Studio	1st
	4.	The Automotive Body Manufacturing Systems and Processes	Mohammed A. Omar	2011 John Wiley & Sons Ltd	1st
	5.	Manufacturing Processes 4 Forming	Klocke, F. (n.d.)	Retrieved from http://www.springer.com/series/7858	1st
	6.	Sheet Metal Forming Processes: Constitutive Modelling and Numerical Simulation	Banabic, D. (n.d.).	Retrieved from https://www.springer.com/gp/book/9783540881124	1st

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Syllabus of Third Year B. Tech. (All) Semester VI

Course Code: AED381 Course: Open Elective-II (Fundamentals of Bioenergy) **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 End Semester Examination: 60Marks End Semester Examination (Duration):3 Hrs

Prerequisite	• Biomass sources and waste to energy recovery
Objectives	1. Understand bioenergy technologies, processes, reactions and energy conversion rates for anaerobic Digestion, gasification, pyrolysis 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, Road Map of Bioenergy, Basic Biomass Technology (Resources and Production) Exploration of Photosynthesis Process **(6 Hrs)**
Unit II	**Biogas-** Basic concept in anaerobic digestion and bio gasification, mechanism of anaerobic digestion, Biochemical methane potential assay and calculations for bio gasification feasibility analysis, Biogas utilization, Biomass production System and their Categorization, Components of biogas plants **(6 Hrs)**
Unit III	**Bioethanol-** Basic concept of Cellulosic Bioethanol Process, Pre-treatment and Enzyme treatment of Cellulosic Bioethanol Process, Fermentation and Distillation in Cellulosic Bioethanol Production, characteristics of bioethanol **(6 Hrs)**
Unit IV	**Biodiesel-** Biodiesel production processes, Biodiesel characterization , Biodiesel feedstocks, biodiesel characteristics, Environmental permitting and safety considerations for biodiesel production **(6 Hrs)**
Unit V	**Thermo Chemical Processes:** Basic concepts in gasification and pyrolysis, Gasification and pyrolysis systems, Gasification Types - Up Drift Gasifier, Down Draft and cross flow gasifier, operation and performance of gasifier **(6 Hrs)**
Unit VI	Bioenergy distribution and end use for a sustainable future: Biological root of gasification, non-conventional energy sources, waste-to-energy recovery **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Introduction to Bioenergy (Energy and the Environment)	Vaughn C. Nelson (Author), Kenneth L. Starcher	CRC press	1st
2.	Bioenergy: Biomass to Biofuels	Anju Dahiya	AP Publications	Illustrated edition (2014)
3.	Bioenergy: Principles and Applications	Yebo Li and Samir Kumar Khanal	Wiley Publications	1st

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Syllabus of Third Year B. Tech. (All) Semester VI

Course Code: CED381 Course: Open Elective-II (Solid Waste Management) **Teaching Scheme:** Theory: 3 Hrs/week	Credits: 3 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 10 Marks End Semester Examination: 60 Marks End Semester Examination (Duration): 3Hrs

Prerequisite	• Environmental Engineering
Objectives	1. 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, Pyrolysis, Incineration, Advantages and disadvantages of various technological options. **(6 Hrs)**
Unit V	**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)**
Unit VI	**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, labeling and handling of hazardous wastes, incineration, solidification & stabilization of hazardous waste. **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Integrated Solid Waste Management	Hilary Theisen and Samuel A, Vigil, George Tchobanoglous	McGraw- Hill, New York	1993
2.	Manual on Municipal Solid	CPHEEO, Central Public	Government of India, New Delhi	2000

		waste management	Health and Environmental Engineering Organization		
	3.	Environmental Resources Management and Hazardous waste Management,	Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans	Mc-Graw Hill International edition, New York	2001
	4.	Solid waste Engineering	Vesilind P.A., Worrell W and Reinhart	Thomson Learning Inc., Singapore	2002
	5.	Hazardous Waste Management	Charles A. Wentz	McGraw Hill International Edition, New York	1995 Second Edition

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (All) Semester VI	
Course Code: CSE381 Course: Open Elective-II (Information & Cyber Security) **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 End Semester Examination: 60Marks End Semester Examination (Duration):3 Hrs

Prerequisite	Knowledge of Computer Networking is necessary to understand the concepts.
Objectives	1. To understand the foundations of Information Security. 2. To learn various types of algorithms and its applications of Cyber Security 3. To identify insights on how to apply Cyber Security
Unit I	**Introduction** The History of Information Security, Balancing Information Security and Access, Introduction and Security Trends, General Security Concepts and introduction to what is an "infosphere", Operational Security and People's Role in Information Security. **(6 Hrs)**
Unit II	**Security Needs** The Need for Security, Business Needs, needs to protect against Threats and Attacks, Security in Emails. Secure Software Development. Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. **(6 Hrs)**
Unit III	**Cryptography Concepts** Concepts of Data encryption, Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric &Asymmetric key Cryptography. Public Key Infrastructure (PKI), Different attacks on Cryptosystems. **(6 Hrs)**
Unit IV	**Internet Standards and Authentication** Basic concepts of Internet Standards and Physical Security, Network Security and Infrastructure, Authentication Basics, Password, Authentication Token, Certificate based Authentication, Basics of authentication in Wireless Networks, Need of authentication in Wireless Communication. **(6 Hrs)**
Unit V	**Security in Evolving Technology** Biometrics, Mobile Computing and Hardening on android and ios, IOT Security, Web server configuration and Security. Introduction, Basic security for HTTP Applications and Services, Basic Security for Web Services like SOAP, REST etc., Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. Open Source/ Free/ Trial Tools: adb for android, xcode for ios, **(6 Hrs)**
Unit VI	**Cyber Security Vulnerabilities& Safeguards** Vulnerabilities-Overview, vulnerabilities in software, System administration, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, IT Audit, Authentication. Open Web Application Security Project (OWASP), Web Site Audit and Vulnerabilities assessment. Open Source/ Free/ Trial Tools: WinAudit, Zap proxy (OWASP), burp suite, DVWA kit. **(6 Hrs)**

	Sr. No.	Title	Author	Publication	Edition
Textbook/ Reference Books	1.	Cryptography and Network Security	William Stallings	Pearson Education/PHI	2006
	2.	Cryptography and Network Security	V.K. Jain	Khanna Publishing House.	7th
	3.	Principles of Information Security	Michael E Whitman and Herbert J Mattord	Vikas Publishing House, New Delhi.	6th
	4.	Handbook of Information Security Management	Micki Krause, Harold F. Tipton,	CRC Press LLC	6th
	5.	Information and Cyber Security	Gupta Sarika	Khanna Publishing House, Delhi.	1st
	6.	Cryptography and Network Security	Atul Kahate	McGraw Hill.	3rd

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (All) Semester VI	
Course Code: EED381 Course: Open Elective-II (Electrical Materials) **Teaching Scheme:** Theory: 3 Hrs/week Practical: 2 Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 10 Marks End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	• Basics of Electrical and Electronics Engineering, Physics, Chemistry
Objectives	1.To understand Basic electrical and electronics engineering. 2.To understand Electromagnetism and its laws. 3.To study the conducting and superconducting materials 4. To study the dielectric and nano materials
Unit I	**Crystallography** Crystal directions and planes, Diatomic Crystal (CsCl, NaCl, Diamond, BaTiO3) Crystal imperfection, Point defects, Line defects, Surface and Volume defects, Structure properties relationship, structure determination by X-ray diffraction. **(8 Hrs)**
Unit II	**Magnetic Materials** Origin of magnetization using atomic theory, classification of magnetic materials and properties, Laws of magnetism, comparison of electrical and magnetic circuits theory of Día, Para and ferromagnetism, Soft and Hard magnetic materials and their uses, Domain theory of ferromagnetism, Hysteresis loss, Antiferromagnetic and Ferrimagnetic materials, Ferrites and Garnets. **(5 Hrs)**
Unit III	**Conducting and Superconducting Materials** Band theory of solids, Classical free electron theory of metals, Quantum free electron theory, Density of energy states and carrier concentration, Fermi energy, Temperature and Fermi energy distribution, Superconductivity, Factor affecting Superconductivity, Meissner effect, Type-I and Type-II superconductors, BCS theory, Josephson effect, High temperature superconductors, Application of superconductors. **(5 Hrs)**
Unit IV	**Semiconducting Materials** Band structure of semiconductor, Charge carrier concentration, Fermi level and temperature, Electrical conductivity, Hall effect in semiconductors, P-N junction diode, Preparation of single crystals, LED, Photovoltaic cell. **(6 Hrs)**
Unit V	**Dielectric Materials** Dielectric constant and polarizability, types of polarization, temperature and frequency dependences of Dielectric parameter, internal fields in solids, Clausius-Mosotti equation, dielectric loss, dielectric breakdown, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials. **(6 Hrs)**
Unit VI	**Nano Materials** Nanomaterials: Introduction and properties, synthesis of nanomaterials, Carbon Nano Tubes, Characterization techniques of nanomaterials- SEM, TEM, EDAX, FMR,

	XRD. Applications of nanomaterials. (6 Hrs)				
Textbook/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Electrical engineering materials	A.J. Dekkar	McGraw Hill Publication	2nd
	2.	Science of Engineering Materials and Carbon Nanotubes	C.M. Srivastava and C. Srinivasan	New Academic Science	3rd
	3.	Material Science and Engineering	V.Raghavan	PHI Learning	5th
	4.	Solid State Physics	A.J. Dekkar	Laxmi publication	3rd

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (All) Semester VI

Course Code: ETC381 Course: Open Elective-II (Internet of Things) **Teaching Scheme:** Theory: 3Hrs/week	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 10 Marks End Semester Examination: 60 Marks End Semester Examination (Duration):3 Hrs

Prerequisite	• Python Fundamentals, basics of electronics, Networking fundamentals, WWW Terminology
Objectives	1. To understand IOT value chain structure (device, data cloud), application areas and technologies involved 2. To understand IOT sensors and technological challenges faces by IoT devices. 3. Explore and learn about Internet of things with the help of projects
Unit I	**Introduction to IoT:** Industry 4.0., Definition of IOT- Evolution of IOT and related terms, hardware, software, network stack for IoT, SAAS Model **(6 Hrs)**
Unit II	**Elements of IoT:** Introduction to elements of IOT, Basic Architecture of an IOT application sensors, and Actuators, WPAN and LPWAN, 6LoPAN, Sigfox **(6 Hrs)**
Unit III	**IoT Sensors:** Node MCU ESP 8266- hardware specification, GPIO programming, WIFI connectivity programming, Access Point Programming, Introduction to basis looping and conditional statements, basics of HTML. **(6 Hrs)**
Unit IV	**Communication and Connectivity Technologies:** Introduction to: TCP/IP, UDP, NTP, MQTT, Network and Sockets, Cloud Computing in IOT, IOT Communication Model **(6 Hrs)**
Unit V	**Data Analytics and IOT Platforms:** Basics of statistics, Descriptive statistics and probability distributions. Big Data Analytics, Hadoop, Data Visualization, IOT Platforms Things speak, Microsoft Azure and Amazon Web Services, IBM Watson, Google Home and Amazon's Alexa **(6 Hrs)**
Unit VI	**Preparing IoT Projects** Creating the sensor project with Node MCU ESP 8266, Sensor libraries, Internal representation of sensor values, External representation of sensor values, Exporting sensor data, Creating the actuator project **(6 Hrs)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	The Internet of Things: Applications and Protocols,	Oliver Hersent, David Boswarthick, Omar Elloumi	Wiley publications	2nd
2.	Architecting the Internet of Things,	Dieter Uckelmann, Mark Harrison, Florian Michahelles	Springer publications	1st

	3.	Internet of Things with Arduino	Marco Schwatrz	Cookbook, Packt Publications	1st
	4.	Internet of Things	Arshdeep Bagha, Vijay Madisetti	Universities Press (India) Pvt. Ltd.	First
	5.	Introduction to internet of things - Course (nptel.ac.in)			

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
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Syllabus of Third Year B. Tech. (All) Semester VI

Course Code: MED381 Course: Open Elective II (Industry 4.0) **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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs

Prerequisite	Nil
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)**

Textbook/ Reference Books

Sr. No.	Title	Author	Publication	Edition
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	Dr. Mirjana	UNIDO	-

		4.0_Opportunities Behind The Challenge	Stankovic, Ravi Gupta and Dr. Juan E. Figueroa	General Conference 2017	
	5	Handbook of Ind. Automation	Richard L. Shell Ernest L. Hall	CRC Press	1st

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (All) Semester VI	
Course Code: PPE381 Course: Open Elective-II (Polymer Recycling and 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 End Semester Examination: 60 Marks End Semester Examination (Duration): 3 Hrs
Prerequisite	• Basic knowledge of polymeric materials, additives and their properties. • Basic knowledge of polymer rheology and processing.
Objectives	1. To learn the basic concepts used in the recycling of polymers along with learning about solid waste management.
Unit I	**Significance of Recycling** Introduction and classification of waste. Global polymer production and consumption, Global polymer waste composition, quantities and disposal, Identification of polymer for recycling. Recycling Process: collection, sorting and segregation of waste, Use of advanced technologies such as artificial intelligence in sorting, Recycling methods: primary, secondary, tertiary and quaternary recycling, landfilling. **(6 Hrs)**
Unit II	**Recycling Equipment/Machinery** Equipment for primary and secondary recycling: shredder, granulator, pulverizer, shredder, cutter, Classification and types of reactors for tertiary recycling, Case study on waste to energy conversion plant. **(5 Hrs)**
Unit III	**Recycling of Plastics from Urban Waste** Physiochemical, mechanical and rheological characteristics of recycled plastics, hydrolytic treatment of plastics waste containing paper, mixed plastic waste and its processing, recycling extrusion and additives used in polymer recycling, wood plastic composites, use of x-ray photoelectron spectroscopy (XPS) in recycling, international standards in recycling. **(7 Hrs)**
Unit IV	**Recycling Techniques** PE/PP packaging films and woven sacks, PET bottles and films, PVC products, fiber reinforced plastics (FRP), and rubber products. **(6 Hrs)**
Unit V	**Municipal Solid Waste Management and Treatment Techniques** Collection, storage, transportation and disposal of municipal solid waste, sorting of MSW, vehicles and equipment for primary collection, secondary collection and transport. a) Sanitary landfilling: Requirements, layout, leachate management, waste placement and inspection. b) Composting: windrow, aerated static pile, in vessel, decentralized, bin, box and vermicomposting. c) Biomethanation and refuse derived fuel. **(7 Hrs)**

Unit VI	**Tools for Combating Polymer Waste** Combating tools for waste management: Case studies on extended producer responsibility, product stewardship, usage of green products and usage of biodegradable or environmentally degradable polymers, plastic roads. **(5 Hrs)**				
Textbook/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Plastics Fabrication and Recycling	Manas Chanda and Salil K. Roy	CRC Press	4th
	2.	Introduction to Plastics Recycling	Vannessa Goodship	Smithers Rapra	2nd
	3.	Recycling of Polymers	Raju Francis	Wiley-VCH	1st
	4.	Recycling of Plastic Materials	Francesco Paolo La Mantia	Chemtec Publishing	2nd
	5.	Feedstock Recycling and pyrolysis of waste plastics	John Schiers & W. Kaminsky	John Wiley and Sons	1st
	6.	Mixed Plastic Recycling Technology	B. Hegberg, G. Brenniman	Noyes Data Corporation	1st
	7.	Plastics Waste: Recovery of Economic value	Jacob Leidner	Marcel Decker Inc.	2nd
	8.	Management of municipal solid waste	T. V. Ramchandra	TERI Press	1st
	9.	Waste Management	Martin F. Lehmann	I. A. Publishers	1st
	10.	Environmental Waste Management	Ram Chandra	CRC Press	1st
	11.	Plastic Waste	Jacob Leidner	Marcel Decker Inc.	1st

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech (Mechanical Engineering) Semester VI	
Course Code: MED371 Course: Lab-Design of Machine Elements-II **Teaching Scheme:** Practical: 2 Hrs/week	Credits: 0-0-1 Practical: 25 Marks
Course Content: The lab work consists of the assignments/experiments related to **A. Two full imperial sheets on following:** 1. Design and drawing sheet on any one of the following: Gear drives with two stages minimum 2. Design and drawing sheet on any one of the following: Friction clutches, Flat belt drive, v- belt drive, wire rope drive, chain drive **B. Assignments on following topics:** Design of Gear Drive, Design of Friction Clutch, Design of Belt Drives, Design of Bearings, Design of Wire rope & Chain Drive, Advanced Techniques in Machine Design **C. Case Study-II** Case study on the design of mechanical power transmission drive involving multiple machine components: It should expose the students to some aspects of mechanical power transmission drive design such as selection and configuration of the mechanical power transmission drive and its components.	

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester VI		
Course Code: MED372 Course: Lab - Theory of Machine **Teaching Scheme:** Practical: 2 Hrs/week		Credits: 0-0-1 Practical: 25 Marks
Objectives	:	1. To understand classification and types of mechanisms. 2. To understand kinematics and dynamics of various machines. 3. To understand functions and types of various machine elements. 4. To understand balancing of various unbalanced forces in machines.
List of Practical/ Assignments	:	1. Study of kinematics, pairs, various simple mechanisms and their inversions. 2. Solution of two problems on velocity analysis by instantaneous center method. 3 Solution of two problems on velocity analysis by relative velocity method. 4. Solution of two problems on acceleration analysis by relative velocity method. 5. Study of various types of brakes and dynamometers. 6. Solution of two problems on balancing. 7. Determine radius of gyration of a given bar using bifilar and trifler suspension. 8. Plotting controlling force diagram for porter and Hartnell governor. 9. Solution of two problems on Cams. 10. Study of Whirling of Shaft 11. Study of Static and dynamic balancing machine 12. Study of gyroscopic effect and finding moment of inertia of gyroscopic disc.
(Any 10 number of practical to be performed from the given list)		

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech (Mechanical Engineering) Semester VI	
Course Code: MED373 Course: Lab-Heat Transfer **Teaching Scheme:** Practical: 2 Hrs/week	Credits: 0-0-1 Practical: 25 Marks

Course Content (Any 10 of the following)

The lab work consists of the assignments/experiments related to

1. Determination of Thermal conductivity of metal rod
2. Determination of Thermal conductivity of Composite Wall
3. Determination of Thermal conductivity of Insulating Powder
4. Determination of the local heat transfer coefficient of air for a vertical tube losing heat by natural convection.
5. Determination of average heat transfer coefficient in forced convection of air in a tube.
6. Determination of heat transfer, fin efficiency and temperature distribution along the length of pin-fin in natural and forced convection.
7. Experimental verification of Steffen Boltzmann's constant.
8. Determination of emissivity of the test plate surface.
9. Determination of LMTD, the heat transfer rate, overall heat transfer coefficient and effectiveness for parallel flow and counter flow arrangement of a heat exchanger.
10. Determination of heat transfer coefficient in dropwise and film wise condensation.
11. Experimental study of pool boiling phenomenon up to critical heat flux point.
12. Assignments on Unit I, II, III,IV,V,VI (Any Three)

The assessment of term work shall be done on the basis of the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
(Faculty of Science & Technology)
Syllabus of Third Year B. Tech. (All) Semester VI

Course Code: MED374 Course: Major Project I **Teaching Scheme:** Practical: 4 Hrs/week	Credits:0-0-2 Practical: 50 Marks

Objectives	:	The Projects in the undergraduate study of engineering aims at developing in the student, knowledge and skills to match the current and projected needs of industry, society or user systems and to create social awareness and professional attitudes. Apart from monitoring the engineering processes and maintenance of engineering work, machines and equipment, an engineer has to do investigate survey, collect data, refer handbooks/datasheets, prepare estimates and design the systems.
Contents	:	• The completion of project is to be carried out in two semesters i.e. in Third Year Sem. VI and Final Year B. Tech Sem. VII. • The students shall form project group of maximum 3 students for within department projects and maximum of 6 students in case of interdisciplinary projects of their choice. • The students groups shall collect the information on the topic/area of interest and submit brief synopsis to Project Coordinator. • The Project Coordinator shall allot the Project Guide depending upon the area or specialization of eligible faculty members from the department. • The individual student from the project group shall maintain the project diary and update weekly by taking remark of respective guide. • The industry sponsored projects and inter departmental projects shall be encouraged and in case of inter departmental projects, students of maximum 3 different departments/disciplines shall work together by forming the group. The guide allotment and internal/external assessment of such groups shall be done by the respective departments. • The projects addressing issues related to environmental, rural development and societal issues shall be preferred. • The selected project shall help to promote participation in government approved schemes like Unnat Maharashtra Abhiyaan (UMA) and Unnat Bharat Abhiyaan (UBA). • The students shall aim to promote their project work in project exhibitions/competitions, paper presentation/publication in reputed journals and conferences. • The relevance of project and implementation including details of attainment of POs and PSOs addressed through the projects with justification must be clearly stated. **Phases of Major Project - I:** **Phase I:** Problem Identification, Literature survey, data collection, deciding scope of topic and objectives and Methodology of the project. **Phase II:** Confirmation of block diagram or layout of the proposed project. **Phase III:** Submission of report of project work.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (Mechanical Engineering) Semester VI	
Course Code: MED375 Course: Lab- Development of Software Skills-II **Teaching Scheme:** Practical: 2 Hrs/week	Credits: 0-0-1 Term-work: 25 Marks
Course Contents: The lab work consists of the assignments/experiments related to 1. Modelling of structure using line element 2. Modelling of two- and three-dimensional machine components. 3. Mesh generation of solid part 4. Static structural analysis of machine component 5. Steady state thermal analysis of machine components 6. Buckling analysis of machine components 7. Modal analysis of machine components 8. Post processing of results	

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

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Code No.: BSH807 Course: Mandatory non-credit course (German Language) **Teaching Scheme:** Theory: 2 Hrs/week	Credits: 0-0-0 Marks: 50 (Continuous Assessment)

Objectives		1. Students will be able to apply communicative German Grammar in communication. 2. Students will be able to enhance the level of German vocabulary. 3. Students will be able to pronounce and articulate words as well as sentences accurately. 4. Students will be able to understand and apply German language eventually. 5. Students will be able to develop German language skills. 6. Students will be able to manage situational communication in German. .
Unit I	:	**Introduction** - Self–Introduction - Nos. up to 10,000 - Weekdays, Months - Date and Time - Greetings **(6 Hrs)**
Unit II	:	**Vocabulary** - My house - My family - Daily routine - Hobbies - Food **(6 Hrs)**
Unit III	:	**Grammar** - Verb forms (Present Tense) - Articles - Possessive pronouns - Auxiliary verbs - Wh-Questions / Yes-No Questions - Past-Tense of haben and sein **(12 Hrs)**

List of Reference	**Sr. No.**	**Title**	**Author**	**Publication**
Books	1	German Made Simple: Learn to speak and understand German quickly and easily	Arnold Leitner PhD	Namrata's Amazon.in
	2	The Everything Learning German Book: Speak, write, and understand basic German in no time	Edward Swick	Adams Media
	3	Langenscheidt German in 30 Days	Von Angelika G. Beck	Langenscheidt

	4	Complete German Beginner to Intermediate Book and Audio Course: Learn to read, write, speak and understand a new language with Teach Yourself	Heiner Schenke	The McGraw Hill
	5	German: How to Speak and Write It (Beginners' Guides)	Joseph Rosenberg	Repro Books
	6	Collins Easy Learning – Collins Easy Learning German Grammar and Practice	Collins	Collins

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Course Code.: BSH808 Course: Mandatory non-credit course (Japanese language) **Teaching Scheme:** Theory: 2 Hrs/week	Credits: 0-0-0 Marks: 50 (Continuous Assessment)

Objectives		1. Students will be able to apply communicative Japanese Grammar in communication. 2. Students will be able to enhance the level of Japanese vocabulary. 3. Students will be able to pronounce and articulate words as well as sentences accurately. 4. Students will be able to understand and apply Japanese language eventually. 5. Students will be able to develop Japanese language skills. 6. Students will be able to manage situational communication in Japanese.
Unit I	:	**Introduction** (8 Hrs) - Introduction - Numbers - Days, Months, Dates
Unit II	:	**Grammar** (8 Hrs) - Verb and verb forms - Present and Past Tense
Unit III	:	**Communication** (8 Hrs) - Introduction of Japanese script - Dialogues (Shopping, in the restaurant) - Themes: Family, my city, my country, my friend

Text Book/ Reference Books

Sr. No.	Title	Author	Publication
1	Japanese Kanji for Beginners	Timothy G. Stout and Kaori Hakone	Tuttle Publishing
2	Essential Japanese Grammar: A Comprehensive Guide to Contemporary Usage	Masahiro Tanimori and Eriko Sato Ph.D.	Tuttle Publishing
3	15-Minute Japanese: Learn in Just 12 Weeks	D.K. Goel and Rajesh Goel	Amazon.in
4	Oxford Japanese Grammar and Verbs (Dictionary)	Bunt Jonathan	Oxford Publication
5	Read and write Japanese scripts: Teach yourself	Helen Gilhooly	Teach Yourself

	6	Complete Japanese Beginner to Intermediate Book and Audio Course: Learn to read, write, speak and understand a new language with Teach Yourself	Helen Gilhooly	Teach Yourself

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of Third Year B. Tech. (All) Semester VI	
Course Code: CED801 Course: Mandatory non-credit course (Professional Ethics and Constitution of India) **Teaching Scheme:** Theory: 2 Hrs/week	Credits: 0-0-0 Marks: 50 (Continuous Assessment)
Prerequisite	• Knowledge of the basic structure of constitution of India.
Objectives	1. To create awareness of Engineering Ethics and human values, instill moral social values, loyalty and ethical issues. 2. To allow the students to assimilate with basic information about Indian Constitution, know its salient features and thus functioning of Democracy in India.
Unit I	**Professional Ethics:** Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift v/s Bribery, Environmental breaches, Negligence, Deficiencies in state of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures. **(4 Hrs)**
Unit II	**Engineering and Professionalism:** Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. **(4 Hrs)**
Unit III	**Responsibility and reliability in Engineering:** Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering. **(4 Hrs)**
Unit IV	**Introduction to Indian Constitution:** The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building. **(4 Hrs)**
Unit V	**Union Executive and State Executive:** Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370.371,371J) for some States. **(4 Hrs)**
Unit VI	**Elections, Amendments and Emergency Provisions:** Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73,74, ,75, 86, and 91,94,95,100,101,118 and some important Case Studies. Emergency Provisions, types of Emergencies and its consequences. **(4 Hrs)**

	Sr. No.	Title	Author	Publication	Edition
Text Book/ Reference Books	1.	"Engineering Ethics (Including Human Values)	Govindrajan.M, Natrajan S, Senthilkumar V.S	PHI publication	2004
	2.	Ethics, Integrity and Aptitude	Reddy.N H, Ajmera, Santosh,	Tata McGraw Hill	2014
	3.	Introduction to the Constitution on India	Durga Das Basu	Prentice –Hall EEE, 19th / 20th Ed.	2008 and latest
	4.	"Constitution of India and Professional Ethics	Shubham Singles, Charles E. Haries, and Et al	Cengage Learning India Private Limited	2018
	5.	An Introduction to Constitution of India	M.V.Pylee	Vikas Publishing	2002

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Course Code: CSE801 Audit Course: Mandatory non-credit course (Green Computing) **Teaching Scheme:** Theory: 2 Hrs /week	Credits: 0-0-0 Marks: 50 (Continuous Assessment)

Prerequisite	Nil
Objectives	1. To learn the fundamentals of Green Computing. 2. To understand the concepts related to Green IT, Green devices and hardware along with software methods, green enterprise activities. 3. To study the various laws, standards, protocols for regulating green IT 4. To study various case studies related to the application of Green IT strategies.
Unit I	**Green IT: An Overview** Introduction, Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green IT, Holistic Approach to Greening IT, Applying IT for enhancing Environmental sustainability, Green IT Standards and Eco-Labelling of IT. **(4 Hrs)**
Unit II	**Green Devices and Hardware with Green Software** Green Devices and Hardware: Introduction, Life Cycle of a device or hardware, Reuse, Recycle and Dispose. Green Software: Introduction, Energy-saving software techniques. **(4 Hrs)**
Unit III	**Green Enterprises and the Role of IT** Introduction, Organization and Enterprise Greening, Information systems in Greening Enterprises, Greening Enterprise: IT Usage and Hardware, Inter-Organizational Enterprise activities and Green Issues. **(4 Hrs)**
Unit IV	**Managing Green IT:** Introduction, Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social media. **(4 Hrs)**
Unit V	**Regulating the Green IT: Laws, Standards and Protocols** Introduction, The regulatory environment and IT manufacturers, Non regulatory government initiatives, Industry associations and standards bodies, Green building standards, Green data centers, Social movements and Greenpeace. **(4 Hrs)**
Unit VI	**Case Studies** The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital. **(4 Hrs)**

	Sr. No.	Title	Author	Publication	Edition
Text Book/ Reference Books	1.	Harnessing Green IT Principles and Practices	San Murugesan, G.R. Gangadharan	Wiley Publication	-
	2.	Green IT Strategies and Applications-Using	Bhuvan Unhelkar	CRC Press	June 2014

		Environmental Intelligence			
	3.	The Greening of IT	John Lamb	Pearson Education	2009
	4.	Green Home computing for dummies	Woody Leonhard, Katherine Murray		2012

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Course Code: ETC801 Course: Mandatory Non-credit Course: (Smart Cities) **Teaching Scheme:** Theory: 2 Hrs/week	Credits: 0-0-0 Marks: 50 (Continuous Assessment)
Prerequisite	Nil
Objectives	1. To identify urban problems. 2. To study Effective and feasible ways to coordinate urban technologies. 3. To study models and methods for effective implementation of Smart Cities.
Unit I	Smart cities: Ideal Smart City loop, Socio-economic and environmental issues, Implications of Urbanization, Urbanization models and global trends, Urbanization in India **(4 Hrs)**
Unit II	Criteria for smart cities: Smartness - Citizens, Living, Environment, Mobility, Economy, Governance Pillars of Smart cities, Buildings, Utilities, Transportation and road Infrastructure, Health Care, Sustainability issues **(4 Hrs)**
Unit III	Fundamental Technologies: Ubiquitous computing, Big Data, Networking, Internet of Things, Cloud computing, Cyber security architectures **(4 Hrs)**
Unit IV	ICT for Smart Cities: Complex Urban systems ICT Infrastructure modelling, Typical Edge Environment, Smart Cities as Systems of Systems, IoT Centric approach, IoT technologies: WiFi, 6LowPAN, Cellular, NFC, LoRa, Bluetooth, RFID, Zigbee **(4 Hrs)**
Unit V	Smart City: Smart Street lighting, Smart Parking, Environmental pollution monitoring, Vehicular tracking, Smart Traffic Control, Waste Management, Smart Grid, Amenity availability, Heritage Information portal, Mobile application design, development and Visualization **(4 Hrs)**
Unit VI	Case Studies of Smart Cities: National and International smart cities, their model, Clusters and Urbanization, Environmental Issues: The Role of Local and Global Climate Change **(4 Hrs)**

Text Book/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	The City of Tomorrow: Sensors, Networks, Hackers, and the Future of Urban Life (The Future Series)	Carlo Ratti and Matthew Claudel	Yale University Press	Illustrated edition (2 August 2016)
2.	The Responsive City: Engaging Communities Through Data-Smart Governance	Stephen Goldsmith, Susan Crawford	Jossey Bass – Wiley	1st

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Course Code: MED801 Course: Mandatory noncredit course (Research Methodology) **Teaching Scheme:** Theory: 2 Hrs/week	Credits: 0-0-0 Marks: 50 (Continuous Assessment)

Prerequisite	Nil
Objectives	1. To introduce students to quantitative and qualitative methods for conducting meaningful inquiry and research. 2. Prepare a preliminary research design for projects in their subject matter areas 3. Accurately collect, analyse, and report data 4. Present complex data or situations clearly
Unit I	**Research Problems and Research Design:** -Meaning of research, objectives of research, motivation in research, types of research, steps in involved in research process, criteria of good research, significance of research, research methods versus methodology, selection of research problem, steps involved in defining research problem, research process, need for research design, types of research designs, basic principles of experimental design, formal and informal experimental design. **(4 Hrs)**
Unit II	**Sampling Design:** -Need for sampling, steps in sampling design, different types of sampling designs, sampling distributions, concept of central limit and standard error, sources of errors, population mean and proportion, sample size calculations, tests of measurements for validity, reliability, and practicality **(4 Hrs)**
Unit III	**Data collection, Processing and Analysis:** -Methods for collection of data, selection of data collection method, data processing operations, statistics in research, confidence level, measures of central tendency, dispersion, asymmetry and relationship. Spearman's and Pearson's coefficient of correlation, simple & multiple regression analysis, analysis of variance (ANOVA), factor analysis methods. **(4 Hrs)**
Unit IV	**Hypothesis Test:**-Concept of research hypothesis, concept of testing of hypothesis, Procedure for hypothesis testing, Flow diagram for hypothesis testing, Measuring the power of a hypothesis test, Parametric tests (z, t, F and chi-square tests), Hypothesis testing of means and correlation coefficient, Limitations of the tests of hypotheses. **(4 Hrs)**
Unit V	**Report Writing** **Interpretation:** Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Precaution in Interpretation. **Report Writing:** Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions. **(4 Hrs)**
Unit VI	**Ethics:** - Ethical Issues, Ethical Committees, Commercialization, copy right, royalty, Intellectual Property rights and patent law, Reproduction of published material, Plagiarism, Citation and Acknowledgement, Reproducibility and accountability.

					(4 Hrs)
Text Book/ Reference Books	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Research Methodology: Methods & Techniques	C. R. Kothari and G. Garg	New Age International	4th
	2.	Research Methodology	R. Pannerselvam	PHI Learning	2nd
	3.	Research Methods and Statistics	Bernard C. Beins & Maureen A. McCarthy	Pearson Education Inc.	2012
	4.	Research Methods Handbook	Stuart MacDonald & Nicola Headlam	CLES	-
	5.	Intellectual Property Rights--Unleashing the Knowledge Economy,	Ganguli Prabuddha.	Tata McGraw-Hill,	2001
	6.	Intellectual Property Rights	Neeraj Pandey and Khushdeep Dharni.	PHI Learning	1st
	7.	Fundamentals of Intellectual Property Rights,	Ramakrishna B.	Notion Press	1st
	8.	The Indian Patents Act 1970 (as amended in 2005)	-	-	-

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Course Code: PPE801 Course: Mandatory non-credit audit course: Industrial Safety and Management **Teaching Scheme:** Theory: 2 Hrs/week	Credits: 0-0-0 Marks: 50 (Continuous Assessment)

Objectives	1. To understand the fundamental concepts, and methods in Industrial Safety. 2. To understand the impact of safe industrial operations, its benefits and safety management.
Unit I	**Introduction to Industrial Safety** Introduction, key concepts, terminologies, Need for safety, Safety information system. **(4 Hrs)**
Unit II	**Safety Management** Safety inspection, procedure, checklist, safety sampling, safety audit, safety survey, accident prevention, training for safety. **(4 Hrs)**
Unit III	**Safety in Process** Safety in material handling and equipment used, design for safety in process. **(4 Hrs)**
Unit IV	**Fire Safety** Classification of fires. Common causes of industrial fires. Fire protection systems. **(4 Hrs)**
Unit V	**Hazards** Occupational health hazards, physical and chemical hazards. **(4 Hrs)**
Unit VI	**Hazard Analysis** Fault tree and event tree analysis, hazard identification techniques (e.g., HAZOP, HAZAN, OSHAS 18001). **(4 Hrs)**

Text Book/ Reference Books

Sr. No.	Title	Author	Publication	Edition
1.	Industrial Safety, Health and Environment Management Systems	R.K.Jain and Sunil S.Rao	Khanna Publishers, New Delhi	2006
2.	Industrial Safety Management	Deshmukh L M	Tata McGraw-Hill	New 2017
3.	Handbook of Occupational Safety and Health	Slote.L	John Willey and Sons, New York	1st
4.	Safety at Work	Ridley J and Channing J	Butterworth-Heinemann UK	3rd
5.	Loss of prevention in Process Industries, Vol.	Frank P. Lees	Butterworth-Heinemann Ltd.,	1991

		1 and 2		London	
	6.	Safety Management	Grimaldi and Simonds	AITBS Publishers, New Delhi	2001
Website	https://nptel.ac.in/courses/110/105/110105094/				

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ABKulkarni
26/10/21