



Shri Vile Parle Kelavani Mandal's

DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING

(Autonomous College Affiliated to the University of Mumbai)

NAAC Accredited with "A" Grade (CGPA: 3.18)



Department of Mechanical Engineering

B. Tech. Program (Mechanical Engineering)

Shri Vile Parle Kelavani Mandal's
Dwarkadas J. Sanghvi College of Engineering
(Autonomous College affiliated to the University of Mumbai)

Scheme and detailed syllabus (DJS22)
Final Year B. Tech
In
Mechanical Engineering
(Semester VIII)

Revision 0 (Effective from A.Y. 2025-26)

**Scheme for Final Year of B.Tech. Program in Mechanical Engineering: Semester VIII
(Autonomous-DJS22) (Academic Year 2025-2026)**

Sr. No.	Course Code	Course	Teaching Scheme (hrs.)				Semester End Examination (SEE) - A						Continuous Assessment (CA) - B					(A+B)	Total Credits	
			Th	P	T	Credits	Duration (Hrs)	Th	O	P	O&P	SEE Total (A)	TT1	TT2	TT Total	T/W	CA Total (B)			
1	DJS22MEC801	Industrial Engineering and Management	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	3
2 @	DJS22MEC8011	Automation and IoT	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	4
	DJS22MEL8011	Automation and IoT Laboratory	--	2	--	1	2	--	25	-	--	25	--	--	--	25	25	50	1	
	DJS22MEC8012	Motorsports Engineering	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	4
	DJS22MEL8012	Motorsports Engineering Laboratory	--	2	--	1	2	--	25	-	--	25	--	--	--	25	25	50	1	
	DJS22MEC8013	Process Equipment Design	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	4
	DJS22MEL8013	Process Equipment Design Laboratory	--	2	--	1	2	--	25	-	--	25	--	--	--	25	25	50	1	
	DJS22MEC8014	Air Handling Units	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	4
	DJS22MEL8014	Air Handling Units Laboratory	--	2	--	1	2	--	25	-	--	25	--	--	--	25	25	50	1	
	DJS22MEC8015	Startup Sustainability	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	4
	DJS22MEL8015	Startup Sustainability Laboratory	--	2	--	1	2	--	25	-	--	25	--	--	--	25	25	50	1	
	DJS22MEC8016	Business Analytics	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	4
	DJS22MEL8016	Business Analytics Laboratory	--	2	--	1	2	--	25	-	--	25	--	--	--	25	25	50	1	
3 @	DJS22MEC8021	Sustainable Manufacturing	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	3
	DJS22MEC8022	Hydrogen Powered Vehicles																		
	DJS22MEC8023	Energy Audit and Management																		
	DJS22MEC8024	Startup Scalability																		
	DJS22MEC8025	Digital Twin																		
4#	DJS22ILO8021	Project Management	3	--	--	3	2	65	--	-	--	65	20	15	35	--	35	100	3	3
	DJS22ILO8022	Entrepreneurship Development and Management																		
	DJS22ILO8023	Corporate Social Responsibility																		
	DJS22ILO8024	Human Resource Management																		
	DJS22ILO8025	Corporate Finance Management																		
	DJS22ILO8026	Logistic and Supply Chain Management																		
	DJS22ILO8027	IPR and Patenting																		
	DJS22ILO8028	Digital Marketing Management																		
	DJS22ILO8029	Environmental Management																		
DJS22ILO8030	Labour and Corporate Law																			
5	DJS22MEP802	Project Stage II	-	10	--	5	2	--	--	-	100	--	--	--	100	100	200	5	5	
6	DJS22A4	Disaster Management and Preparedness	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total			14	12	0	18	12	260	25	0	100	385	80	60	140	125	265	650	18	

@Any 1 Department Level Elective from each set. #Any 1 Institute Level Elective from the given list.

Th: Theory; P: Practical; T: Tutorial; O: Oral; P: Practical; O&P: Oral and Practical; TT1: Term Test 1; TT2: Term Test 2; TT3: Term Test 3; TT: Term Test; T/W: Term Work

Prepared by

Checked by

Head of the Department

Principal



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Department of Mechanical Engineering



Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (min.)
Theory	a. Term test 1 (based on 40 % syllabus)	20	60
	b. Term test 2 (next 40 % syllabus)	15	45
	Total Marks (a + b)	35	--
Audit course	Performance in the assignments / quiz / power point presentation / poster presentation / group project / any other tool.	--	As applicable
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory and Tutorial	Performance in the laboratory and tutorial.	50	

The final certification and acceptance of term work will be subject to satisfactory performance upon fulfilling the minimum passing criteria in the term work/completion of the audit course.

Semester End Assessment (B):

Course	Assessment Tools	Marks	Time (hrs.)
Theory / * Computer based	Written paper based on the entire syllabus.	65	2
	* Computer-based assessment on the college premises.		
Oral	Questions based on the entire syllabus.	25	As applicable
Practical	Performance of the practical assigned during the examination and the output/results obtained.	25	2
Oral and Practical	Project-based courses - Performance of the practical assigned during the examination and the output/results obtained. Based on the practical performed during the examination and on the entire syllabus.	as per the scheme	2

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Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year of B.Tech	Semester: VIII
Course: Industrial Engineering and Management (DJS22MEC801)		

Pre-requisites:

- Basic knowledge of Manufacturing processes.
- Basic knowledge of various manufacturing systems.

Objectives:

1. To introduce Industrial Engineering foundations, productivity concepts, and value engineering for efficiency improvement.
2. To build skills in work study, ergonomics, and system design for optimizing human-machine interaction and workplace performance.
3. To provide knowledge of facility planning, layout design, line balancing, and agile/lean practices for sustainable resource utilization.
4. To understand the principles and practices of Quality Management, including Quality Circles, TQM and apply them in real-world scenarios.

Outcomes: On completion of the course, the learner will be able to:

1. Illustrate the need for optimization of resources and its significance
2. Develop the ability to integrate knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.
3. Manage and implement different concepts involved in method study and understanding of work content in different situations.
4. Describe different aspects of work system design and facilities design pertinent to manufacturing industries.
5. Explain concepts of Agile manufacturing, Lean manufacturing, and Flexible manufacturing.
6. Apply Quality Circles and TQM to analyze case studies and recommend strategies for continuous improvement in organizations.

Industrial Engineering and Management (DJS22MEC801)		
Unit	Description	Duration
1	Introduction to Industrial Engineering <ul style="list-style-type: none"> • History and contribution of Industrial Engineering, Industrial Engineering approach to problem solving and system improvement. • Definition and concept of Productivity. • Productivity measurements: partial, total, multifactor productivity. • Factors influencing productivity: Organizational and managerial aspects, Environmental and social influences. • Productivity improvement techniques. • Value Engineering and Value Analysis: Distinction between value engineering and value analysis, Significance, and role in cost reduction and efficiency improvement. • Steps in value engineering and analysis. • Checklists for systematic implementation. 	7
2	Work Study <ul style="list-style-type: none"> • Method study: Definition and objectives, Steps in method study • Micro-motion study, Principles of motion economy 	8



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	<ul style="list-style-type: none"> • Therbligs: elemental motions in work study • Time study: objectives, equipment, procedure. • Work sampling: applications, methodology. • Standard data: development and application. • Predetermined Motion Time Systems (PMTS): concept and use. • Maynard Operation Sequence Technique (MOST): principles and applications. 	
3	<p>Work System Design</p> <ul style="list-style-type: none"> • Introduction to ergonomics and its scope in relation to work. • Anatomy, physiology, and psychology: relevance to ergonomics. • Ergonomics building blocks: Anthropometry- measurement and application in workplace design, Biomechanics: human body mechanics in work. • Industrial Psychology: Concept, Aims and objectives, Scope in industrial settings. • Job evaluation: purpose, methods. • Merit rating: individual performance assessment. • Incentive schemes: types and applications. • Wage administration: principles and methods. • Business process re-engineering (BPR): objectives and process. 	7
4	<p>Facility Design</p> <ul style="list-style-type: none"> • Factors affecting location decisions, Evaluation of alternative locations (qualitative and quantitative techniques). • Plant layout: Types of layouts (product, process, fixed-position, cellular, hybrid), Evaluation of layouts, Computer-aided layout design techniques. • Line Balancing: Objectives and constraints, Terminology in assembly line. • Heuristic methods: Kilbridge-Wester method, Largest Candidate Rule, and Rank Positional Weight method. • Materials handling systems: principles, equipment, and Automated Guided Vehicles (AGVs). • Group Technology (GT) and Cellular Manufacturing concepts. 	7
5	<p>Agile Manufacturing</p> <ul style="list-style-type: none"> • Introduction to Agile Manufacturing: need and concept. • Developing agile manufacturing systems. • Integration of Product and Process Development. • Application of IT/IS concepts in agile systems. • Agile supply chain management. • Design of skills and knowledge in workforce development. • Computer control of agile manufacturing. • Flexible manufacturing systems (FMS): features and applications. • Lean Manufacturing: principles and practices. • Value Stream Mapping (VSM): process, tools, and applications. • Industry 5.0 and Cyber physical systems 	6
6	<p>Quality Management</p> <ul style="list-style-type: none"> • History and fundamentals of Quality Management, • Quality function deployment, Quality circle. • Total Quality Management and TQM case studies. 	7

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Department of Mechanical Engineering		
	Total	42

Books Recommended:

Textbooks:



- Ravi Shankar, Industrial Engineering and Management, Galgotia Publications Pvt Ltd ,June 2000.

Reference Books:

- Apple, James M., Plant Layout and Material Handling, John Wiley & Sons, New York, 1977.
- Besterfield, Dale H. et al., Total Quality Management, Prentice Hall, New Jersey, 2011.
- Elion, Samuel, Production Planning and Control, Prentice Hall, New Jersey, 1987.
- Francis, Richard L. & White, John A., Facility Layout and Location – An Analytical Approach, Prentice Hall, New Jersey, 1974.
- International Labour Organization (ILO), Introduction to Work Study, Oxford & IBH Publishing Co. Pvt. Ltd., Geneva/New Delhi, 1978.
- Juran, J. M. & Gryna, F. M., Quality Planning and Analysis, Tata McGraw-Hill, New Delhi, 1993.
- Menon, H. G., TQM in New Product Manufacturing, Tata McGraw-Hill, New Delhi, 1992.
- Monks, Joseph G., Production and Operations Management, McGraw-Hill, New York, 1982.
- Murrell, K. F. H., Ergonomics at Work, Taylor & Francis, London, 1965.

Web References:

- www.nptel.ac.in
- <https://www.smartworld.com/notes/management-and-entrepreneurship-notes-me-vtu/>
- <https://www.maggubhai.com/management-process-organising-and-staffing/>
- <https://tutorstips.com/difference-between-directing-and-controlling/>

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	Department of Mechanical Engineering	
Program: Mechanical Engineering		Final Year B.Tech
Course: Automation and IoT (DJS22MEC8011)		
Course: Automation and IoT Laboratory (DJS22MEL8011)		

Pre-requisites:

- Fundamentals of Mechanical, Electrical, and Electronics Engineering.
- Basics of Control Systems and Mechatronics.
- Programming skills in C/Python/Arduino.
- Basic knowledge of Computer Networks and Sensors.



Objectives:

1. To introduce the fundamentals of automation and IoT technologies in mechanical engineering applications.
2. To develop an understanding of sensors, actuators, and communication protocols for IoT-based systems.
3. To study automation tools like PLC, SCADA, and their integration with IoT.
4. To apply data analytics, cloud computing, and cybersecurity principles to IoT systems.
5. To analyze real-world industrial case studies in smart manufacturing and predictive maintenance.

Outcomes: On completion of the course, the learner will be able to:

1. Explain the role of automation and IoT in Industry 4.0 and smart manufacturing.
2. Apply the principles of sensors, actuators, and controllers for industrial automation.
3. Design IoT-enabled systems using microcontrollers and communication protocols.
4. Analyze industrial processes using PLC, SCADA, and IoT integration.
5. Evaluate the benefits and challenges of cloud-based monitoring and predictive maintenance.
6. Assess security, scalability, and sustainability challenges in IoT-enabled automation systems.

Automation and IoT (DJS22MEC8011)		
Unit	Description	Duration
1	Introduction to Automation and IoT <ul style="list-style-type: none"> • Overview of Automation and IoT in Industry 4.0. • Evolution of automation technologies. • Role of IoT in mechanical engineering systems. • Case studies: Smart manufacturing, automotive, healthcare. 	8
2	Sensors, Actuators, and Controllers <ul style="list-style-type: none"> • Sensors: Temperature, vibration, pressure, proximity, flow. • Actuators: Pneumatic, hydraulic, and electrical actuators. • Controllers: Arduino, Raspberry Pi, ESP32. • Interfacing basics with industrial systems. 	8
3	Communication Technologies for IoT <ul style="list-style-type: none"> • IoT architecture and layers. • Communication protocols: MQTT, OPC-UA, Modbus, Zigbee, 5G. • Edge, Fog, and Cloud computing. • IoT data pipelines. 	8
4	Industrial Automation Systems <ul style="list-style-type: none"> • Programmable Logic Controllers (PLC): Architecture, ladder logic. • Supervisory Control and Data Acquisition (SCADA) systems. 	9

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	<ul style="list-style-type: none"> Integration of PLC/SCADA with IoT. Case studies: Automated production line, robotics in manufacturing. 	
5	Data Analytics, Cybersecurity, and Emerging Trends <ul style="list-style-type: none"> IoT data analytics and predictive maintenance. Cloud platforms for IoT: AWS, Azure, ThingWorx. Cybersecurity issues in IoT-based automation. Emerging trends: Digital twins, AR/VR, blockchain in IoT. 	9
	Total	42

Automation and IoT Laboratory (DJS22MEL8011)	
Sr. No.	Experiment Title
	Study / Case Study-based Experiments
1	Study the architecture and applications of IoT in smart manufacturing.
2	Case study on PLC and SCADA in an industrial process.
3	Study of communication protocols (MQTT/OPC-UA).
4	Analyze predictive maintenance in industrial pumps/motors using IoT.
	Simulation / Software-based Experiments
1	Develop a sensor-based IoT application using Arduino/ESP32.
2	Simulate IoT data transmission using MQTT protocol (Python/MATLAB).
3	PLC programming for an automated conveyor system.
4	Cloud-based monitoring of a simulated machine (AWS/Azure IoT).
	Performance / Hands-on Experiments
1	Interface sensors and actuators with Arduino/Raspberry Pi.
2	Demonstrate SCADA integration with IoT hardware.
3	Real-time data logging and dashboard visualization.
4	Implementation of IoT-based condition monitoring for a motor.

Books Recommended:

Textbooks:



- Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016.
- Ovidiu Vermesan & Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013.
- Mukesh Kumar & Ravi Joshi, Industrial Automation and Robotics, PHI Learning, 2021.

Reference Books:

- Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Elsevier, 2014.
- John Soldatos, Building Blocks for IoT Analytics, River Publishers, 2017.
- Frank Lamb, PLC Control Systems for Industrial Automation, McGraw Hill, 2013.

Web References:

- IoT and Digital Twins: <https://nptel.ac.in/courses/106105166>
- NPTEL Course on Industrial Automation and Control: <https://nptel.ac.in/courses/108105062>
- NPTEL Course on IoT: <https://nptel.ac.in/courses/106105166>
- Coursera – Industrial IoT Fundamentals: <https://www.coursera.org/learn/industrial-internet-of-things>

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Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year B.Tech	Semester: VIII
Course: Motorsports Engineering (DJS22MEC8012)		
Course: Motorsports Engineering Laboratory (DJS22MEL8012)		

Pre-requisites:

- Knowledge of materials technology (metallic and non-metallic materials).
- Basics of Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD).
- Fundamentals of automotive prime movers.
- Fundamentals of electronics devices and sensors.



Objectives:

1. To provide knowledge of advanced materials and their manufacturing techniques applied in motorsport vehicles.
2. To enable learners to understand and apply scientific and engineering principles that govern high performance in motorsports.
3. To develop skills in design, structural analysis, and optimization techniques for competition vehicles.
4. To impart analysis and optimization skills for vehicle powertrain, transmission, aerodynamics and data acquisition technologies relevant to motorsport engineering.

Outcomes: On completion of the course, the learner will be able to:

1. Summarize and justify the selection criteria and specifications of metallic and non-metallic materials used in motorsport applications.
2. Apply design and simulation techniques to analyze and evaluate motorsport vehicle structures.
3. Analyze vehicle stability using tire dynamics, suspension geometry, and control systems.
4. Analyse, design, and evaluate high-performance motorsport powertrains to optimize vehicle performance.
5. Analyse the performance of motorsport aerodynamics components.
6. Comprehend the need for data acquisition and analysis in motorsports.

Motorsports Engineering (DJS22MEC8012)		
Unit	Description	Duration
1	Introduction to Advanced Materials, Application, and Manufacturing: History of motorsport and its development; Competition vehicle categories; sporting and technical regulations. The physical and metallurgical properties of high-strength steels, stainless steels, metal matrix composites, aluminium, titanium alloys, rubbers, elastomers, plastics, and honeycomb structures. Case studies on the application of advanced materials in the motorsport industry, which includes material forms, performance, selection, advanced manufacturing technologies, and joining techniques in the context of motorsports.	8
2	Design, Analysis, and Optimization of Competition Vehicles: Introduction to structural design principles for competition vehicles; finite element modelling and simulation for structural analysis; shape and topology optimization methods; identification and analysis of common structural failure modes; non-destructive testing (NDT) techniques.	8
3	Vehicle Stability: Concept of vehicle stability and controllability; tire mechanics and force generation, slip angle, cornering stiffness, and tire models; suspension geometry and chassis	10

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	interactions; role of springs, dampers, and anti-roll bars in stability; longitudinal and lateral stability including understeer, oversteer, rollover, and load transfer; stability control systems (ABS, TCS, ESP, active suspension and steering); introduction to differentials and brake balancing simulation tools.	
4	Powertrains in Motorsport: Role and evolution of powertrain, features of high performance of SI, CI engines, performance optimizations, tuning of intake, exhaust, fuel systems, turbocharging, combustion, etc, importance of dyno and simulation data analysis. Transmission systems, gear ratios analysis and optimization, engine matching, shift point, and max. top speed estimation. Hybrid and electric powertrains employed in motorsports. Sustainable and future technologies.	6
5	Motorsport Aerodynamics: Role of aerodynamics in motorsports, evolution of aero components, boundary layers, flow regimes, pressure distribution, lift/downforce, drag, side forces, and their analysis. Aerodynamic devices: Airfoil design, characteristics, function and tuning, drag and downforce optimization, DRS, vortex generators, and active aero. Introduction to CFD tools, importance, meshing strategies, modeling, and simulation setup for motorsport applications, wind tunnels, flow visualization techniques, and motorsport regulations.	5
6	Data Acquisition and Analysis in Motorsports: Role of data in modern racing, system overview of ECUs, sensors, data loggers and telemetry, sensor calibration, data logging software, signal conditioning and filters, data analysis of powertrain, vehicle dynamics, driver performance, importance of real-time data and telemetry in race strategy optimization and live tuning.	5
	Total	42



Motorsports Engineering Laboratory (DJS22MEL8012)	
Sr. No.	Experiment/Case study
1	Case study on the application of Carbon Fiber Composites and Honeycomb Sandwich Structures in motorsports vehicles.
2	Case study on the application of Titanium and Aluminium in motorsports vehicles.
3	Case study on the application of Rubbers and Elastomers in Motorsports vehicles.
4	Fatigue analysis of automobile components (Connecting rod/Crank shaft/Piston) using Finite Element Analysis (FEA) software.
5	Crash analysis of impact attenuator by using FEA software.
6	Analysis of automobile chassis by using FEA software.
7	Analysis of steering and suspension system using suitable software.
8	Analysis and optimization of transmission gear ratios for any motorsport vehicle on excel / python code.
9	Comparative analysis of gradeability of any 2 vehicles on excel / python.
10	Simulations on airfoil optimization and drag force estimation on ANSYS / Simscale.
11	Comparative simulations of different aerodynamic devices on ANSYS / Simscale.

A minimum of seven experiments/exercises from the above-suggested list or any other experiment based on the syllabus will be included, which would help the learner to apply the concept.

Books Recommended:

Reference Books:

- Andrew Livesey, Advanced Motorsport Engineering, Routledge, London, 2012.
- Simon McBeath, Competition Car Composites: A Practical Handbook, Veloce Publishing, Dorchester, 2016.
- John C. Dixon, Suspension Geometry and Computation, John Wiley & Sons, Hoboken (NJ), 2009.
- William F. Milliken and Douglas L. Milliken, Race Car Vehicle Dynamics, SAE International, Warrendale (PA), 1995.
- Herb Adams, Chassis Engineering: Chassis Design, Building & Tuning for High Performance Cars, HP Books/Penguin Publishing Group, London, 1993.
- Michael F. Ashby, Materials Selection in Mechanical Design, Butterworth-Heinemann, Burlington, 2005.

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Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year of B.Tech	Semester: VIII
Course: Process Equipment Design (DJS22MEC8013)		
Course: Process Equipment Design Laboratory (DJS22MEL8013)		

Pre-requisites:

- Fundamentals of Mechanics of Materials
- Fundamentals of Thermodynamics and Heat Transfer
- Fundamentals of Fluid Mechanics
- Fundamentals of Material Properties and Corrosion
- Fundamentals of Machine Design concepts
- Familiarity with CAD software



Objectives:

1. To introduce fundamental process design principles, optimization methods, and the application of design codes and standards.
2. To enable students to design reaction vessels and their components.
3. To enable students to design storage tanks.
4. To enable students to design shell-and-tube heat exchangers.
5. To build competence in the mechanical design of distillation columns.
6. To enable students to design piping systems with suitable fittings and supports.

Outcomes: On completion of the course, the learner will be able to:

1. Apply design principles, optimization techniques, and relevant design codes (IS, ASME, TEMA, API, BS) in process equipment design.
2. Design reaction vessels and select suitable agitators, jackets, and sealing systems based on process requirements.
3. Design storage tanks, including shells, plates, roofs, and structural supports.
4. Design shell-and-tube heat exchangers and their key components in line with TEMA standards.
5. Design distillation columns, tray supports, and packing supports, considering applicable standards.
6. Design piping systems, including fittings, flanges, gaskets, and supports.

Process Equipment Design (DJS22MEC8013)		
Unit	Description	Duration
1	Process equipment design fundamentals: Basic concepts in process design, Block diagrams for flow of processes, Material flow balance, Design pressures & temperatures, Design stresses, Factor of safety, Minimum shell thickness and corrosion allowance, Weld joints efficiency, Design loading, Stress concentration and thermal stresses, Failure criteria, Optimization technique such as Lagrange's multiplier and golden section method, Cost and profitability estimation. Introduction to design codes like IS-2825, ASME-SECT, EIGHT-DIV-II TEMA.API-650, BS-1500 & 1515.	08
2	Mechanical design of Reaction Vessel: Mechanical design of shell, head, Jacket, coil, agitator, nozzle, body flange, etc., Different types of agitators & their selection criteria, Different types of agitator shaft sealing system & their selection criteria, Different types of power transmission system, Determination of power required for agitation, shaft diameter, blade thickness, etc., Different types of jackets & their selection criteria.	08

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3	Mechanical design of Storage Tank: Classification of storage tank as per IS-803, Determination of storage tank capacity, diameter & height, Design of shell and bottom plate for storage tank, Design of conical roof, Selection of column, girders and rafters, roof curb angle and floating roof.	06
4	Mechanical design of Shell & Tube Heat Exchangers: Mechanical design of shell, tube, tube sheet, head, channel shell, etc. of shell & tube heat exchanger.	06
5	Mechanical design of Vertical Tall Tower (Distillation Column): Mechanical design of shell, head, tray support, nozzle, body flange for vertical tall tower, Determination of shell thicknesses at various heights for tray tower & packed tower in case of internal & external pressure, Different types of tray supports & their selection criteria, Design of horizontal structural member with periphery ring type packing support.	07
6	Piping & Fittings: Pipe classifications (low pressure, high pressure, schedule numbers), Thickness calculation for pipes, Design of flanges, gaskets, bolts, expansion joints, Pipe supports and stress considerations, Layout basics: bends, elbows, reducers, tees	07
	Total	42

Process Equipment Design Laboratory (DJS22MEL8013)	
Sr. No.	Experiment Title
	The following assignments are to be solved in the lab sessions in the form of tutorial or any software-based exercises (Minimum six):
1	Fundamentals of Process Equipment Design – Design Codes, Stress Analysis, and Optimization
2	Influence of Pressure, Temperature, and Safety Factors on Equipment Design
3	Mechanical Design of Reaction Vessel – Shell, Head, and Nozzle
4	Mechanical Design of Reaction Vessel – Jacket, Agitator, and Power Requirement
5	Design of Storage Tank
6	Design of Shell & Tube Heat Exchanger
7	Design of Distillation Column
8	Design of Piping & Fittings
	Prepare a layout for the following using any CAD software (Minimum two):
1	Layout of Reaction Vessel with Jacket & Agitator
2	Layout of Storage Tank with Roof & Supports
3	Layout of Shell & Tube Heat Exchanger
4	Layout of Vertical Tall Tower with Tray Supports

A minimum of eight experiments from the above-suggested list or any other experiment based on the syllabus will be included, which would help the learner to apply the concept.

Books Recommended:

Textbooks:



- V. V. Mahajani, Joshi's Process Equipment Design, Macmillan Publishers India Ltd., New Delhi, 2009.
- B. C. Bhattacharya, Introduction to Chemical Equipment Design (Mechanical Aspects), CBS Publishers & Distributors, New Delhi, 2020.

Reference Books:

- Bureau of Indian Standards, Code for Unfired Pressure Vessels (IS: 2825), BIS, New Delhi, 1969.
- D. R. Moss and M. M. Basic, Pressure Vessel Design Manual, Elsevier Butterworth-Heinemann, Oxford, 2013.
- E. F. Megyesy, Pressure Vessel Handbook, Pressure Vessel Publishing, Tulsa, 2008.
- L. E. Brownell and E. H. Young, Process Equipment Design, John Wiley & Sons, New York, 2

Web References:

- Process Equipment Design (<https://nptel.ac.in/courses/103107207>)
- Principles and Practices of Process Equipment and Plant Design (https://onlinecourses.nptel.ac.in/noc21_ch52/preview)
- Equipment Design: Mechanical Aspects (https://onlinecourses.nptel.ac.in/noc20_ch17/preview)

	Shri Vile Parle Kelavani Mandal's DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING (Autonomous College Affiliated to the University of Mumbai) NAAC Accredited with "A" Grade (CGPA: 3.18)	
Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year of B.Tech	Semester: VIII
Course: Air Handling Units (DJS22MEC8014)		
Course: Air Handling Units Laboratory (DJS22MEL8014)		

Pre-requisites:

- Fundamentals of mechanical, electronics, and electrical engineering.
- Fundamentals of Fluid Mechanics, Thermodynamics, and Heat Transfer.



Objectives:

1. To Understand the Fundamentals of AHUs and Airflow Principles.
2. To study the Components and Construction of AHUs.
3. To gain the knowledge of AHU Design, Sizing, and Selection Criteria.
4. To explore AHU Control Systems and Automation
5. To develop Skills for AHU Installation, Commissioning, and Maintenance.
6. To develop skills to Analyze Industry Applications and Future Trends in AHUs.



Outcomes: On completion of the course, the learner will be able to:

1. Explain the Fundamentals and Functions of AHUs.
2. Analyze and Select AHU Components for Different Applications.
3. Perform AHU Design, Sizing, and Selection Based on Requirements.
4. Implement Control Strategies and Automation in AHUs.
5. Execute proper installation procedures, testing, troubleshooting, and preventive maintenance of AHUs.
6. Evaluate Energy Efficiency, Sustainability, and Future Trends in AHUs.

Air Handling Unit ((DJS22MEC8014)		
Unit	Description	Duration
1	Fundamentals of Air Handling Units (AHUs) and Airflow Principles <ul style="list-style-type: none"> • Introduction to Air Handling Units (AHUs): Definition, Purpose, and Importance of AHUs; Role of AHUs in HVAC Systems and Building Management; Basic Structure and Working Principle • Principles of Airflow in AHUs: Concepts of Airflow, Static Pressure, and Velocity; Psychrometrics and Air Conditioning Processes; Ventilation: Fresh Air, Recirculated Air, and Exhaust Air; Air Distribution Systems: • Classification and Types of AHUs: Centralized vs. Decentralized AHUs; Packaged AHUs vs. Custom-Built AHUs; Indoor vs. Outdoor AHUs; Modular vs. Integrated AHUs; AHUs for District Cooling system (DCS) • Industry Standards and Regulations: ASHRAE, ISO, and EN Standards for AHUs; Air Quality Standards and Energy Regulations 	8
2	AHU Components and Their Functions <ul style="list-style-type: none"> • Components: AHU Casing: Materials, Insulation, and Construction; Fans and Blowers: Types, Selection Criteria, and Efficiency; Fan Laws and Performance Curves; Variable Frequency Drives (VFDs) and Energy Optimization • Air Filtration Systems: Types of Filters: Pre-Filters, Bag Filters, HEPA, Carbon Filters; Filtration Efficiency and Pressure Drop Considerations; Filter Replacement, Cleaning, and Maintenance Strategies 	8

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Department of Mechanical Engineering		
	<ul style="list-style-type: none"> Air Treatment Components: Cooling and Heating Coils; Humidifiers and Dehumidifiers; Dampers and Louvers; Heat Recovery Systems (HRV, ERV) and Energy Efficiency 	
3	Design, Sizing, and Selection of AHUs <ul style="list-style-type: none"> AHU System Design Principles: Load Calculations for AHU Sizing, Airflow Rate and Capacity Calculations, Heat Load Considerations for Cooling and Heating Coils AHU Selection Criteria: Application-Based AHU Selection (Commercial, Industrial, Healthcare, clean rooms etc.), Sizing and Capacity Planning (CFM, ESP, Face Velocity), Fan Selection Based on System Resistance and Duct Design Energy Efficiency and Performance Optimization: AHU Efficiency Metrics (COP, SEER, and EER), Variable Air Volume (VAV) vs. Constant Air Volume (CAV) Systems, Energy Recovery Strategies (Heat Exchangers, Enthalpy Wheels) 	8
4	AHU Control Systems and Automation <ul style="list-style-type: none"> Control Strategies: Temperature, Humidity, and Pressure Control; Airflow Regulation and Demand-Based Ventilation Sensors and Actuators: Temperature and Humidity Sensors; CO₂ and Air Quality Sensors; Actuators for Dampers and Valves Smart AHUs and IoT-Enabled Control: Role of Artificial Intelligence and Machine Learning in AHUs; Predictive Maintenance using IoT 	6
5	Installation, Commissioning, and Applications <ul style="list-style-type: none"> Installation and Site Considerations: AHU Placement (Indoor vs. Outdoor); Ductwork Connections and Air Distribution Considerations; Condensate Drainage and Water Management Testing and Commissioning of AHUs: Pre-Commissioning Checklist and Procedures; Airflow Measurement and Balancing; Performance Testing and Functional Verification 	6
6	Industry Applications and Future Trends <ul style="list-style-type: none"> Application-Specific AHU Configurations: Commercial Buildings; Industrial Applications; Healthcare and Cleanrooms; Data Centers Future Challenges and Market Trends: Market Growth and Emerging Technologies; Challenges in Retrofitting Old AHUs; Impact of Regulations on Future AHU Design 	6
	Total	42

Air Handling Unit Laboratory (DJS22MEL8014)	
Sr. No.	Experiment Title
1	AHU Component Identification and Functionality Study
2	Airflow Measurement and Balancing in AHUs
3	Study of Air Filtration Efficiency in AHUs.
4	Study of AHU Control Systems and Sensors.
5	Energy Efficiency Analysis and Fan Power Consumption.
6	Computational Fluid Dynamics (CFD) Simulation of AHU Airflow.
7	Study of Heat Recovery Systems in AHUs.
8	AHU Design and Selection Based on Load Calculation

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9	Duct System Design and Air Distribution Optimization	
10	Smart AHU Design with IoT-Based Controls	
11	Case Study: AHU Performance in a Commercial Building.	
12	Case Study: Energy Savings through AHU Control Optimization	

A minimum of eight experiments from the above-suggested list or any other experiment based on the syllabus will be included, which would help the learner to apply the concept.

Books Recommended:

Text Books:



- Roger Legg, Air Handling Systems Design, CRC Press, 2018.
- Ronald H. Howell, William J. Coad, Harry J. Sauer Jr., Ventilation, and Air Conditioning: ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers, 2017).
- Stanley E. Cummings, Airflow in Ducts and Fans, Elsevier, 2018.
- William Cory, Fans and Ventilation: A Practical Guide, 2007.
- R. A. Wallis, Centrifugal and Axial Flow Fans: Design and Applications, John Wiley & Sons.

Reference Books:

- Frank P. Bleier, Fan Handbook: Selection, Application, and Design, McGraw-Hill, 2009.
- Faye C. McQuiston, Jerald D. Parker, Jeffrey D. Spitler, Heating, Ventilating, and Air Conditioning: Analysis and Design, Wiley publication, 2005.

Web References:

- Refrigeration and Air-conditioning (https://onlinecourses.nptel.ac.in/noc19_me58)

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	Department of Mechanical Engineering	
Program: Mechanical Engineering		Final Year of B.Tech
Course: Startup Sustainability (DJS22MEC8015)		
Course: Startup Sustainability Laboratory (DJS22MEL8015)		

Pre-requisite: Nil



Objectives:

1. To enable learners to understand the principles of long-term startup sustainability.
2. To enable learners to evaluate financial stability and risk management strategies.
3. To enable learners to analyze sustainable innovation and environmental consideration
4. To enable learners to examine stakeholder engagement and corporate social responsibility.
5. To enable learners to assess business resilience strategies for long-term growth.
6. To enable learners to develop frameworks for continuous improvement in startups.

Outcomes: Upon successful completion of the course, learners will be able to:

1. Apply sustainability principles in startup operations.
2. Analyze financial and risk management strategies for long-term business stability.
3. Integrate sustainable innovation and ethical considerations in decision-making.
4. Assess stakeholder engagement and corporate social responsibility practices.
5. Develop business resilience strategies against market and operational risks.
6. Create continuous improvement models for business growth.



Startup Sustainability (DJS22MEC8015)		
Unit	Description	Duration
1	Introduction to Startup Sustainability Definition and Importance of Sustainable Startups, Key Drivers of Sustainability in Business, Economic, Social, and Environmental Aspects of Sustainability. Includes numericals on carbon footprint reduction, renewable energy payback, and sustainability indices.	8
2	Financial Stability and Risk Management Cash Flow and Revenue Planning for Sustainable Growth, Risk Identification and Mitigation Strategies, Case Studies on Financially Sustainable Startups. Includes numericals on cash flow stability, financial runway, and risk-adjusted profitability.	8
3	Innovation and Sustainability in Product Development Circular Economy and Sustainable Engineering Practices, Green Manufacturing and Eco-friendly Design, Case Studies on Sustainable Product Innovations. Includes numericals on waste reduction, profitability of green products, and material recycling efficiency.	8
4	Corporate Social Responsibility (CSR) and Ethical Business Practices Importance of CSR in Startups, Ethical Decision-Making and Responsible Leadership, Impact Measurement and Reporting. Includes numericals on CSR budgeting, project expenditure, and cost of ethical sourcing.	6
5	Business Resilience and Crisis Management Identifying and Managing Market Uncertainties, Crisis Response Strategies for Startups, Business Continuity Planning. Includes numericals on crisis-induced revenue loss, downtime savings, and emergency fund survival analysis.	6
6	Scaling Sustainability for Long-Term Impact	6

	Shri Vile Parle Kelavani Mandal's DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING (Autonomous College Affiliated to the University of Mumbai) NAAC Accredited with "A" Grade (CGPA: 3.18)	
Department of Mechanical Engineering		
	Sustainable Business Models, Strategies for Scaling Sustainability in Manufacturing and Services, Final Project: Sustainable Business Model Development. Includes numericals on CAGR of sustainable revenues, payback of green investments, and financial modeling for sustainable growth.	
		42

Course: Startup Sustainability Laboratory (DJS22MEL8015)		
Sr. No.	Exercise	Detailed Description
1	Sustainability Assessment of Startups	Conduct sustainability audits and assess environmental and financial sustainability of startups.
2	Financial Risk Management Simulation	Apply risk analysis tools to identify and mitigate financial risks for startups.
3	Life Cycle Analysis of a Product	Evaluate the environmental impact of a product using life cycle assessment (LCA) techniques.
4	Green Business Model Canvas Development	Develop a business model canvas integrating sustainability principles.
5	CSR Strategy Development	Create a corporate social responsibility (CSR) plan for a startup.
6	Business Resilience Strategy Exercise	Develop and test contingency plans for business resilience.
7	Market Impact Assessment	Assess the long-term market impact of sustainable business strategies.
8	Final Sustainable Startup Project	Design and present a fully sustainable startup strategy.

Books Recommended:

- Apte, Suhas, and Jagdish N. Sheth. The Sustainability Edge. University of Toronto Press, Toronto, 2016.
- Sanford, Carol. The Responsible Entrepreneur. Wiley, New Jersey, 2014.
- Rainey, David L. Sustainable Business Development. Cambridge University Press, Cambridge, 2010.
- Esty, Daniel C., and Andrew S. Winston. Green to Gold. Wiley, New Jersey, 2009.
- Christensen, Clayton. The Innovator's Dilemma. Harvard Business Review Press, Boston, 1997.

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Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year B.Tech	Semester: VIII
Course: Business Analytics (DJS22MEC8016)		
Course: Business Analytics Laboratory (DJS22MEL8016)		

Pre-requisites:

- Basic knowledge of statistics and probability.
- Fundamentals of programming and data handling.



Objectives:

1. To understand the fundamental concepts, processes, and types of business analytics and their applications across industries.
2. To develop the ability to manage, pre-process, and visualize data using appropriate tools and technologies for informed decision-making.
3. To be able to apply statistical methods, predictive modeling, and machine learning techniques to analyze and interpret business data.
4. To formulate prescriptive analytics models for optimization and decision support in real-world business contexts.
5. To evaluate emerging trends, ethical considerations, and industry practices in business analytics for strategic advantage.



Outcomes: On completion of the course, the learner will be able to:

1. Describe the role and scope of business analytics in supporting organizational decision-making.
2. Organize structured and unstructured data using SQL, Python, R, and visualization tools.
3. Perform descriptive, predictive, and prescriptive analytics using statistical and machine learning techniques.
4. Design dashboards, reports, and visualizations to communicate analytical findings effectively.
5. Develop business analytics models for applications such as customer churn prediction, segmentation, and risk detection.
6. Analyze industry trends, implement best practices, and address ethical and privacy considerations in business analytics projects.

Business Analytics (DJS22MEC8016)		
Unit	Description	Duration
1	Fundamentals of Business Analytics <ul style="list-style-type: none"> • Introduction to business analytics: Definition, need, importance, and evolution • Mechanical datasets (e.g., CNC sensor logs, HVAC energy data) • Introduction to database management • Types of analytics: descriptive, diagnostic, predictive, prescriptive • Business intelligence vs. Business analytics • Data-driven decision-making and business applications of analytics • Big data, AI, and ML in business analytics • Applications and case studies 	7
2	Business Analytics Process and Tools <ul style="list-style-type: none"> • Business analytics process: Data collection, cleaning, analysis, and interpretation • Tools and technologies: Overview of Python, R, SQL, Tableau, Power BI, and Excel for industry-standard reporting • Data types and sources: Structured vs. unstructured data, internal vs. external data 	7

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Department of Mechanical Engineering		
	<ul style="list-style-type: none"> Databases and data warehousing: OLTP vs. OLAP, Extract, Transform, Load (ETL) SQL for data management: Basics of relational databases, normalization, SQL queries Jupyter Notebooks, Visual Studio code, and GitHub for documentation and collaboration 	
3	Descriptive Analytics and Data Visualization <ul style="list-style-type: none"> Data visualization: principles of effective visualization, tools, dashboards, and reporting tools Descriptive analytics: Data summarization, central tendency, dispersion, data distributions Exploratory Data Analysis (EDA): Identifying patterns and trends 	7
4	Predictive Analytics and Statistical Modeling <ul style="list-style-type: none"> Introduction to predictive analytics: Concepts and applications Statistics for analytics: Probability distributions, hypothesis testing, confidence intervals Regression analysis: Simple and multiple linear regression, logistic regression Time series forecasting: ARIMA, exponential smoothing Classification techniques: Decision trees, random forest, SVM Clustering techniques: K-means, hierarchical clustering Model evaluation metrics: RMSE, R-squared, ROC curve, confusion matrix Applications and case studies 	7
5	Advanced Machine Learning and Prescriptive Analytics <ul style="list-style-type: none"> Machine learning in BA: Supervised vs. unsupervised learning Neural Networks (NN): Basics, topology, training algorithms Optimization models Recommendation systems: Collaborative filtering, content-based filtering Prescriptive analytics: Optimization for decision-making, supply chain analytics Applications and case studies 	7
6	Applications, Trends, and Ethics in Business Analytics <ul style="list-style-type: none"> Text mining and sentiment analysis: Natural Language Processing (NLP) for business insights Social media and web analytics: Google analytics, customer sentiment analysis Risk and fraud analytics: Credit risk modeling, fraud detection techniques Ethical considerations and data privacy in BA Emerging trends: AI-driven analytics, cloud-based analytics, edge computing Model deployment practices using Flask or Streamlit Applications and case studies 	7
	Total	42

Note – Applications, numerical, and case studies should be related to mechanical and allied engineering domains only.

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Department of Mechanical Engineering		
Business Analytics Laboratory (DJS22MEL8016)		
Sr. No.	Experiment Title	
Group A: Any five experiments from the following list for a data set using a suitable software package/programming language		
1	Exploratory Data Analysis (EDA) and Dashboard Creation using Tableau/Python	
2	SQL-based Data Management and ETL Process Implementation	
3	Descriptive Statistics and Hypothesis Testing on Business Data	
4	Time Series Sales Forecasting using ARIMA and Exponential Smoothing	
5	Predictive Modeling for Customer Churn using Classification Techniques	
6	Customer Segmentation using K-Means and Hierarchical Clustering	
7	Text Mining and Sentiment Analysis of Customer Reviews	
8	Building a Recommendation System (Collaborative and Content-Based Filtering)	
9	Fraud Detection using Anomaly Detection Techniques	
10	Prescriptive Analytics for Dynamic Pricing using Optimization Models	
Group B (Mandatory): One interdisciplinary mini project (in a group of 2-3 students) based on the above contents and using a mechanical engineering application dataset.		

Books Recommended:

Textbooks:

- Foster Provost & Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly Media, Sebastopol, USA, 2nd Edition, 2013.
- S. Christian Albright & Wayne L. Winston, Business Analytics: Data Analysis & Decision Making, Cengage Learning, Boston, USA, 6th Edition, 2016.
- Ramesh Sharda, Dursun Delen & Efraim Turban, Business Intelligence, Analytics, and Data Science: A Managerial Perspective, Pearson, London, UK, 5th Edition, 2024.
- Galit Shmueli, Peter C. Bruce, Nitin R. Patel & Mia Stephens, Machine Learning for Business Analytics, Wiley, Hoboken, USA, 2nd Edition, 2023.
- James Evans, Business Analytics: Methods, Models, and Decisions, Pearson, London, UK, 2nd Edition, 2015.

Reference Books:

- Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter, O'Reilly Media, Sebastopol, USA, 2nd Edition, 2017.
- Trevor Hastie, Robert Tibshirani & Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer, New York, USA, 2nd Edition, 2009.
- Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Wiley, Hoboken, USA, 1st Edition, 2014.
- Hadley Wickham & Garrett Golemund, R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, Sebastopol, USA, 1st Edition, 2017.
- Ian H. Witten, Eibe Frank & Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, Burlington, USA, 4th Edition, 2016.

Web References:

- Business Analytics For Management Decision (<https://nptel.ac.in/courses/110105089>)
- Business Intelligence & Analytics (<https://nptel.ac.in/courses/106106361>)



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Department of Mechanical Engineering

- Business Analytics & Text Mining Modeling Using Python (<https://nptel.ac.in/courses/110107129>).
- Business Analytics & Data Mining Modeling Using R Part II (<https://nptel.ac.in/courses/110107095>)
- Introduction to Business Analysis for Engineers (<https://nptel.ac.in/courses/110106050>)
- Business Statistics (<https://nptel.ac.in/courses/110107114>)
- Business analytics and data mining Modeling using R (<https://nptel.ac.in/courses/110107092>)

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Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year B.Tech	Semester: VIII
Course: Sustainable Manufacturing (DJS22MEC8021)		

Pre-requisites:

- Fundamentals of manufacturing processes, materials science, and energy systems.
- Basics of sustainability principles, optimization techniques, and data analysis.



Objectives:

1. Introduce the fundamental concepts of sustainable manufacturing and its significance in modern industry.
2. Analyze the environmental, economic, and social impacts of manufacturing processes.
3. Equip students with tools and methodologies for assessing and improving the sustainability of products and processes.
4. Explore advanced topics such as life cycle analysis, green supply chain management, and sustainable product design.
5. Encourage critical thinking and problem-solving skills to develop innovative solutions for sustainable manufacturing challenges.

Outcomes: On completion of the course, the learner will be able to:

1. Understand and articulate the principles and importance of sustainable manufacturing.
2. Perform environmental impact assessments using LCA methodologies, carbon footprint analysis, and regulatory frameworks.
3. Implement sustainable design methodologies integrating material selection, product lifecycle optimization, and end-of-life strategies.
4. Enhance manufacturing efficiency through energy optimization, waste minimization, and advanced sustainable technologies.
5. Develop resilient and circular supply chain models incorporating green logistics, ethical sourcing, and digital transparency.
6. Evaluate sustainability metrics, frameworks, and regulations while exploring emerging technologies and future trends in sustainable manufacturing.

Sustainable Manufacturing (DJS22MEC8021)		
Unit	Description	Duration
1	Introduction to Sustainable Manufacturing: Definition and significance, three pillars of sustainability: environmental, economic, and social. comparison between traditional and sustainable manufacturing practices. global trends and drivers for adopting sustainable manufacturing, role of Industry 4.0 and digitalization in sustainability, sustainability challenges, and future scope.	6
2	Environmental Impact Assessment and Life Cycle Analysis (LCA): Introduction to environmental impact assessment methodologies. life cycle analysis (LCA): principles, phases, types, and applications. tools and software for conducting LCA, carbon footprint analysis, and case studies on LCA in manufacturing industries.	6
3	Sustainable Product Design and Development: Eco-design principles, integration of Circular Economy principles in product design, biomimicry, and material innovation. Design for Environment (DFE), design for disassembly (DFD), and remanufacturing strategies. Application of additive manufacturing in sustainable design, extended producer responsibility (EPR) and regulatory aspects, and case studies on sustainable product innovations.	8

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Department of Mechanical Engineering		
4	Green Manufacturing Processes and Technologies: Energy-efficient and waste-minimization techniques, lean and six sigma for sustainability, renewable energy integration in manufacturing, advanced and hybrid manufacturing approaches, metrics and key performance indicators, case studies on sustainable manufacturing implementation.	8
5	Sustainable Supply Chain and Operations Management: Green procurement, sourcing strategies, circular economy principles, recycling, and reuse of finished products. Reverse logistics and end-of-life product management. Sustainable logistics, digital transformation, and blockchain for supply chain transparency. Corporate social responsibility in manufacturing. Industry case studies on sustainable supply chain models.	8
6	Sustainable Manufacturing Metrics, Policies, and Future Trends: Key performance indicators, standards, and sustainability assessment methods, government policies, industry regulations, incentives, role of AI, IoT, and digital twins.	6
Total		42



Books Recommended:

Textbooks:

- Umeda, Y., Fukushige, S., & Kondoh, S., Sustainable Manufacturing: An Introduction, Springer, 2022.
- Jawahir, I. S., & Dillon, O. W. (Eds.), Sustainable Manufacturing: The Path to a Circular Economy, Springer, 2019.
- Jayal, A. D., Badurdeen, F., Dillon, O. W., & Jawahir, I. S., Sustainable Manufacturing: Modeling and Optimization Challenges at the Product, Process and System Levels, Springer, 2013.
- Sutherland, J. W., Jawahir, I. S., & Brocchi, E. (Eds.), Progress in Sustainable Manufacturing, Springer, 2018.
- Low, J. S. C., & Ong, S. K. (Eds.), Sustainable Manufacturing and Remanufacturing Management: Enhancing Knowledge through Lifecycle Thinking, Springer, 2014.
- Dornfeld, D. A. (Ed.), Green Manufacturing: Fundamentals and Applications, Springer Science & Business Media, 2012.
- Ashby, M. F., Materials and the Environment: Eco-informed Material Choice, Elsevier, 2012.

Reference Books:

- Hauschild, M. Z., Rosenbaum, R. K., & Olsen, S. I. (Eds.), Life Cycle Assessment: Theory and Practice, Springer, 2018.
- Seidel, M. (Ed.), Green Supply Chain Management: Product Life Cycle Approach, Springer, 2017.
- Allwood, J. M., & Cullen, J. M., Sustainable Materials: With Both Eyes Open, UIT Cambridge, 2012.
- Atkinson, G., Dietz, S., & Neumayer, E., Handbook of Sustainable Manufacturing, Edward Elgar Publishing Limited, 2007.
- Fiksel, J., Design for Environment: A Guide to Sustainable Product Development, McGraw Hill, 2009.

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Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year B.Tech	Semester: VIII
Course: Hydrogen Powered Vehicles (DJS22MEC8022)		

Pre-requisites:

- Fundamentals of mechanical, electronics, and electrical engineering.
- Fundamentals of chemistry, physics, and engineering mechanics.



Objectives:



1. To comprehend the role of hydrogen as a clean energy carrier, its production methods, types, and associated environmental impacts.
2. To gain knowledge about the principles, components, types, materials, and challenges in hydrogen fuel cell systems.
3. To study various methods of hydrogen storage, transportation, and infrastructure, emphasizing safety, cost, and emerging technologies.
4. To understand the design and integration of hydrogen-powered vehicles, including architecture, hybrid systems, and case studies of commercial models.
5. To evaluate the life cycle, economic viability, and contributions of hydrogen technology to sustainability goals.
6. To explore advancements in hydrogen technology, its role in renewable energy integration, and applications in heavy-duty and aerospace industries.

Outcomes: On completion of the course, the learner will be able to:

1. Explain the global potential, challenges, and characteristics of hydrogen as a fuel and energy carrier.
2. Apply the understanding of fuel cell types, principles, thermodynamics, and materials used in hydrogen fuel cells.
3. Identify and evaluate methods for hydrogen storage, transportation, and refueling infrastructure, considering safety and economic aspects.
4. Design and analyse the architecture and systems of hydrogen-powered vehicles, integrating fuel cell and hybrid configurations.
5. Assess the environmental benefits, economic viability, and barriers to the adoption of hydrogen technology.
6. Recognize future trends in hydrogen applications and technology, including research challenges and market outlook.

Hydrogen Powered Vehicles (DJS22MEC8022)		
Unit	Description	Duration
1	Fundamentals of Hydrogen as a Fuel <ul style="list-style-type: none"> • Overview of hydrogen as a clean energy carrier and global potential. • Global hydrogen economy: Opportunities and challenges. • Physical and chemical characteristics relevant to transportation. • Hydrogen production methods: Steam reforming, electrolysis, biomass gasification, and thermochemical methods. • Types of hydrogen: Grey, blue, green, and environmental impacts. • Water splitting using renewable energy sources. • National and international standards 	6

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Department of Mechanical Engineering		
2	Principles of Hydrogen Fuel Cells <ul style="list-style-type: none"> • Proton Exchange Membrane (PEM), Solid Oxide Fuel Cell (SOFC), and Direct Methanol Fuel Cell (DMFC) – Working Principles, Applications, Advantages, Limitations, and Comparative Analysis. • Thermodynamics principles and efficiency. • Materials Used in Fuel Cells: Catalysts, Membranes, Bipolar Plates, Gas Diffusion Layers, and Electrodes– Properties and Selection Criteria. • Fuel cell modeling and system integration. • Challenges and opportunities: Durability, costs, and efficiency improvements. 	6
3	Hydrogen Storage, Distribution, and Infrastructure <ul style="list-style-type: none"> • Storage methods: Compressed hydrogen, liquid hydrogen, and metal hydrides, and chemical storage. • Solid-state hydrogen storage. • Codes and technical standards for hydrogen safety and the storage of hydrogen. • Hydrogen transportation and refuelling/ distribution infrastructure. • Safety in hydrogen logistics. • Cost analysis and feasibility of hydrogen logistics. • Emerging technologies in hydrogen storage and delivery systems. 	7
4	Design and Architecture of Hydrogen-Powered Vehicles <ul style="list-style-type: none"> • Vehicle architecture: Fuel cell stack, hydrogen tank, electric drivetrain, and auxiliary systems. • Fuel cell integration into vehicle platforms. • Fuel cell integration with hybrid systems. • Power management systems and hybrid configurations. • Comparison: Hydrogen-powered vehicles Vs. BEVs and ICEs. • Fuel cell hybrid electric vehicle acts, codes, regulations, and guidelines. • Integration of hydrogen systems with digital tools like IoT and AI for monitoring and optimization. • Thermal management of fuel cells. • Case studies: Toyota Mirai, Hyundai Nexo, Honda Clarity, and other commercial models. 	7
5	Environmental and Economic Impacts of Hydrogen Technology <ul style="list-style-type: none"> • Life cycle assessment of hydrogen-powered vehicles. • Refueling infrastructure: Design, operation, and global deployment. • Policies and global initiatives for hydrogen adoption: International and national perspectives. • Economic viability: Cost analysis and market potential. • Environmental and economic benefits of hydrogen infrastructure. • Provide examples of policies from key players (e.g., EU Hydrogen Strategy, Japan's Hydrogen Roadmap). • Barriers to large-scale adoption and strategies to overcome them. • Equity and global energy transition strategies. • Contribution to Sustainable Development Goals (SDGs): Focus on Clean Energy (SDG 7), Climate Action (SDG 13), and Decarbonisation of the Transportation Sector. 	8

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Department of Mechanical Engineering		
6	Future Trends and Applications of Hydrogen Technology <ul style="list-style-type: none"> • Hindenburg Disaster and Modern Hydrogen Safety Technologies. • Advances in fuel cell technology and materials. • Autonomous hydrogen-powered vehicles. • Applications in heavy-duty applications: Hydrogen in heavy-duty transport and aerospace (trucks, buses, trains, ships, and aircraft). • Role of hydrogen in renewable energy integration and storage. • Research and development in hydrogen vehicle technology. • Research frontiers: Challenges and future market outlook. 	8
Total		42

Books Recommended:

Textbooks:



- Pasquale Corbo, Fortunato Migliardini, Ottorino Veneri, Hydrogen Fuel Cells for Road Vehicles, Springer London, 2011.
- Marco Alverà, The Hydrogen Revolution: A Blueprint for the Future of Clean Energy, Hodder & Stoughton, 2021.
- Paulo Emilio Miranda, Science and Engineering of Hydrogen-Based Energy Technologies: Hydrogen Production and Practical Applications in Energy Generation, Elsevier Science, 2018.
- Catherine Azzaro-Pantel, Hydrogen Supply Chain: Design, Deployment and Operation, Elsevier Science, 2018.
- Shigenori Mitsushima, Viktor Hacker, Fuel Cells and Hydrogen: From Fundamentals to Applied Research, Elsevier, 2018.
- Adolfo Iulianelli, Angelo Basile, Advances in Hydrogen Production, Storage and Distribution, Woodhead Publishing, 2014.

Reference Books:

- Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Practice, CRC Press, 2009.
- Mehmet Sankir, Nurdan Demirci Sankir, Hydrogen Electrical Vehicles, Wiley, 2023.
- Akari Hayashi, Hai-Wen Li, Junichiro Yamabe, Kazunari Sasaki, Stephen M. Lyth, Teppei Ogura, Hydrogen Energy Engineering: A Japanese Perspective, Springer Japan.
- Selim Koca, Transition to Hydrogen Fuel Cell Vehicles, Nova Science Publishers, 2010.
- Ronald K. Jurgen, Fuel Cell Hybrid EVs, SAE International, 2010.
- Amgad Elgowainy, Electric, Hybrid, and Fuel Cell Vehicles, Springer New York, 2021.
- Joseph M. Norbeck, Thomas Durbin, James Heffel, Michelle Montano, Hydrogen Fuel for Surface Transportation, SAE International, 1996.
- James John MacKenzie, The Keys to the Car: Electric and Hydrogen Vehicles for the 21st Century, World Resources Institute, 1994.

Web References:

- Hydrogen Energy: Production, Storage, Transportation and Safety (<https://nptel.ac.in/courses/103101215>)
- Cryogenic Hydrogen Technology (<https://nptel.ac.in/courses/112105422>)
- Fuel Cell Technology (<https://nptel.ac.in/courses/103102015>)

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Department of Mechanical Engineering		
Program: Mechanical Engineering		Final Year B.Tech
Semester: VIII		
Course: Energy Audit and Management (DJS22MEC8023)		

Pre-requisites:

- Fundamentals of mechanical, electronics, and electrical engineering.
- Fundamentals of chemistry, physics, and engineering mechanics.



Objectives:

1. To emphasize the significance of energy security and sustainability in industrial and commercial applications.
2. To explore various methodologies used in energy audits and understand their practical implications.
3. To evaluate and optimize the energy performance of electrical and thermal systems for enhanced efficiency.
4. To analyze energy data effectively to identify opportunities for reducing energy consumption.
5. To apply energy management strategies for industrial, commercial, and residential applications.

Outcomes: On completion of the course, the learner will be able to:

1. Explain the present energy scenario and the importance of energy security and conservation.
2. Demonstrate knowledge of the principles, methodologies, and significance of energy audits.
3. Assess and improve the energy performance of electrical installations to identify conservation opportunities.
4. Evaluate the energy efficiency of thermal installations and propose optimization measures
5. Analyze energy audit data and recommend strategies for enhancing energy efficiency and sustainability.
6. To apply financial analysis techniques for assessing energy-saving investments and project feasibility.

Energy Audit and Management (DJS22MEC8023)		
Unit	Description	Duration
1	Energy Scenario and Policies: Present energy scenario, energy pricing, energy sector reforms, energy security and conservation (Energy Conservation Act-2001), basics of energy forms, material and energy balance. National and renewable energy policies, carbon trading, renewable energy certification, and the clean development mechanism (CDM).	6
2	Energy Audit: Definition, need for energy audit, types of energy audit, role and responsibilities of energy auditor and manager, energy management (audit) approach including understanding energy costs, bench marking, energy performance, matching energy use to requirement, optimizing the input energy requirements, fuel and energy substitution, elements of monitoring & targeting, energy audit instruments, energy audit report, use of modern simulation tools/software for energy consumption analysis and audit.	8
3	Energy Management and Energy Conservation in Electrical System: Electricity billing, electrical load management and maximum demand control; power factor improvement, energy efficient equipment and appliances, star ratings. energy efficiency measures in lighting system: lighting control, occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in water pumps, compressors, blowers, industrial drives, induction motors, motor retrofitting, soft starters, and variable speed drives.	8

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Department of Mechanical Engineering		
4	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads, energy conservation opportunities in steam distribution system, steam leakages, steam trapping, condensate and flash steam recovery system, waste heat recovery, use of insulation types and application. Energy conservation opportunities in the boiler system, refrigeration, and HVAC system.	8
5	Energy Conservation in Buildings: Energy conservation building codes (ECBC): green building, LEED rating system, integration of non-conventional and renewable energy sources in buildings.	6
6	Energy Economics and Investment Appraisal: Need, criteria, and financial analysis techniques - break-even analysis, simple payback period, return on investment (ROI), net present value (NPV), internal rate of return (IRR), discounted cash flows (DCF), debt service coverage ratio (DSCR). Financing options for energy efficiency projects, Energy service company (ESCO) concept, Economic feasibility, and decision-making.	6
Total		42

Books Recommended:

Textbooks:



- Thumann, A., & Mehta, D. P., Handbook of Energy Engineering, The Fairmont Press, 2020.
- Geofry Stokes, Handbook of Electrical Installation Practice, Blackwell Science, Oxford, 2018.
- Anil Valia, Designing with Light: Lighting Handbook, Lighting System, Mumbai, 2019.
- W.C. Turner, Energy Management Handbook, John Wiley and Sons, New York, 2019.
- Sharma, K., Industrial Energy Conservation Techniques, CRC Press, 2015.
- Capehart, B. L., Turner, W. C., & Kennedy, W. J., Guide to Energy Management, The Fairmont Press, 2016.
- A.K. Tyagi (Ed.), Handbook on Energy Audits and Management, Tata Energy Research Institute (TERI), New Delhi, 2020.

Reference Books:

- Bureau of Energy Efficiency (BEE), Energy Manager and Auditor Guidebooks (Vol. 1 to 4), Ministry of Power, India, 2021.
- Soni, M. S., Gupta, J. P., & Bhatnagar, R. P., A Course in Electrical Power, Dhanpat Rai & Sons, 2020.
- C.B. Smith, Energy Management Principles, Pergamon Press, Oxford, 2020.
- Dale R. Patrick, S. Fardo, Ray E. Richardson, Energy Conservation Guidebook, Fairmont Press, Georgia, 2021.
- Albert Thumann, W.J. Younger, T. Niehus, Handbook of Energy Audits, CRC Press, Boca Raton, 2021.

Web References:

- Bureau of Energy Efficiency (BEE), India (<https://beeindia.gov.in>)
- Energy Manager Training (<https://www.energymanagertraining.com>)
- Energy Audits - Open Access Research Papers (<https://www.sciencedirect.com>)

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Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year B.Tech	Semester: VIII
Course: Startup Scalability (DJS22MEC8024)		

Pre-requisite:

Nil



Objectives:

1. To enable learners to analyze growth drivers and scaling strategies.
2. To enable learners to evaluate market expansion techniques.
3. To enable learners to assess technology adoption in scalability.
4. To enable learners to examine operational scalability models.
5. To enable learners to develop financial strategies for scaling businesses.
6. To enable learners to apply strategic decision-making for sustainable growth.

Outcomes: Upon successful completion of the course, learners will be able to:



1. Identify key growth factors influencing startup scalability.
2. Evaluate market expansion strategies for business growth.
3. Assess the role of technology in business scalability.
4. Develop operational strategies to support scalable growth.
5. Apply financial models for sustained business expansion.
6. Formulate strategic scaling plans for competitive advantage.

Startup Scalability (DJS22MEC8024)		
Unit	Description	Duration
1	Introduction to Startup Scalability Concept and Importance of Scalability Challenges in Scaling Startups Case Studies on Scalable Startups Includes numericals on customer growth rate, scaling factor, and growth projections	8
2	Market Expansion Strategies Identifying Growth Markets International Expansion Strategies Franchising and Licensing Models Includes numericals on revenue expansion, franchising profitability, and payback period for international markets.	8
3	Technology and Digital Transformation Role of Technology in Scaling Automation and AI Integration Case Studies on Digital Business Models Includes numericals on automation savings, AI-driven conversion rates, and CAGR of digital models.	6
4	Operational Scalability Lean Operations and Process Optimization Supply Chain and Logistics for Growth Managing Human Resource Scaling Includes numericals on productivity improvement, workforce scaling, and supply chain cost optimization.	6

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Department of Mechanical Engineering		
5	Financial Strategies for Scaling Growth Financing Options Venture Capital and IPOs Financial Risk Management Includes numericals on valuation, IPO calculations, and financial risk ratios.	7
6	Strategic Decision-Making for Growth Leadership in High-Growth Startups Strategic Planning for Scaling Final Project: Scalable Business Plan Development Includes numericals on risk-adjusted ROI, strategic revenue projections, and scalable business plan financials.	7
		42

Books Recommended:

- Harnish, Verne. Scaling Up. Gazelles, Ashburn, 2014.
- Hoffman, Reid, and Chris Yeh. Blitzscaling. Currency, New York, 2018.
- Mattes, Frank. The Lean Scaleup. Wiley, New Jersey, 2021.
- Miller, Andrew Lee. The Startup Growth Handbook. Self-Published, 2021.
- Ismail, Salim. Exponential Organizations. Diversion Books, New York, 2014.

	Shri Vile Parle Kelavani Mandal's DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING (Autonomous College Affiliated to the University of Mumbai) NAAC Accredited with "A" Grade (CGPA: 3.18)	
Department of Mechanical Engineering		
Program: Mechanical Engineering	Final Year B.Tech	Semester: VIII
Course: Digital Twin (DJS22MEC8025)		

Pre-requisites:

- Fundamentals of Mechanical Engineering and Design.
- Basics of Computer-Aided Design (CAD).
- Fundamentals of IoT, Sensors, and Data Acquisition.
- Basics of Programming (Python/ MATLAB/ Simulink).



Objectives:

1. To introduce the concept, evolution, and importance of Digital Twins in mechanical engineering.
2. To develop knowledge of modeling, simulation, and integration of mechanical systems with Digital Twins.
3. To study IoT-based data acquisition, communication protocols, and real-time monitoring for DT.
4. To explore predictive maintenance, product lifecycle management, and manufacturing optimization using DT.
5. To examine the role of AI, machine learning, and emerging technologies in advancing DT.
6. To analyze industrial case studies and applications of DT in automotive, aerospace, and energy sectors.

Outcomes: On completion of the course, the learner will be able to:

1. Explain the fundamentals, architecture, and scope of Digital Twin in the mechanical industries.
2. Apply CAD/CAE modeling and simulation principles to create Digital Twin models of mechanical systems.
3. Identify IoT devices, sensors, and communication technologies for DT integration.
4. Design predictive maintenance and optimization strategies using DT.
5. Assess applications of DT in product lifecycle management, manufacturing, and robotics.
6. Evaluate emerging trends, challenges, and future directions of DT technology in Industry 4.0.

Digital Twin (DJS22MEC8025)		
Unit	Description	Duration
1	Fundamentals of Digital Twin <ul style="list-style-type: none"> • Definition, evolution, and importance of Digital Twin. • Types of DT: Component, System, and Process Twins. • Digital Twin vs. Digital Thread. • Architecture of DT systems. • Applications and case studies in mechanical industries. 	8
2	Modeling and Simulation for Digital Twins <ul style="list-style-type: none"> • CAD/CAE-based modeling for DT. • Multi-physics simulations: structural, thermal, fluid. • Integration of simulation with real-time data. • Tools: ANSYS Twin Builder, MATLAB Simulink, Siemens NX. • Challenges: Accuracy, scalability, and cost. 	8
3	IoT, Sensors, and Data Acquisition <ul style="list-style-type: none"> • Role of IoT in DT implementation. • Sensors and actuators for mechanical systems. • Data acquisition systems and protocols (MQTT, OPC-UA, 5G). 	8

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Department of Mechanical Engineering		
	<ul style="list-style-type: none"> • Edge, Fog, and Cloud computing in DT. • Cyber-physical systems and security issues. 	
4	Data Analytics, AI, and Predictive Maintenance <ul style="list-style-type: none"> • Data-driven modeling and digital twins. • Role of AI/ML in DT optimization. • Predictive analytics for mechanical system failures. • Case study: Predictive maintenance in rotating machinery. • Integration of DT with AR/VR for visualization. 	9
5	Industrial Applications and Emerging Trends <ul style="list-style-type: none"> • DT in Product Lifecycle Management (PLM). • Applications in manufacturing, robotics, aerospace, automotive, and energy systems. • DT for sustainability and smart factories. • Blockchain and cybersecurity for DT. • Future challenges and opportunities. 	9
	Total	42

Books Recommended:

Textbooks:



- Rajkumar Roy, Aydin Nassehi, and Bahman Azad, Digital Twin Technologies and Smart Manufacturing, Springer, 2020.
- Ang Liu, Digital Twin Driven Smart Manufacturing, Elsevier, 2021.
- Jaspreet Singh Dhupia, Digital Twin Technologies for Mechanical Engineering, CRC Press, 2022.

Reference Books:

- Dieter Uckelmann, Mark Harrison, and Florian Michahelles, Architecting the Internet of Things, Springer, 2011.
- David Gelernter, Mirror Worlds: Or the Day Software Puts the Universe in a Shoebox, Oxford University Press, 2014.
- Jay Lee, Behrad Bagheri, and Hung-an Kao, A Cyber-Physical Systems Architecture for Industry 4.0-Based Manufacturing Systems, Elsevier, 2015.

Web References:

- Digital Twin – NPTEL Course: <https://nptel.ac.in/courses/112107322>
- IoT and Digital Twins: <https://nptel.ac.in/courses/106105166>
- Digital Manufacturing and Design: <https://www.coursera.org/learn/digital-manufacturing-design>

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	Department of Mechanical Engineering	
Program: Common for All Programs		Final Year B.Tech
Course: Project Management (DJS22ILO8021)		

Pre-requisites: Basic concepts of Management.



Objectives:

1. To familiarize the students with the use of a structured methodology/approach for every unique project undertaken, utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: On completion of the course, learners will be able to:

1. Explain the project management life cycle and the various project phases, as well as the role of the project manager.
2. Apply selection criteria and select an appropriate project from different options.
3. Create a work breakdown structure for a project and develop a schedule based on it. Manage project risk strategically.
4. Use the Earned Value technique and determine & predict the status of the project.
5. Capture lessons learned during project phases and document them for future reference.

Project Management (DJS22ILO8021)		
Unit	Description	Duration
1	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical), Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Introduction to project leadership, ethics in projects, Multicultural and virtual projects, Project management in various organizational structures, PM knowledge areas as per the Project Management Institute (PMI).	8
2	Initiating Projects: How to get a project started, selecting a project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating a charter, Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	8
3	Project Planning: Work Breakdown Structure (WBS) and linear responsibility chart, Project cost estimation and budgeting, top-down and bottom-up budgeting. Networking and Scheduling techniques, PERT, CPM, Crashing project time, Resource loading and levelling, Goldratt's critical chain, GANTT chart, Project Stakeholders and Communication plan, Introduction to Project Management Information System (PMIS). Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks.	10
4	Monitoring and Controlling Projects: Planning, monitoring, and controlling cycle, Information needs and reporting, engaging all stakeholders of the projects, communication, and project meetings. With Earned Value Management techniques for measuring the value of work completed, using milestones for measurement, change requests, and scope creep, Project audit. Project Contracting Project procurement	8

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Department of Mechanical Engineering		
	management, contracting and outsourcing.	
5	Closing the Project: Customer acceptance, Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report, doing a lessons learned analysis, acknowledging successes and failures.	8
	Total	42



Books Recommended:

Text books:

- Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India.
- Project Management: The Managerial Process, 6th edition, Erik Larson, Clifford Gray, McGraw Hill Education.

Reference Books:

- A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed. Project Management Institute PA, USA.
- Project Management, Gido Clements, Cengage Learning.
- Project Management, Gopalan, Wiley India.
- Project Management, Dennis Lock, 9th Edition, Gower Publishing England.

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Department of Mechanical Engineering		
Program: Common for All Programs	Final Year B.Tech	Semester: VIII
Course: Entrepreneurship Development and Management (DJS22ILO8022)		



Objectives:

1. To develop entrepreneurial abilities by providing background information about support systems, skill sets, financial and risk covering institutions.
2. To appraise the students with the fundamentals that can help them make the right decisions for.

Outcomes: On completion of the course, learners will be able to:

1. Develop idea generation, creative and innovative skills
2. Prepare a Business Plan
3. Compare different entrepreneur-supporting institutions
4. Correlate a suitable MSME scheme for an entrepreneur
5. Interpret the financial and legal aspects of a business.



Entrepreneurship Development and Management (DJS22ILO8022)		
Unit	Description	Duration
1	Meaning of Entrepreneur Evolution of the concept, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur- an emerging class, Concept of Entrepreneurship, Evolution of Entrepreneurship Development of Entrepreneurship Entrepreneurial, Culture Stages in the entrepreneurial process: Develop idea generation, creative, and innovative skills	08
2	Business Planning Process Meaning of business plan, Business plan process, Advantages of business planning Marketing plan, Production/operations plan, Organization plan, Financial plan, Final Project Report with Feasibility Study, Preparing a model project report for starting a new venture.	08
3	Institutions Supporting Entrepreneurs: Small industry financing in developing countries, A brief overview of financial institutions in India, Central level and state level institutions - SIDBI-NABARD-IDBI-SIDCO, Indian Institute of Entrepreneurship System. District Industries Centers - Single Window	08
4	Micro, Small, and Medium Enterprises (MSMES): MSMEs - Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes, Forms of Business; Make-In India, Start-Up India, Stand-Up India. Women Entrepreneurship; Rural Entrepreneurship; Family Business and First-Generation Entrepreneurs	09
5	Finance, Accounting, Costing, and Legal Aspects of Business: Funding new ventures: Conventional Source of Finance, bootstrapping, crowd sourcing- angel investors, VCs, debt financing, due diligence, Legal aspects of business (IPR, GST, Labour law)- Cost, volume, profit, and break-even analysis - Margin of safety and the degree of operating leverage. Capital budgeting for comparing projects or opportunities, Product costing- Product pricing- Introduction to financial statements - Profit & Loss statement, Balance sheet - Cash flow-Closure of Business	09
	Total	42

	<p>Shri Vile Parle Kelavani Mandal's DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING (Autonomous College Affiliated to the University of Mumbai) NAAC Accredited with "A" Grade (CGPA: 3.18)</p>	
Department of Mechanical Engineering		

Books Recommended:

Reference Books:

- Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and Organization - by Robert D. Hisrich Veland Ramadani, Springer Publication (2017)
- Entrepreneurship-Theory, Process Practice -by Donald F.Kuratko, Cengage Learning(2014)
- Entrepreneurship 6/E-by Robert D. Hisrich McGraw-Hill Education (India) (2011)
- Entrepreneurship and small business- by Burns, P. New Jersey: Palgrave. (2001).
- Innovation and entrepreneurship by Drucker. F. Peter, Harper business, (2006).
- Entrepreneurship development small business enterprises, Poornima M Charantimath Pearson Publication (2013)
- Entrepreneurial Development -Jayshree Suresh, Margham Publishers, Chennai
- The Design of Business- by Martin Roger, Harvard Business Publishing (2009)
- Entrepreneurship-by Roy Rajiv Oxford University Press (2011)

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Department of Mechanical Engineering		
Program: Common for All Programs	Final Year B.Tech	Semester: VIII
Course: Corporate Social Responsibility (DJS22ILO8023)		

Objectives:

1. To make students understand the concept, theories, and application of CSR for the Development of Society.

Outcomes: On completion of the course, learner will be able to:

1. Understand the key characteristics of Corporate Social Responsibility (CSR) in the context of present-day management.
2. Apprise regarding business decision-making, which is informed by ethical values and respect for people, communities, and the environment.
3. Become aware of creating a strategic plan that enables an organization to reach out to its internal and external stakeholders with consistent messages.
4. Understand critical issues of Corporate Social Responsibility (CSR) in a cross-cultural setting.

Corporate Social Responsibility (DJS22ILO8023)		
Unit	Description	Duration
1	Introduction to CSR Meaning and Definition, History of CSR, Concepts of Charity, Corporate Philanthropy, Corporate Citizenship, Sustainability, and Stakeholder Management. Environmental aspects of CSR, Chronological evolution, and Models of CSR in India, including Carroll's model and major codes on CSR Initiatives in India.	09
2	International Framework for Corporate Social Responsibility Millennium Development Goals, Sustainable Development Goals, Relationship between CSR and MDGs. United Nations (UN) Global Compact 2011. UN guiding principles on business and human rights. OECD CSR policy tool, ILO Tripartite Declaration of Principles on Multinational Enterprises and Social Policy.	09
3	CSR-Legislation in India and the World Section 135 of the Companies Act 2013. Scope for CSR Activities under Schedule VII, Appointment of Independent Directors on the Board, and the Implementation of the Computation of Net Profit in India.	08
4	The Drivers of CSR in India Market-based pressure and incentives, civil society pressure, the regulatory environment in India, Counter trends, Review of current trends and opportunities in CSR, Review of successful corporate initiatives, and challenges of CSR. Case Studies of Major CSR Initiatives, Corporate Social Responsibility and Public-Private Partnership (PPP).	08
5	Identifying key stakeholders of CSR Role of Public Sector in Corporate, government programs, Nonprofit, and Local Self Governance in implementing CSR, Global Compact Self-Assessment Tool, National Voluntary Guidelines by the Govt. of India, and Roles and responsibilities of corporate foundations.	08
	Total	42



Books Recommended:

Textbooks:

- Corporate Social Responsibility in India, Sanjay K Agarwal, Sage Publications, 2008.
- Corporate Social Responsibility in India, Bidyut Chakrabarty, Routledge, New Delhi, 2015.

Reference Books:

- Corporate Social Responsibility: An Ethical Approach, Mark S. Schwartz, Broadview Press, 2011
- Attaining Sustainable Growth through Corporate Social Responsibility, George Pohle and Jeff Hittner, IBA Global Business Services, 2008.
- Strategic Corporate Social Responsibility: Stakeholders in a Global Environment, William B. Werther Jr. and David Chandler, 2nd Edition, Sage Publications, 2011

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Department of Mechanical Engineering		
Program: Common for All Programs	Final Year B.Tech	Semester: VIII
Course: Human Resource Management (DJS22ILO8024)		



Objectives:

1. To introduce the students to basic concepts, techniques, and practices of human resource management.
2. To provide an opportunity of learning Human Resource Management (HRM) processes, related to the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students with the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders, and managers.

Outcomes: On completion of the course, the learner will be able to:

1. Understand the concepts, aspects, techniques, and practices of human resource management.
2. Understand the Human Resource Management (HRM) processes, functions, changes, and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with interpersonal and intergroup environments, emerging as future stable engineers and managers.



Human Resource Management (DJS22ILO8024)		
Unit	Description	Duration
1	Introduction to HR Human Resource Management- Concept, Scope, and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM, Human resource Planning, Technological change, Restructuring, and rightsizing. Empowerment, TQM, and Managing ethical issues.	08
2	Organizational Behaviour (OB) Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary Issues. Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness. Perception: Attitude and Value, Effect of perception on Individual Decision-making. Attitude and Behaviour. Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); Group Behaviour and Group Dynamics: Work groups, formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study.	10
3	Organizational Structure & Design Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power, Politics at the workplace, Tactics and	08

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Department of Mechanical Engineering		
	strategies.	
4	Human Resource Planning Recruitment and Selection process, Job-enrichment, Empowerment-Job Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counselling. Career Planning. Training & Development: Identification of Training Needs, Training Methods. Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making: Strategic Intent-Corporate Mission, Vision, Objectives, and Goals.	08
5	Labor Laws and Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act. Emerging Trends in HR Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment. Cross-Cultural Leadership and Decision Making: Cross-Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women, and ageing people, intra-company cultural differences among employees motivation.	08
	Total	42

Books Recommended:

Reference Books:

- Stephen Robbins, Organizational Behavior, 16th Ed, 2013.
- V SP Rao, Human Resource Management, 3rd Ed, 2010, Excel Publishing.
- Aswathapa, Human Resource Management: Text & Cases, 6th edition,
- C. B. Mamoria and SV Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
- P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
- Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

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Department of Mechanical Engineering		
Program: Common for All Programs	Final Year B.Tech	Semester: VIII
Course: Corporate Finance Management (DJS22ILO8025)		

Pre-requisites: Basic Knowledge of Algebra, Probability, and Statistics.



Objectives:

1. Overview of the Indian financial system, instruments, and market.
2. Basic concepts of value of money, returns and risks, corporate finance, working capital, and its management.
3. Knowledge about sources of finance, capital structure, and dividend policy.

Outcomes: On completion of the course, the learner will be able to:

1. Understand the Indian finance system.
2. Apply concepts of time value, money, and risk returns to products, services, and businesses.
3. Understand corporate finance; evaluate and compare the performance of multiple firms.
4. Take Investment, finance, as well as dividend decisions.



Corporate Finance Management (DJS22ILO8025)		
Unit	Description	Duration
01	Overview of the Indian Financial System: Characteristics, Components, and Functions of the Financial System. Financial Instruments: Meaning, Characteristics, and Classification of Basic Financial Instruments: Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets - Capital Market, Money Market, and Foreign Currency Market Financial Institutions: Meaning, Characteristics, and Classification of Financial Institutions-Commercial Banks, Investment-Merchant Banks, and Stock Exchanges	08
02	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis. Overview of Financial Statements: Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios: Stock Market Ratios; Limitations of Ratio Analysis	08
03	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-Security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-Security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due: Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	08
04	Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities. Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion-Accounting Rate of Return,	09

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Department of Mechanical Engineering		
	Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR).	
05	Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches- Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	09
	Total	42

Books Recommended:

Reference Books:

- Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
- Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
- Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
- Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.
- Financial Management, Theory & Practice 8th Edition (2011), by Prasanna Chandra: Tata McGraw Hill Education Private Limited, New Delhi.

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Department of Mechanical Engineering		
Program: Common for All Programs	Final Year B.Tech	Semester: VIII
Course: Logistic and Supply Chain Management (DJS22ILO8026)		



Objectives:

1. To acquaint with the concept of key drivers of supply chain performance and their inter-relationships with strategy.
2. To acquaint with the design problems and develop an understanding of information technology in supply chain optimization.
3. To acquaint with the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.

Outcomes: On completion of the course, the learner will be able to:

1. Demonstrate the functional strategy map of supply chain management.
2. Analyze the determinants of Supply Chain and Transportation networks design.
3. Demonstrate the need of coordination and sourcing decisions in supply chain.
4. Understand pricing, revenue management and role of IT in supply chain.
5. Understand various sustainability aspects of a supply chain.



Logistic and Supply Chain Management (DJS22ILO8026)		
Unit	Description	Duration
01	<p>Understanding the Supply Chain: Objective, Importance, Decision Phases, Process Views.</p> <p>Achieving Strategic Fit and Scope: Competitive and Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope, Challenges to Achieving and Maintaining Strategic Fit.</p> <p>Supply Chain Drivers and Metrics: Financial Measures of Performance, Drivers of Supply Chain Performance, Framework for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.</p> <p>Creating the Responsive Supply Chain: Product push versus demand pull, The Japanese philosophy, The foundations of agility, A route-map to responsiveness.</p>	8
02	<p>Designing the Supply Chain and Transportation Networks</p> <p>Designing Distribution Networks: The Role of Distribution in the Supply Chain, Factors Influencing Distribution Network Design, Design Options for a Distribution Network.</p> <p>Network Design in the Supply Chain: The Role of Network Design in the Supply Chain, Factors Influencing Network Design Decisions, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.</p> <p>Designing Global Supply Chain Networks: The Impact of Globalization on Supply Chain Networks, The Offshoring Decision: Total Cost, Risk Management in Global Supply Chains, Discounted Cash Flows, Evaluating Network Design Decisions Using Decision Trees.</p> <p>Transportation in a Supply Chain: The Role of Transportation in a Supply Chain, Modes of Transportation and their Performance Characteristics, Design Options for a Transportation Network, Trade-Offs in Transportation Design, Tailored Transportation.</p>	10

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Department of Mechanical Engineering		
03	<p>Coordination in a Supply Chain: Lack of Supply Chain Coordination and the Bullwhip Effect, The Effect on Performance of Lack of Coordination, Obstacles to Coordination in a Supply Chain, Managerial Levers to Achieve Coordination, Continuous Replenishment and Vendor-Managed Inventories, Collaborative Planning, Forecasting, and Replenishment.</p> <p>Sourcing Decisions in a Supply Chain: The Role of Sourcing in a Supply Chain, In-House or Outsource, Third- and Fourth-Party Logistics Providers, Using Total Cost to Score and Assess Suppliers, Supplier Selection-Auctions and Negotiations, Contracts, Risk Sharing and Supply Chain Performance, Design Collaboration, The Procurement Process.</p>	8
04	<p>Pricing and Revenue Management in a Supply Chain: The Role of Pricing and Revenue Management in a Supply Chain, Pricing and Revenue Management for Multiple Customer Segments, Pricing and Revenue Management for Perishable Assets, Pricing and Revenue Management for Seasonal Demand, Pricing and Revenue Management for Bulk and Spot Contracts.</p> <p>Information Technology in a Supply Chain: The Role of IT in a Supply Chain, The Supply Chain IT Framework, Customer Relationship Management, Internal Supply Chain Management, Supplier Relationship Management, The Transaction Management Foundation, Managing the supply chain as a network, Seven major business transformations, From 3PL to 4PL. The Future of IT in the Supply Chain.</p>	8
05	<p>Creating a Sustainable Supply Chain: The Role of Triple Bottom Line, Key Metrics for Sustainability, Greenhouse gases and the supply chain, Reducing the transport-intensity of supply chains, Beyond the carbon footprint, Reduce, reuse, recycle, Sustainability and Supply Chain Drivers.</p> <p>Introduction to the Supply Chain of the Future: Emerging Megatrends.</p>	8
Total		42

Books Recommended:

Reference Books:

- Logistics & Supply Chain Management, Martin Christopher, Pearson Education Limited, 2016.
- Supply Chain Management Strategy, Planning, and Operation, Sunil Chopra and Peter Meindl, Pearson, 2016.
- Essentials of Supply Chain Management, Michael H. Hugos, Wiley, 2018.
- Supply Chain Management For Dummies, Daniel Stanton, Wiley, 2020.
- Global Supply Chain and Operations Management A Decision-Oriented Introduction to the Creation of Value, Dmitry Ivanov, Alexander Tsipoulaidis and Jörn Schönberger, Springer International Publishing, 2016.
- Supply Chain Management, Sinha, McGraw-Hill Education (India) Pvt Limited, 2012.

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Department of Mechanical Engineering		
Program: Common for All Programs	Final Year B.Tech	Semester: VIII
Course: IPR and Patenting (DJS22ILO8027)		



Objectives:

1. Understanding, defining, and differentiating different types of intellectual properties (IPs)
2. Assessing different IP management (IPM) approaches
3. Exposure to the Legal management of IP and understanding of real-life practice of IPM.

Outcomes: On completion of the course, the learner will be able to:

1. Recognize the crucial role of IP for the purposes of product and technology development.
2. Understand how and when to file a patent
3. Apply the knowledge to understand the entire ecosystem
4. Derive value from IP and leverage its value in new product and service development.



IPR and Patenting (DJS22ILO8027)		
Unit	Description	Duration
1	Concept of Intellectual Property Law Idea/Expression dichotomy, Introduction, and the need for intellectual property rights (IPR), Intellectual Property laws, IPR in India: Genesis and development, IPR abroad, Major International Instruments concerning Intellectual Property Rights: Paris Convention, the Berne Convention, the Universal Copyright Convention, the WIPO Convention, the Patent Cooperation Treaty, the TRIPS Agreement, incentive theory, types of IPR, India's New National IP Policy, 2016, Govt. Schemes in IPR IP	8
2	Patents and Trademarks Elements of Patentability: Novelty, Non-Obviousness, Industrial Application, Non Patentable Subject Matter, Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties, Patent Office and Appellate Board, Case study of existing patents related to software, healthcare, and devices Concept of Trademarks, Different kinds of marks (brand names, logos, signatures, symbols, well-known marks, certification marks, and service marks), Non Registrable Trademarks, Registration of Trademarks, Rights of holder and assignment and licensing of marks, Infringement, Remedies & Penalties, Trademarks registry and appellate board	10
3	Copyrights and Designs Copyrights: Nature, Subject matter: original literary, dramatic, musical, artistic works, cinematograph films and sound recordings, Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright, Infringement, Remedies & Penalties, Related Rights, distinction between related rights and copyrights Design: meaning and concept of novel and original, procedure for registration, effect of registration and term of protection.	8
4	GI, PVP, and LDP Geographical indication: meaning, difference between GI and trademarks, procedure for registration, effect of registration, and term of protection. Plant variety protection: meaning, benefit sharing, farmers' rights, procedure for registration, effect of registration, and term of protection. Layout Design protection: meaning, procedure for registration, effect of registration, term of protection	8

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Department of Mechanical Engineering		
5	Beyond IP Introduction to Competition Law: concept of competition, relationship and Interaction between IPR and competition law, IP and competition issues, Technology transfer agreements. EU experience with IP and Competition Law, the Indian Competition Act, and IPR protection, IPR issues in mergers and acquisitions, harmonization of IP protection, and competition Law in India.	8
	Total	42

Books Recommended:

Reference Books:

- Feroz Ali, The Law of Patents, LexisNexis
- Ronald D. Slusky, Invention Analysis and Claiming - A Patent Lawyer's Guide, Second Edition, American Bar Association, 2012.
- Feroz Ali, The Touchstone Effect: The Impact of Pre-grant Opposition on Patents, LexisNexis, 2009.
- Innovation and entrepreneurship by Drucker. F. Peter, Harper's Business, (2006).
- Intellectual Property Rights, Deborah. E. Bouchoux, Cengage Learning.
- Intellectual Property Rights-Unleash The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,
- The Design of Business- by Martin Roger, Harvard Business Publishing (2009)

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Department of Mechanical Engineering		
Program: Common for All Programs	Final Year B.Tech	Semester: VIII
Course: Digital Marketing Management (DJS22ILO8028)		



Objectives:

1. To explain the evolution of digital marketing and outline the underlying technology and frameworks within which digital marketing operates.
2. To understand digital marketing business models elucidating on the six core digital value elements and how they can be used to generate customer value.
3. To understand the key concepts of developing strategy for digital business and the emerging business structures.
4. To plan the digital marketing strategy roadmap, its four key stages and their elements and understand the 6S Digital Marketing Implementation Stages.
5. To understand digital marketing planning & operations setup.
6. To explain the implementation of search campaigns which include Search Engine Marketing (SEM) and Search Engine Optimization (SEO) concepts.
7. To explain upcoming digital marketing concepts including Big Data and Internet of Things
8. (IoT), Small and Medium Businesses (SMB), B2B marketing and Social, Local and Mobile (SoLoMo) concept.

Outcomes: Upon Completion of the course, the learner should be able to:

1. Understand the digital marketing framework & model and consumer behaviour.
2. Develop a digital marketing strategy roadmap.
3. Explain the terminology and concepts for developing web-specific media plans.
4. Understand concepts related to digital campaign management and revenue generation models.
5. Get a perspective on global digital marketing technology/tools and future trends.



Digital Marketing Management (DJS22ILO8028)		
Unit	Description	Duration
1	Introduction to Digital Marketing Emergence of Digital Marketing as a tool, media consumption drivers for a new marketing environment, applications, and benefits of digital marketing. Digital Marketing Framework: Delivering enhanced customer value, market opportunity analysis, and digital services development, ASCOR framework, and critical success factors for digital marketing. Digital Marketing Models Creation: Factors impacting the digital marketplace, value chain digitization, and business models. The Consumer for Digital Marketing: Consumer behavior on the internet, evolution of consumer behavior models, managing consumer demand, integrated marketing communications (IMC), and impact of digital channels on IMC.	8
2	Digital Marketing Strategy Development Elements of the assessment phase, macro-micro environmental analysis, and marketing situation analysis. Digital Marketing Internal Assessment and Objectives Planning: Analyzing the present offerings mix, marketing mix, core competencies analysis, and internal resource mapping. Digital presence analysis, digital marketing objectives development, and review.	10

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Department of Mechanical Engineering		
	<p>Digital Marketing Strategy Definition Understanding digital business strategy and structures, consumer development strategy, offering mix for Digital, digital pricing models, managing promotional channels, and developing the extended Ps- People, process, programs, and performance.</p> <p>Digital Marketing Strategy Roadmap: Developing a digital marketing strategy roadmap, the 6s digital marketing implementation strategy, and marketing across the product life cycle.</p>	
3	<p>Digital Marketing Planning and Setup Understanding digital media planning terminology and stages, steps to creating a marketing communications strategy, introduction to search marketing, display marketing, and social media marketing.</p> <p>Digital Marketing Operations Setup: Basics of lead generation and conversion marketing, website content development and management, elements of user experience, web usability, and evaluation.</p>	8
4	<p>Digital Marketing Execution Basic elements of digital campaign management, search execution, display execution, social media execution, and content marketing. Digital Marketing Execution Elements Digital revenue generation models, managing service delivery and payments, managing digital implementation challenges like e-commerce, internal & external, and consumer-specific challenges.</p>	8
5	<p>Digital Business - Present and Future Digital Marketing - Global Landscape, digital marketing overview, global spend, advertising spend, and technology/tools landscape. Data technologies (Big data and IOT) impacting marketing, segment-based digital marketing, and SoLoMo - the next level of hyperlocal marketing.</p>	8
	Total	42

Books Recommended:

Reference Books:

- Fundamentals of Digital Marketing by Puneet Singh Bhatia, Pearson Education Limited.
- Digital Marketing by Seema Gupta- McGraw-Hill Education.
- Digital Marketing Excellence: Planning, Optimizing, and Integrating Online Marketing by Dave Chaffey and P. R. Smith, 5th edition, Taylor & Francis.
- Digital Marketing: Strategy, Implementation and Practice- 6th edition by Dave Chaffey, Fiona Ellis-Chadwick, Pearson Education Limited.
- Digital marketing by Vandana Ahuja, Oxford University Press.
- The Art of Digital Marketing by Ian Dodson, John Wiley & Sons.

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	Department of Mechanical Engineering		
Program: Common for All Programs		Final Year B.Tech	Semester: VIII
Course: Environmental Management (DJS22ILO8029)			

Pre-requisites: Basic Knowledge of Probability and Statistics.

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise with environment-related legislation
4. Understand Environmental Auditing Procedures.

Outcomes: On completion of the course, the learner will be able to:

1. Identify Environmental issues and get familiarized with the concept of the Ecosystem and environmental management.
2. Know policies and legal aspects and understand EM system standards.
3. Understand the Environmental Impact Assessment.
4. Understand Environment Auditing procedures.
5. Describe Environmental Management Techniques

Environmental Management (DJS22ILO8029)		
Unit	Description	Duration
1	Principles of Environmental Management (EM): Introduction of EM, Definition, Ecosystem concept, Participants in EM, Ethics and the environment, International Environmental Movement, Environmental issues relevant to India.	8
2	Policy and Legal Aspects of EM: - Introduction to various Environmental Policies, Indian and International Environmental laws and legislation. EM system Standards: Core Elements, Benefits, Certification Body Assessment & Documentation for EMS, ISO-14000 Standards.	9
3	Environmental Impact Assessment (EIA): Purpose, steps, hierarchy of EIA, Environmental Impact Statement and Impact Indicators, Evolution of IA in India and worldwide. Preliminary stages of EIA, Impact, Prediction, Evaluation and Mitigation.	9
4	Environmental Auditing (EA):- Objectives, Scope and Types of EA, Audit Methodology, Elements of Audit Process, Auditing of EMS.	8
5	Environmental Management Techniques: - Environmental Monitoring and Modelling, Environmental technology Assessment and Environmental Risk Assessment, Eco-mapping.	8
Total		42

Books Recommended:

Text Books:

- Environmental Management, T V Ramachandra and Vijay Kulkarni, TERI Press
- Environmental Management: Principles and Practice, CJ Barrow, Routledge Publishers, London, 1999

Reference Books:

Prepared by

Checked by

Head of the Department

Principal



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Department of Mechanical Engineering

- A Handbook of Environmental Management, Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing.
- Indian Standard Environmental Management Systems - Requirements with Guidance for Use, Bureau Of Indian Standards, February 2005.
- Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000.
- Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press.
- Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing, 2015.

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	Department of Mechanical Engineering		
Program: Common for All Programs		Final Year B.Tech	Semester: VIII
Course: Labour and Corporate Law (DJS22ILO8030)			

Objectives:

1. To understand the development and judicial setup of Labour Laws.
2. To learn the laws relating to Industrial Disputes, Social Security, and Working Conditions.
3. To analyse the laws related to corporate governance in different settings.
4. To develop awareness of legal principles involved in economic relationships and business transactions.
5. To develop an understanding of the free enterprise system and the legal safeguards of the same.

Outcomes: On completion of the course, the learner will be able to:

1. Illustrate the role of a trade union in the industrial setup.
2. Understand the important causes, impact of industrial disputes, and settlement procedures.
3. To provide an in-depth understanding of corporate social responsibility.
4. Apply concepts, principles, and theories to understand simple business laws.
5. Analyse the principles of international business and the strategies adopted by firms to expand globally.

Labour and Corporate Law (DJS22ILO8030)		
Unit	Description	Duration
1	Trade Unions and Collective Bargaining: Trade Unionism in India, Definition of Trade Union and Trade Dispute, General and Political Funds of Trade Union, Civil and Criminal Immunities of Registered Trade Unions, Recognition of Trade Union, Collective Bargaining	8
2	Industrial Dispute and Instruments of Economic Coercion: Industrial Dispute and Individual Dispute, Settlement of Industrial Dispute. Concept of strike, Gherao, Bandh, and Lock-out, Types of Strike, Rights to Strike and Lock-out	9
3	Formation of a Company and Corporate Governance: Company and Other Forms of Business Organizations, Different Kinds of Companies: One Person Company, Foreign Company. Kinds of Company Meetings and Procedure Powers, Duties, and Kinds of Directors: Independent Director, Women Director. Different Prevention of Oppression and Mismanagement, Investor Protection, Insider Trading, Corporate Fraud.	9
4	Corporate Social Responsibility and Corporate Liquidation: Evolution of Corporate Social Responsibility, Corporate Criminal Liability, Corporate Environmental Liability, Different Types of Winding up of Company, Role of Courts in Winding up of Company, Merger and Acquisition of Company, Cross-Border Merger, Takeover Code: Role of SEBI	8
5	Case Studies on A) Labour law B) Labour relations C) Corporate laws D) Securities laws	8
	Total	42

Books Recommended:

Reference Books:

- Surya Narayan Misra, An Introduction to Labour and Industrial Law, Allahabad Law Agency, 1978.



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Department of Mechanical Engineering

- Indian Law Institute, Cases and Materials on Labour Law and Labour Relations, P.L. Malik, Industrial Law, Eastern Book Company, 2013.
- S.C. Srivastava, Industrial Relations and Labour Law, Vikas Publishing House, New Delhi.
- C.A. Kamal Garg, Bharat's Corporate and Allied Laws, 2013.
- Institute of Company Secretaries of India, Companies Act 2013, CCH Wolter Kluver Business, 2013.
- Saleem Sheikh & William Rees, Corporate Governance & Corporate Control, Cavendish Publishing Ltd., 1995
- Taxmann, A Comparative Study of Companies Act 2013 and Companies Act 1956.

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Department of Mechanical Engineering		
Program: Mechanical Engineering	B.Tech	Semester: VIII
Course: Project Stage II (DJSMEP802)		

Pre-requisite:

Knowledge of mechanical &/or interdisciplinary subjects, concepts & analytical software.

Objectives:

1. To acquaint with the process of undertaking a literature survey/industrial visit and identifying the problem
2. To familiarize with the process of solving the problem in a group
3. To acquaint with the process of applying basic engineering fundamentals in the domain of practical applications
4. To inculcate the process of research

Outcomes: On completion of the course, the learner will be able to:

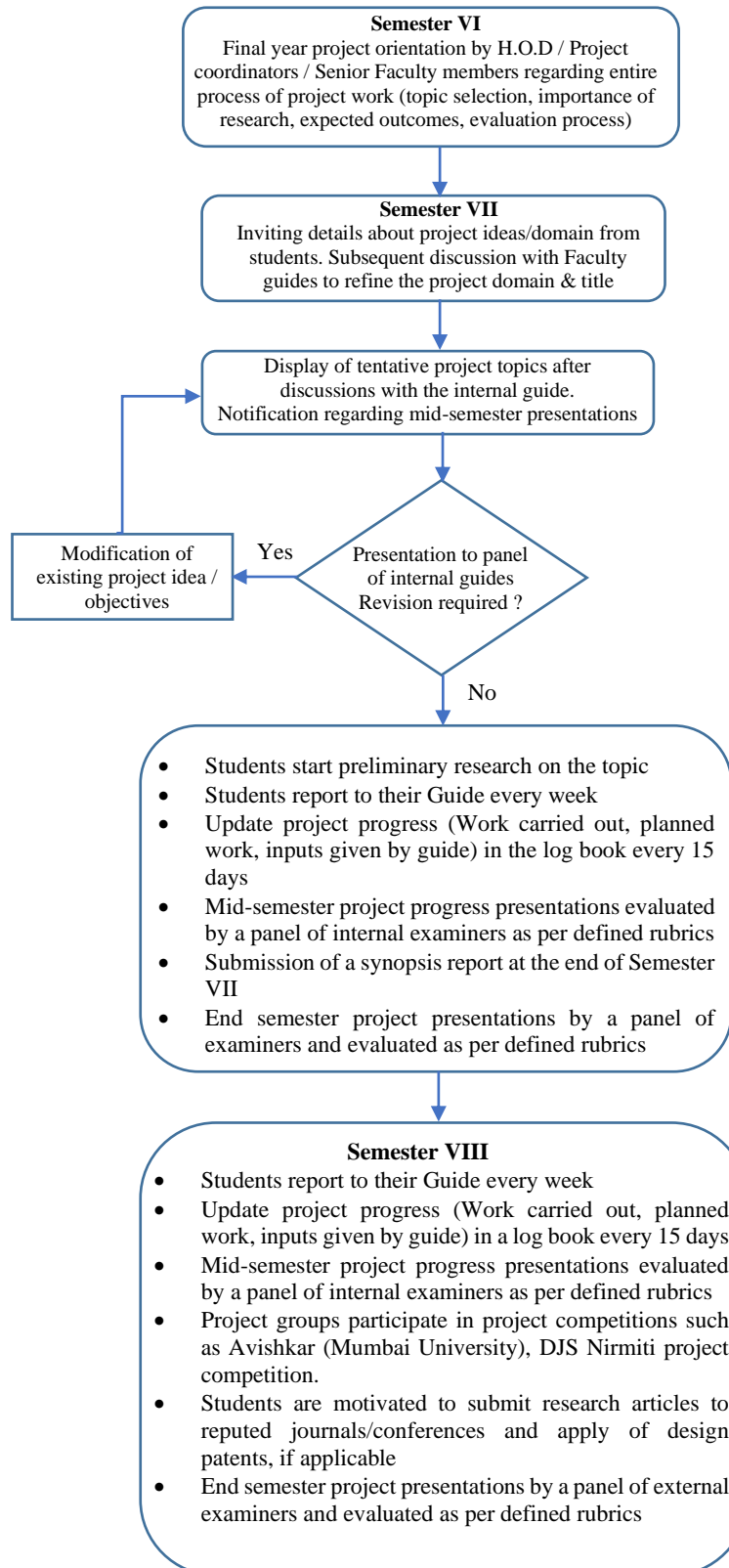
1. Apply basic engineering fundamentals in the domain of practical applications.
2. Identify, formulate, and analyse the engineering problems based on the literature review.
3. Attempt a problem solution with a systematic approach and ethics.
4. Correlate the theoretical and experimental / simulation results and draw the proper inferences.
5. Develop the habit of working in a team and communicating efficiently with the engineering community and society.
6. Recognize the need for lifelong learning activities to cope with technological changes.

Project-II

- To proceed with the project work on the basis of the outcomes of the literature review. The project can be undertaken on any subject addressing Mechanical &/or interdisciplinary concepts.
- Research and development projects on problems of practical and theoretical interest should be encouraged.
- Students must develop clarity on the objectives/scope of the project after analysing their project problem statement.
- Students must be guided to think critically and arrive at relevant solutions to their project's technical challenges.
- Students must make an effort to validate their experimental data with analytical/software simulations, if applicable.
- Students must work together as a Team and share responsibilities. Students can certainly take ideas from anywhere, but be sure they adapt them to suit their project requirements.
- The project work can be undertaken in a research institute or organization/company/any business establishment.
- Student must consult the internal guide along with the external guide (if any) and update the progress.
- The student has to document the progress report every 15 days in the project log book, and the internal guide has to keep track of the progress of the project and maintain the attendance report. This progress report, along with a synopsis report, can be used for awarding term work marks.
- In case of industry projects, regular monitoring by internal guide is recommended.



PROJECT IMPLEMENTATION AND EVALUATION:





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Department of Mechanical Engineering

Guidelines for Assessment of Project-II

Project-II should be assessed based on the following points:

1. Problem Identification
2. Objectives & Scope
3. Innovation & Creativity
4. Technical Complexity
5. Design
6. Fabrication
7. Cost & Feasibility
8. Environmental & Safety Aspects
9. Documentation & Presentation
10. Body language and teamwork

Project II should be assessed through the Project thesis/report & presentations by the student project group to a panel of Internal and External Examiners approved by the B.o.S. / Head of Department.



Shri Vile Parle Kelavani Mandal's

DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING

(Autonomous College Affiliated to the University of Mumbai)

NAAC Accredited with "A" Grade (CGPA: 3.18)



Department of Mechanical Engineering

Program: Mechanical Engineering

B.Tech

Semester: VIII

Course: Disaster Management and Preparedness (DJS22A4)

Objectives:

1. To provide a basic understanding of hazards, disasters, and various types and categories of disasters occurring around the world.
2. To identify the extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize them.
4. To understand the roles and responsibilities of individuals and various organizations during and after a disaster.
5. To appreciate the significance of GIS, GPS in the field of disaster management.
6. To understand the emergency government response structures before, during, and after a disaster.

Outcomes: On completion of the course, the learner will be able to:

1. Apply disaster management principles & guidelines.
2. Conduct risk assessments.
3. Develop community awareness & participation.
4. Utilize Science & Technology tools (GIS, GPS).
5. Prepare disaster management plans.



Disaster Management and Preparedness (DJS22A4)		
Unit	Description	Duration
1	<p>Understanding Disasters & Hazards:</p> <ul style="list-style-type: none"> • Definition and types of disasters: Natural, Man-made and hybrid disasters, Study of Natural disasters: Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc. Study of Human/Technology Induced Disasters: Chemical, Industrial and Nuclear disasters, internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy, • Hazard & Vulnerability profiles of India (seismic zones, flood-prone areas). • India's vulnerability to disasters, and the impact of disasters on National development. 	06
2	<p>Disaster Risk Reduction (DRR) & Mitigation:</p> <ul style="list-style-type: none"> • Disaster Management Cycle: Prevention, Mitigation, Preparedness, Response, Recovery. Need for disaster prevention and mitigation, mitigation guiding principles, challenging areas, structural and non-structural measures for disaster risk reduction. • Risk Assessment & Vulnerability Analysis. • Science & Technology: Use of information management, Geo informatics like RS, GIS, GPS and remote sensing mitigation measure. 	06
3	<p>Disaster Preparedness & Response:</p> <ul style="list-style-type: none"> • Preparedness Planning, Early Warning Systems (EWS), & Communication. • Emergency Response: Search & Rescue, Logistics, Medical Aid. • Psychological Response & Management (Trauma, Stress). • Role of IT, Media, Govt., NGOs, & Community. 	04

Prepared by

Checked by

Head of the Department

Principal

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4	Recovery, Rehabilitation & Reconstruction: <ul style="list-style-type: none"> • Post-disaster damage assessment. • Rehabilitation, Reconstruction, & Livelihood Restoration. • Sanitation, Hygiene, & Waste Management. 	04
5	Policy, Governance & Capacity Building: <ul style="list-style-type: none"> • National Disaster Management Authority (NDMA) & Legislation. • Institutional Mechanisms & Community Mobilization. Non-Structural Mitigation: Community based disaster preparedness, capacity development and training, awareness and education, contingency plans. 	04
6	Case studies on disaster (National /International): <ul style="list-style-type: none"> • Case study discussion of National Disasters: Tsunami (2004), Bhopal gas tragedy, Kerala and Uttarakhand flood disaster, 26th July 2005 Mumbai flood • Case study discussion of International Disasters: Hiroshima – Nagasaki (Japan), Cyclone Phailin (2013), Fukushima, Daiichi nuclear disaster (2011), Chernobyl meltdown 	04
Total		28

Books Recommended:

Reference Books and Reports:

- Disaster Management, by Harsh K. Gupta, Universities Press Publications (2003).
- Disaster Management: An Appraisal of Institutional Mechanisms in India, by O. S. Dagur, published by Centre for Land Warfare Studies, New Delhi, 2011.
- Introduction to International Disaster Management, by Damon Copolla, Butterworth Heinemann Elsevier Publications (2015).
- Disaster Management Handbook, by Jack Pinkowski, CRC Press, Taylor and Francis group (2008).
- Disaster management & rehabilitation, by Rajdeep Dasgupta, Mittal Publications, New Delhi (2007).
- Natural Hazards and Disaster Management, Vulnerability and Mitigation, by R B Singh, Rawat Publications (2006).
- Concepts and Techniques of GIS, by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications (2006).
- Risk management of natural disasters, by Claudia G. Flores Gonzales, KIT Scientific Publishing (2010).
- Disaster Management – a disaster manager's handbook, by W. Nick Carter, Asian Development Bank (2008).
- Disaster Management in India, by R. K. Srivastava, Ministry of Home Affairs, GoI, New Delhi (2011)
- The Chernobyl Disaster: Legacy and Impact on the Future of Nuclear Energy, by Wil Mara, Marshall Cavendish Corporation, New York, 2011.
- The Fukushima 2011 Disaster, by Ronald Eisler, Taylor & Francis, Florida, 2013.
- (Learners are expected to refer to reports published at the national and international levels and updated information available on authentic websites.)