4.B.E Syllabus

B.E Sem VII

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC701	Design of Mechanical System	4	-	-	4	-	-	4

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
MEC701	Design of Mechanical System	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To familiarize with the concept of system and methodology of system design

2. To study system design of various systems such as Gear box, snatch block, belt conveyors, I. C. engine system and pumps

Course Outcomes:

1) Apply the concept of system design

2) Select appropriate gears for power transmission on the basis of given load and speed

3) Design material handling systems such as hoisting mechanism of EOT crane
4) Design belt conveyor systems
5) Design engine components such as cylinder, piston, connecting rod and crankshaft
6) Design pumps for the given applications

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Methodology & Morphology of design, Optimum design, system concepts in design	**05**	**CO1**
II	**Design of Transmission Gear Box**	Single stage and Two stage Gear box with fixed ratio consisting of Design of spur, helical, bevel and worm and worm wheel gear pairs, Gear box housing layout and housing design	**14**	**CO2**
III	**Design of Hoisting Mechanism**	Design of Snatch Block Assembly including Rope Selection, Sheave, Hook, Bearing for hook, cross piece, Axle for sheave and shackle plate, Design of rope drum, selection motor with transmission system	**12**	**CO3**

IV	**Design of Belt Conveyors**	Power requirement, selection of belt, design of tension take up unit, idler pulley	**07**	**CO4**
V	**Engine Design (Petrol and Diesel)**	Design of cylinder, Piston with pin and rings, connecting rod & crank shaft with bearings	**12**	**CO5**
VI	**Design of Pump**	**6.1 Design of main components of gear pump** 1 Motor selection 2 Gear design 3 Shaft design and bearing selection 4 Casing and bolt design 5 Sizing of design of suction and delivery pipe **6.2 Design of main components of Centrifugal Pump:** 1 Motor selection 2 Suction and Delivery pipe 3 Design of Impeller, Impeller shaft 4 Design of Volute Casing	**10**	**CO6**

Text Books/ Reference:

1. "Machine Design Exercises", S.N.Trikha - New Delhi Khanna Publisher 1978.

2"Mechanical Engineering Design", Shigley J E and Mischke C R, 11th Edition 2019, McGraw Hill, ISBN: 9788184956207

3. "Design of Machine Elements", Bhandari VB, 5th Edition 2020, TMH, and ISBN: 9789390177479

4. "Engineering Design", Dieter G E, McGraw Hill Inc, ISBN: 9781260113297.

Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_me62
2	https://nptel.ac.in/courses/112/106/112106137/

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC702	Logistics and Supply Chain Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT1 +IAT 2					
MEC702	Logistics and Supply Chain Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand the fundamentals of supply chain management and Logistics

2. To develop an understanding related to Supply Chain Performance and related aspects

3. To understand Inventory management in supply chain

4. To learn tools and techniques used in logistics, transportation, warehousing and outsourcing decisions

5. To develop critical understanding towards digitization in supply chain management and sustainability

6. To develop analytical and critical understanding for planning and designing supply chain network

Course Outcomes:

1) Demonstrate a sound understanding of Logistics and Supply Chain Management concepts and their role in today's business environment
2) Identify the drivers of supply chain performance and risks in supply chain management
3) Apply various techniques of inventory management and rank the items using inventory management technique
4) Apply various strategies and techniques to minimize overall logistics cost
5) Understand the role of digitization in supply chain management leading to sustainability
6) Apply various mathematical models/tools to design the supply chain network

Prerequisite:

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Objectives of a Supply Chain Management, Stages of Supply chain, Value Chain Process, Cycle view of Supply Chain Process, Key issues in SCM, logistics & SCM,	**06**	**CO1**

		Supply Chain Drivers /decisions and obstacles, Supply chain strategies, strategic fit, Best practices in SCM, Obstacles of streamlined SCM. Supplier Selection, Supplier quality audits, Contract management, Non Disclosure Agreement (NDA), Make & Buy Decision while in-out sourcing		
II	**Supply Chain Performance**	Bullwhip effect and reduction, Performance measurement: Dimension, Tools of performance measurement, SCOR Model. Demand chain management, Global Supply chain- Challenges in establishing Global Supply Chain, Factors that influences designing Global Supply Chain Network. Supply Chain Risk Management (Risks involved in supply chain which includes – Supplier Financial Risk, Performance Risk, Compliance Risk, Country specific Risk, Cyber Security. Supplier performance measurement – (Delivery & Quality performance, schedule adherence, Goods receipt compliance etc.), Supplier Capacity Analysis, Supplier Score card.	**10**	**CO2**

III	**Inventory management**	Definition of Inventory, Inventory types & functions; EOQ Model and Buffer Stock, Assumptions, Instantaneous Replenishment case, Demand and production rate are different, when backorders are allowed, Buffer Stock and ROL. Replenishment systems (Q and P system) Inventory Control- ABC Analysis, Numerical problems on ABC analysis, VED Analysis	**07**	**CO3**
IV	**Logistics Management and outsourcing**	Evolution, Objectives, Components and Functions of Logistics Management, Distribution related Issues and Challenges; Gaining competitive advantage through Logistics Management, Transportation- Functions, Costs, and Mode; Network and Decision, Containerization, Cross docking. Warehousing: Concept and types, Warehousing strategy, Warehouse facility location & network design Part Packaging, Use of Returnable pallets, ASN – Advance Shipment Notification. Reverse logistics: Outsourcing - Nature and concept, Strategic decision to Outsourcing, Third party logistics (3PL), and	**08**	**CO4**

		Fourth party logistics (4PL), Cold chain operations in Supply chain.		
V	**Digitization in supply chain Management and Sustainability**	IT in supply chain - Role of IT in a supply chain, The supply chain IT framework, Application of Bar coding, Significance of SAP/RFID, The future of IT in the supply chain, Supply chain IT in practice, TMS (Transport Management System), WMS (Warehouse Management System) Green supply chain management, Supply Chain sustainability, Supply Chain sustainability index measurement with case studies. Social aspects of supply chain (CSR), Environment aspects of supply chain (CO2 emission), resource utilization, recycling	**06**	**CO5**
VI	**Supply Chain Network Design**	Factors influencing distribution network design, Supply chain resilience, Design options for distribution network, Introduction to mathematical modelling, considerations in modelling SCM systems, Overview of the models, Models on transportation, Transportation problem, Vehicle routing problem, Travelling salesman problem, Capacitated	**08**	**CO6**

		transshipment problem, shortest path problem. Value Stream Mapping (VSM), Order Fulfillment Process Flow, understanding the terms related to Supply chain- Lead Time, Takt Time ,Minimum Order Quantity (MOQ), Manufacturing Critical Path Time (MCT)		

Text Books/ Reference:

1. R.P. Mohanty, S.G. Deshmukh, "Essentials of Supply Chain management", 1st Edition 2004, Jaico Publishing House.

2. S.K. Bhattacharya, "Logistics Management", 3rd Edition, Pearson Publication ISBN: 9788131768624

3. Sunil Chopra, P. Meindl, "Supply Chain Management", 6th Edition 2016, Pearson Education Asia

4. Martin Christopher, "Logistics and Supply Chain Management", 4th Edition 2010, Pitman Publishing.

Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_mg74/preview
2	https://onlinecourses.swayam2.ac.in/cec22_mg22/preview

R-2025- BE Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC731	Automotive Power Systems	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
MEC731	Automotive Power Systems	20	20	40	60	2	--	--	100

Rationale:

Most of the engineering branches are being off-spring of manufacturing processes, and the subject Automotive Power Systems are important because they provide the energy required for vehicle operation, including propulsion, lighting, ignition, charging, and auxiliary functions. Studying automotive power systems helps in understanding engines, batteries, alternators, electric drives, hybrid systems, and power distribution in vehicles. It is essential for improving vehicle performance, fuel efficiency, reliability, and supporting the development of electric and hybrid vehicles.

IQAC Format Number: 60_A

Course Objectives:

1. To familiarize with the working of S.I. and C.I. engines and its important systems.
2. To provide insight into the harmful effects of engine pollutants and its control.
3. To familiarize with the latest technological developments in engine technology

Course Outcomes:

1. Demonstrate the working of Fuel supply and ignition system of I.C. engines.
2. Illustrate the working of lubrication, cooling and supercharging systems.
3. Comprehend the different technological advances in engines and alternate fuels.
4. Identify and describe the history and different EV/HEV drivetrain topologies.
5. Compare and evaluate various energy sources and energy storage components for EV and HEV application.
6. Comprehend EV and HEV working through Case studies.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Fuel Supply System and Ignition System**	Constructional Features of I.C. Engines. Parts of I.C. engine and their materials. Fuel Supply System: Fuel-Air ratio, Fuel air mixture requirement, Conventional fuels used in IC engines, Fuel injection system in SI and CI engine and MPFI Engine. Ignition System : Battery Ignition System, Magneto Ignition System, Functions and working of ignition coil, spark plug, contact breaker point, Requirements and working of Ignition advance mechanisms; mechanical and vacuum, Electronic Ignition Systems; Capacitor Discharge Ignition System, Transistorized Coil Assisted Ignition System, Transistor Ignition system with contactless breaker.	09	CO1
II	**Lubrication System, Cooling System and Supercharging/Turbocharging**	Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems Cooling System : Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling Supercharging/Turbocharging : Objectives,	07	CO2

		Limitations, Methods and Types, Different arrangements of turbochargers and superchargers (No Numericals)		
III	**Engine Exhaust Emission and its control,**	Engine Exhaust Emission and its control Constituents of exhaust emission at its harmful effect on environment and human health, Formation of NOx, HC, CO and particulate emissions, Methods of controlling emissions; Catalytic convertors, particulate traps, Exhaust Gas Recirculation, EURO and BHARAT norms. Alternative Fuels Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas - Producer Gas - Properties - Suitability - Engine Modifications - Merits and Demerits as fuels. Basics of Electronic Engine Controls: Electronic Control module (ECM), Inputs required and output signals from ECM, Sensors: Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow and Exhaust Gas Oxygen sensors, their construction and importance in ECM. Electronic Spark control, Air Management system, Idle speed control	06	CO3

IV	**Introduction to Hybrid and Electric Vehicles**	Introduction to Hybrid and Electric Vehicles: History of Electric Vehicles (EV) and Hybrid electric vehicles (HEV), need and importance of EV and HEV, Indian and Global Scenario of EV and HEV. Drivetrain topologies: Electric traction and hybrid traction system, Electric drive topologies, hybrid drivetrain topologies. Power energy supply requirement for EV/HEV applications.	07	CO4
V	**Electric Drives and controller**	Electric system components for EV/HEV, AC and DC motor drives, RPM and Torque calculation of motor, Motor Controllers,	07	CO5
VI	**Energy Sources for EV/HEVs**	Energy Sources for EV/HEVs: Requirement of energy supplies and storage in EV/HEV, Types of batteries(Lead Acid/Li-ion/NiMH) and its working, battery specifications, Battery Management system; Fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, Concept of Hybridisation for different energy sources. Energy Management Strategies: EV/HEV energy management strategies, classification and comparison of various energy management strategies Battery charging: Type of battery charging systems, Selection and Sizing of charging station, Components of charging station.	09	CO6

		Single line diagram of charging station, On board Charger. Payback period of EV and HEV Case Study: Toyota Prius, Honda Insight, Tata Nexon EV		

Text Books:

1. A Course on Internal Combustion Engine,Mathur and Sharma,Dhanpat Rai & Sons,New Delhi,2001. 2.
2. Internal Combustion Engine,V.Ganesan,Mc Graw Hill,1995 3.
3. Internal Combustion Engine, Domkundwar & Domkundwar,Dhanpat Rai & Sons,New Delhi,2013.
4. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, CRC Press,2005

References:

1. Fundamental of Internal Combustion Engines,Gill and Smith,Oxford & IBH Publishing Company Pvt.ltd,2007 2.
2. Internal Combustion Engine Fundamentals,Heywood,McGraw Hill,1988.
3. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press,2003.
4. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley,2003

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	**https://nptel.ac.in/courses/107106088**

2	**https://nptel.ac.in/courses/112103262**
3	**https://nptel.ac.in/courses/108102121**
4	**https://nptel.ac.in/courses/108106170**

Assessment:

Internal Assessment (IA) for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

- **Question paper format**

1. Question paper will comprise of a total six questions, each carrying 15 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC732	Renewable Energy Sources	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC732	Renewable Energy Sources	20	20	40	60	2.5	--	--	100

Rationale :

This subject aims to provide fundamental knowledge of various renewable energy sources such as solar, wind, biomass, hydrogen, geothermal, and ocean energy. It emphasizes the working principles, technologies, and practical applications of renewable systems.

The course also introduces energy management and auditing concepts to promote efficient and sustainable energy usage. With a focus on current global and national energy scenarios, it equips students with the skills to analyze, implement, and evaluate green energy solutions for a sustainable future.

Course Objectives:

1. To study working principles of various renewable energy sources and their utilities.
2. To study design and installation criteria of various equipment's to convert the renewable energy into useful energy.
3. To study economics of harnessing energy from renewable energy sources.

Course Outcomes:

1. Describe the need for renewable energy and its potential for the development of a sustainable environment.
2. Analyze different solar collectors using geometrical parameters and photovoltaics for generation of solar energy.
3. Identify and analyze various wind turbine energy harnessment techniques.
4. Design biogas plant for harnessing energy from organic waste.
5. Describe significance of hydrogen energy to fulfill present and future energy needs.
6. Describe the operating principle of geothermal energy and ocean energy and their role in sustainable development.

Prerequisite: Thermodynamics, Heat Transfer, Fluid Mechanics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Renewable Energy and Solar Radiation**	**1.1: Introduction to Renewable Energy** Sources and Solar Radiation: Global and National current energy scenarios, Prospects of renewable energy sources and renewable	06	CO1

		energies role in developing sustainable model. **1.2: Solar radiation terms**, solar geometry, earth sun angles, attenuation and measurement of solar radiation on horizontal and inclined surfaces, methods of solar radiation estimation.		
II	**Solar Thermal Energy**	**Solar Thermal Energy:** **2.1: Introduction and working** principle of flat plate collectors, thermal performance analysis of flat plate collectors, concentrating collectors, Installation and maintenance criteria of solar thermal systems. **2.2: Solar thermal devices-** Solar air heater and different types of solar air heaters, solar water heater and different types of solar water heaters, solar dryers, solar pond, solar distillation, solar still, solar cooker. 2.3: Solar space heating & cooling, solar refrigerator, solar thermal energy storage systems. Case Study: Solar thermal power plant working operation.	08	CO2
III	**Solar Photovoltaic Energy**	**Solar Photovoltaic Energy:** **3.1:** Introduction and working principle of a solar PV systems, types of solar PV cells, solar tracking systems, controls and measurement methods of solar PV systems. **3.2:** Methods to improve the efficiency of PV cells, parameters which affect the efficiency and life cycle of PV cells. Case Study: Installation of 1 kW of solar PV plant.	08	CO3

IV	**Wind Energy**	**4.1: Basic components and working** principle of wind energy conversion systems, wind data and site selection considerations, various types of wind energy conversion systems, constructional features of horizontal and vertical axis wind machines, performance analysis of horizontal and vertical axis wind machines. **4.2: Estimation of power output**- betz limits, Environmental impacts of wind energy.	07	CO4
V	**Energy from Biomass and Hydrogen Technologies**	**5.1: Energy from Biomass:** Introduction of bioenergy, conversion technologies, types of biogas generation plants, design and construction details of biogas plant (KVIC), site selection, digester design consideration, filling a digester for starting, maintaining biogas production, utilization of biogas. **5.2: Hydrogen Energy:** Introduction and application, General introduction to infrastructure requirement for hydrogen production, storage, dispensing & utilization. Principles of fuel cells, types of fuel cells, power generation by fuel cells, applications of fuel cells.	08	CO5

VI	**Geothermal, Ocean Energy and Sustainable Energy Practices**	**6.1: Geothermal Energy:** Introduction to geothermal technologies and methods of extracting geothermal energy, prospects of geothermal energy in India. **6.2: Energy from the ocean**: Wave energy characteristics and wave energy conversion devices, tide energy conversion devices, Ocean Thermal Energy Conversion (OTEC) systems. **6.3: Energy management and economics:** Energy conservation, energy security, energy economics, energy audit- definition, need, types of energy audit, Energy management (audit) approach-understanding energy costs, Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating.	08	CO6

Text / References Books:

1. "Non-conventional Energy Sources", G.D. Rai, 6th Edition, Khanna Publishers, ISBN: 978-81-7409 073-7
2. "Renewable Energy: Power for a Sustainable Future", Edited by Godfrey Boyle, 3rd Edition 2012, Oxford University Press, ISBN: 978-0199681273
3. "Solar Energy: Principles of Thermal Collection and Storage", SP Sukhatme and J K Nayak, 4th Edition, Tata McGraw Hill Publishing Co. Ltd.
4. "Solar Energy: Fundamentals and Applications", H.P. Garg& Jai Prakash, First Revised Edition, Tata McGraw-Hill Education.

5. "Wind Power Technology", Joshua Earnest, 2nd Edition, PHI Learning, 2015.
6. "Solar Engineering of Thermal Processes", John A. Duffie and William A Bechman, 4th Edition, Wiley Publications.
7. "Renewable Energy Sources", J W Twidell& Anthony D. Weir, 3rd Edition 2015, ELBS Pub, ISBN: : 978-1-315-76641-6
8. "Energy Conversion Systems", Rakosh Das Begamudre, New Age International (P) Ltd., Publishers, New Delhi, 2007, ISBN: 9788122412666
9. "Solar Photovoltaics: Fundamentals, Technologies and Applications", C S Solanki, 3rd Edition, PHI Learning.
10. "Biomass Regenerable Energy", D. D. Hall and R. P. Overend, John Wiley, New York, ISBN:047190919X
11. "Wind and Solar Power Systems", Mukund R Patel, 2nd Revised Edition, CRC Press, ISBN: 9780429114960
12. "Wind Energy Explained: Theory, Design and Application", J F Manwell, J.C. McGowan, A. L. Rogers,2nd Edition 2009, John Wiley and Sons.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/103103206
2	https://nptel.ac.in/courses/103107157
3	https://nptel.ac.in/courses/115105127

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC733	Vehicle Systems	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC733	Vehicle Systems	20	20	40	60	2.5	--	--	100

Rationale :

This subject provides comprehensive knowledge of automobile engineering by covering all essential systems and subsystems involved in vehicle operation. It introduces power flow layouts, clutch mechanisms, various transmission types, and driveline components for different drive configurations.

Steering systems, suspension types, braking technologies, and wheel-tyre dynamics are detailed to develop an understanding of vehicle handling and safety. The course also includes the study of automotive electrical systems such as batteries, ignition, starting, and lighting circuits. Students learn about body engineering, aerodynamics, and structural loads acting on vehicles.

Course Objectives:

1. To study basic and advanced vehicle systems.
2. To study basic and advanced vehicle electrical systems.
3. To study different chassis structures components.
4. To familiarize with the latest technological developments in automotive technology.

Course Outcomes:

1. Understand the working of different Vehicle Systems and Subsystems.
2. Understand the working of different Vehicle Electrical systems and subsystems.
3. Understand different Vehicle Body systems and layouts.
4. Illustrate working, functions of different vehicle mechanical, electrical, and chassis systems.
5. Understand the effect of aerodynamics on the functioning of a vehicle.
6. Comprehend the different technological advances in vehicle systems.

Prerequisite: Basic physics, Engineering Mechanics, Strength of Materials, Basic Electrical and Electronics Engineering

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Automobile Power Transmission Systems**	**Power Flow Layout:** FE FWD, FE RWD, RE FWD, RE RWD, Underfloor Engine **Clutches:** Necessity of clutch in an automobile, Working and Construction of Single plate, Multi plate, Centrifugal, Semi	08	CO1

		Centrifugal, electromagnetic clutches, Fluid Flywheel **Transmission:** Purpose and Elements of Gear Box, Characteristic Curves, Types Sliding mesh, Constant Mesh, Synchromesh, Planetary Gear set, Torque Converter, Semi-Automatic and Automatic **Drive Line:** UV joint, CV joint, Propeller Shaft construction and arrangement, Elements of drive line, 2WD, 4WD, Part time and Full time 2WD and 4WD.		
II	**Automobile Transmission, Steering, and Braking Systems**	**Final Drive:** Types of Final drive; spiral, bevel, Hypoid and worm drives. **Differential:** Necessity of differential, Working of differential, Conventional and non-slip differential. **Axles:** Types of live axles; semi, three quarter and full floating axles. Types of Front Stub Axles; Elliot, Reverse Elliot, Lamoine and Reverse Lamoine **Steering:** Requirement, Types of Steering Gear Box, Steering Geometry, Wheel Alignment and Wheel balancing, Power Steering **Brakes:** Principle, Types; Hydraulic, Air, Electric, Exhaust, Regeneration ,Brake lining materials, ABS, EBD	09	CO2
III	**Automobile Suspension, Wheels, and Tyres**	**Suspension:** Requirement and Types- Independent, Dependent, Air. Types of Shock absorbers, Leaf spring types	07	CO3

		Wheels and Tyres: Tyre requirement, tire characteristics, Constructional detail, , tyre dimensions and specifications, Types of wheels and Hubs		
IV	**Automotive Electrical and Electronic Systems**	**Batteries:** Construction, Types: Lead Acid, Alkaline, Nickel Metal Hydride, Lithium Ion, Battery Ratings, Battery Charging **Starting:** Requirement, Starter Motor Drives, cold cranking Amperes **Charging:** Requirement, Principle and Construction of Dynamo and Alternator **Ignition:** Mechanical and Electronic Ignition and Electronic Engine Control **Lighting and Wiring:** Types of Lamps, Gauges, Cable Sizes, Color Codes, Multiplex Wiring systems **Accessories:** Electric Horn, Wipers, Fuel Pumps, Power operated windows, Fuel Gauges, OBD systems	09	CO4
V	**Body Engineering & Vehicle Aerodynamics**	**Body Engineering:** Chassis types and Structure types - Open, Semi Integral and Integral, Loads acting on chassis, Basic Dimensions and Visibility **Vehicle Aerodynamics :** Aerodynamic drag: Aerodynamic lift and Pitching moments, Side force, Yawing & Rolling moments.	07	CO5

VI	**Recent Technological Developments in Automobile**	**Recent Technological Developments in Automobile:** Telematics, Intelligent Vehicles 03 systems, V2V communication. Scope of AI in Automobile Vehicle	05	CO6

Text Books:

1. Automobile Engineering, Kirpal Singh, Vol I & II, Standard publishers Distributors, Delhi
2. J Powloski, "Vehicle Body Engineering", Business Books Ltd., London
3. Automobile Mechanics, N. K. Giri, 8thEdition, Khanna Publishers
4. P. L. Kohli, "Automotive Chassis & Body", Papyrus Publishing House, New Delhi.
5. Tom Denton, Automobile Electrical and Electronics System, Elsevier Third Edition,2003

References Books:

1. John Fenton, "Vehicle Body Layout & Analysis", Hutchinson, London.
2. Bosch Automotive Handbook, 6thEdition, SAE Publications
3. Automotive Mechanics by William H. Crouse and Donald L. Anglin, 10th Edition, McGraw Hill
4. "A Course in Internal Combustion Engines" by M. L. Mathur & R.P. Sharma, Dhanpat Rai Publications

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/107106088
2	https://nptel.ac.in/courses/107103084
3	https://nptel.ac.in/courses/113106082

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC741	Machinery Diagnostics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC741	Machinery Diagnostics	20	20	40	60	2.5	--	--	100

Rationale :

Machinery diagnostics introduces the fundamentals of vibration and its application in machine condition monitoring. It equips students with the ability to understand vibration behavior through time and frequency domain analysis. Emphasis is placed on fault diagnosis using FFT, sensor selection, and signal interpretation.

Students gain knowledge of vibration transducers, data acquisition systems. The course also provides practical insights into detecting faults like unbalance, misalignment, and bearing defects. Case studies reinforce real-world application in industries such as turbines, sugar mills, and pumps. This subject is crucial for predictive maintenance and enhancing equipment reliability.

Course Objectives:

1. To study basic concepts of Vibration Monitoring.
2. To study different Vibration Measuring Instruments.
3. To study fault detection in Machines using vibration spectrum.

Course Outcomes:

1. Understand basic vibration concepts and principles of vibration-based condition monitoring.
2. Explain vibration measurement tools and sensor selection techniques.
3. Analyze machine signals using FFT and data acquisition settings for condition monitoring.
4. Identify common machine faults such as unbalance, misalignment, and mechanical looseness using natural frequency tests and time-frequency domain analysis.
5. Diagnose faults in bearings, gearboxes, pumps, fans, and blowers.
6. Evaluate real-world machinery faults through case studies using appropriate sensor selection, data analysis, and fault identification techniques.

Prerequisite: Basic Electrical and Instrumentation, Strength of Materials, Mathematics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Fundamentals of Vibration and Condition Monitoring**	**1.1 Basics of Vibration** Periodic and random motion, Spectral Amplitude Scaling: RMS, Peak and Peak to-Peak Conversion and Selection, Time and frequency domain analysis, Phase analysis, Orbit analysis, Understanding signal pattern,	08	CO1

		Importance of speed in accurate diagnosis, Importance of side bands in frequency spectrums. **1.2 Introduction to Vibration based Condition Monitoring** Maintenance Principles, Vibration based fault Prognosis, Goal of Vibration Monitoring, Steps in Vibration Monitoring, Benefits of Vibration based condition monitoring.		
II	**Vibration Measurement**	Vibration measuring instruments: displacement, velocity, acceleration; Force measurement, Laser based measurements: laser vibrometer Sensor Selection Criteria , Sensor – Mounting Locations and Techniques	08	CO2
III	**Data Acquisition & Signal Processing**	Classification of signals, Signal analysis, Fast Fourier Transform (FFT), Essential Settings in Data Acquisition System (Plot Formats, Frequency Span and Frequency Resolution, Average Types and Number of Averages, Windowing, Spectrum Scaling), Signal conditioning	08	CO3
IV	**Machinery Fault Diagnosis-I**	Natural frequency and resonance tests (Practical approach), Time and Frequency domain analysis to identify unbalance, bent shaft, Misalignment, Soft foot conditions, Mechanical looseness	07	CO4

V	**Machinery Fault Diagnosis-II**	Rolling element bearing and Journal Bearing fault diagnosis, Faults related to Gearbox, vane defects in pumps, Fault in Fans and Blowers	07	CO5
VI	**Applications of Condition Monitoring**	Case studies related Balancing Problems in Turbines, Condition Monitoring in Sugar mills, Health Monitoring of Journal Bearing, Condition Monitoring of Industrial Pumps. (Aspects to be covered : Selection of sensors, recommended location of sensor, direction of measurement, selection of plot type, Data validation and Identification of Faults)	07	CO6

Text / References Books:

1. R.B. Randall, "Vibration-based Condition Monitoring", Wiley2021, ISBN: 978-1-119-47755-6
2. A.R. Mohanty, "Machine Condition Monitoring: Principles and Practices", CRC Press 2017, ISBN: 9781138748255
3. R.A. Collacott, "Mechanical Fault Diagnosis and Condition Monitoring",1st Edition, Chapman and Hall, ISBN: 978-94-009-5723-7
4. J.S. Rao, "Vibratory Condition Monitoring of Machine", Narosa Publishing House.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/112105232 – Machinery Fault Diagnosis and Signal Processing, IIT, Kharagpur

R-2025- BE Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC742	Vibration Controls	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
MEC742	Vibration Controls	20	20	40	60	2	--	--	100

Rationale:

Most of the engineering branches are being off-spring of manufacturing processes, and the subject Vibration Control is important because excessive vibration in machines and structures can lead to noise, discomfort, reduced efficiency, wear of components, and even structural failure. Studying vibration control helps in improving system stability, safety, performance, and lifespan. It is widely used in automobiles, machinery, buildings, aerospace, and industrial equipment to reduce unwanted vibrations and ensure smooth operation.

IQAC Format Number: 60_A

Course Objectives:

1. To study Vibration Absorbers.
2. To study Vibration Isolators.
3. To study Vibration Control.

Course Outcomes:

1. Apply basic concepts of Vibration Isolation and Damping.
2. Identify suitable Vibration Absorber
3. Identify suitable Vibration Isolator
4. Apply suitable method to Control the vibrations to the acceptable level.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Vibration reduction at source, factors affecting vibration level, isolation of the source, methods of vibration control, dynamic properties and selection of materials	09	CO1
II	**Dynamic vibration absorbers**	Dynamic vibration neutralizers, self-tuned pendulum neutralizer, optimum design of damped absorbers, absorber with ideal spring and viscous dashpot, gyroscopic vibration absorbers, impact absorbers, absorbers attached to continuous systems	07	CO2
III	**Vibration isolation of single degree of freedom systems**	Isolators with complex stiffness, Isolators with Coulomb damping, Three element isolators, Two-stage isolators, Pneumatic suspension, Concept of negative stiffness in vibration isolation	06	CO3
IV	**Active vibration control and Semi-active vibration control**	Classification and modelling, actuators and sensors for active vibration control, Active vibration absorption and damping, classical control, optimal control, Piezoelectric transducers for active vibration control Introduction, Magneto-rheological fluids, MR models and devices, semi-active suspension, narrowband disturbance	07	CO4

V	**Active, semi-active, and adaptive dynamic vibration absorbers**	Active tuned vibration absorber, active mass damper, adaptive vibration absorber, semi-active tuned vibration absorber	07	CO5
VI	**Active and semi-active vibration isolation**	Active single-axis base isolation, active force isolation system, isolator based on piezoelectric stack actuator, semi-active isolation, Adaptive-passive vibration isolation, active control of vehicle suspensions	09	CO6

Text / Reference Books:

1. A.K. Mallik and A. Chatterjee, "Principles of Active and Passive Vibration Control", East-West Press 2014, ISBN: 9788176710985
2. A. Preumont, "Vibration Control of Active Structures", Springer 2018, ISBN: 9783319722962
3. S.S. Rao, "Mechanical Vibrations", 5th Edition 2004, Pearson Publications
4. Clarence de Silva, "Vibration: Fundamentals and Practice",1st Edition 2000, CRC Press, ISBN: 0849318084 References:

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	**https://nptel.ac.in/courses/112104211– Principles of Vibration Control, IIT Kanpur**

2	**https://nptel.ac.in/courses/112107088– Vibration control, IIT Roorkee**

Assessment:

Internal Assessment (IA) for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

- **Question paper format**

1. Question paper will comprise of a total six questions, each carrying 15 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC743	Advanced Vibration	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC743	Advanced Vibration	20	20	40	60	2.5	--	--	100

Rationale :

Advanced Vibration helps analyze and control complex vibrations in machines and structures, improving performance, safety, and reliability in engineering applications. Random and nonlinear vibration study prepares them for advanced diagnostics. Measurement tools and sensor selection guide practical condition monitoring.

Course Objectives:

1. To study the Multi-degree of freedom system.
2. To study different vibration measurement and control methods, and required instruments.
3. To study basic concepts of Random Vibrations.

4. To study the basic concepts of nonlinear vibrations.

Course Outcomes:

1. Estimate natural frequency of mechanical element / system.
2. Understand the concepts of Vibration Isolation and Control.
3. Analyze vibratory response of mechanical element / system.
4. Analyze vibration of Continuous system.
5. Analyze Random Vibrations.
6. Analyze Non-Linear Vibrations.

Prerequisite: Basic Vibration Theory, Basic Engineering Mechanics, Mathematics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Multi Degree of Freedom System**	**Undamped free vibration:** Free vibration equation of motion, Influence coefficients (stiffness and flexibility), Reciprocity theorem, Generalized Coordinates, and Coordinate Coupling, Lagrangian equations, Rayleigh and Dunkerley method, two rotors and geared systems **Eigen Values and Eigen vectors:** for translatory and torsional two d.o.f. systems, Matrix method, Holzer's method (translatory and torsional unbranched systems)	07	CO1

II	**Vibration Isolation and Control**	Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, vibration isolation, Dynamic vibration absorbers, and Vibration dampers, Passive, semi-active, and active vibration control	07	CO2
III	**Vibration Measurement & Modal Analysis for Condition Monitoring**	**Vibration Measurement:** Introduction, Transducers, Vibration pickups, Frequency measuring instruments, Vibration exciters, Signal analysis. **Modal analysis and Condition Monitoring:** Dynamic Testing of machines and Structures, Experimental Modal analysis, Machine condition monitoring and diagnosis.	07	CO3
IV	**Vibration of Continuous Systems**	Vibration of string, Longitudinal vibration of rods, Torsional vibration of rods, Euler equation for beams.	08	CO4
V	**Random Vibrations**	Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms and response.	08	CO5

VI	**Non-Linear Vibrations**	Introduction, Sources of nonlinearity, Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations, Runge-Kutta method.	08	CO6

Text / References Books:

1. W.T. Thomson and M.D. Dahleh, "Theory of Vibration with Applications", 3rd Edition 2002, Pearson Education
2. G.K. Grover, "Mechanical Vibrations", 5th Edition 2009, Nem Chand and Bros, ISBN: 978 8185240565
3. W.W. Seto, "Mechanical Vibrations- Schaum's Outline Series", McGraw Hill, ISBN: 9780070563278
4. S.S. Rao, "Mechanical Vibrations", 5th Edition 2004, Pearson Publications
5. Leonard Meirovitch, "Fundamentals of Vibration", 1st Edition 2010, McGraw Hill, ISBN: 978 1577666912.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://nptel.ac.in/courses/112107212 – Introduction to Mechanical Vibration, IIT Roorkee
2	https://nptel.ac.in/courses/112103111 – Mechanical Vibrations, IIT Guwahati

3	https://nptel.ac.in/courses/112103022 – Nonlinear Vibration, IIT Guwahati
4	https://nptel.ac.in/courses/112104211 – Principles of Vibration Control, IIT Kanpur

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7501	Product Life Cycle Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7501	Product Life Cycle Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To familiarize students with the need, benefits, and key components of Product Lifecycle Management (PLM).
2. To acquaint students with Product Data Management (PDM) and PLM implementation strategies.
3. To provide insights into the processes involved in new product development.
4. To understand the guidelines and best practices for designing and developing new products.
5. To introduce students to the concept and tools of Virtual Product Development.
6. To explore the integration of PLM with modern engineering and manufacturing systems.

Course Outcomes:

1. Describe the phases of Product Lifecycle Management (PLM), PLM strategies, and feasibility study methodologies.
2. Explain the implementation process of Product Data Management (PDM) within PLM systems.
3. Apply various approaches and techniques for product design and development.
4. Use product engineering guidelines and thumb rules for designing components in moulding, machining, and sheet metal processes.
5. Analyze design decisions for manufacturability and efficiency in product engineering.
6. Demonstrate the use of virtual product development tools for component design, machining simulation, and manufacturing plant layout.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Product Lifecycle Management (PLM)**	Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10	CO1
II	**Product Design**	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models,	09	CO2

		Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process		
III	**Product Data Management (PDM)**	Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05	CO3
IV	**Virtual Product Development Tools**	For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05	CO4
V	**Integration of Environmental**	Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies,	05	CO5

	Aspects in Product Design	Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design		
VI	**Life Cycle Assessment and Life Cycle Cost Analysis**	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05	CO6

References:

1. John Stark, ―Product Lifecycle Management: Paradigm for 21st Century Product Realisation‖, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, ―Product Design for the environment- A life cycle approach‖, Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, ―Product Life Cycle Management‖, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, ―Product Lifecycle Management: Driving the next generation of lean thinking‖, Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7502	Reliability Engineering	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7502	Reliability Engineering	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To explain various types of reliability testing and data analysis techniques.
5. To cover the principles of Maintainability and Availability in system design.
6. To provide knowledge of Failure Modes and Effects Analysis (FMEA) and its application in reliability engineering.

Course Outcomes:

1. Understand and apply the concept of Probability to engineering problems
2. Apply probability theory to solve real-world engineering problems.
3. Explain key reliability concepts such as failure rate, MTTF, MTBF, and hazard rate.
4. Calculate reliability parameters for different types of systems and configurations.

5 Estimate system reliability for both simple and complex systems using appropriate models.

6 Perform Failure Mode, Effects, and Criticality Analysis (FMECA) to assess system risk.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Probability theory**	Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08	CO1
II	**Reliability Concepts**	Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08	CO2

III	**System Reliability**	System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems	05	CO3
IV	**Reliability Improvement**	Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08	CO4
V	**Maintainability and Availability**	System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05	CO5
VI	**Failure Mode, Effects and Criticality Analysis:**	Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05	CO6

References:

1. L.S. Srinath, —Reliability Engineering‖, Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, —Reliability and Maintainability Engineering‖, Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, —Engineering Reliability‖, John Wiley & Sons, 1980.
4. P.D.T. Conor, —Practical Reliability Engg.‖, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, —Reliability in Engineering Design‖, John Wiley & Sons.
6. Murray R. Spiegel, —Probability and Statistics‖, Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7503	Management Information System	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7503	Management Information System	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the role and impact of Information Systems (IS) in organizations and society.
2. To understand data and knowledge management including BI, big data, data warehousing, and data marts.
3. To explore ethical, privacy, and security issues related to Information Systems.
4. To examine the role of Social Computing and its applications in e-commerce and customer relationship management.
5. To study computer networks, mobile computing, and cloud computing models relevant to business operations.
6. To understand the use of IS in organizational functions, ERP systems, and system development life cycle models.

Course Outcomes:

1. Explain the importance of Information Systems and their impact on organizational strategy and society
2. Apply data and knowledge management techniques, including BI tools, for decision-making.
3. Identify security threats and describe ethical and privacy issues in Information Systems.
4. Analyze the use of Social Computing in marketing, CRM, and mobile commerce applications.
5. Differentiate between various computer network types and cloud computing models.
6. Design basic solutions using ERP systems and system development life cycle approaches.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction To Information Systems (IS)**	Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	04	CO1
II	**Data and Knowledge Management:**	Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management **Business intelligence (BI)** Managers and Decision Making, BI for Data analysis and Presenting Results	07	CO2
III	**Ethical issues and Privacy**	Information Security. Threat to IS, and Security Controls	07	CO3
IV	**Social Computing (SC)**	Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRME-business and E-commerce – B2B B2C. Mobile commerce.	07	CO4

V	**Computer Networks**	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	06	CO5
VI	**Information System within Organization**	Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	08	CO6

References:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7504	Design of Experiments	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7504	Design of Experiments	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the strategy of experimentation and its applications in engineering and scientific problems.
2. To understand the process of fitting regression models and performing diagnostic analysis.
3. To study the design and analysis of two-level and multi-level factorial experiments.
4. To explore fractional factorial designs and their relevance in reducing experimental runs.
5. To understand and apply response surface methodology for optimization of processes.
6. To introduce the Taguchi approach for robust parameter design and quality improvement.

Course Outcomes:

1. Explain the strategy of experimentation and identify appropriate experimental designs for given applications.
2. Fit and analyze linear and multiple regression models, including hypothesis testing and prediction.
3. Design and evaluate full and fractional factorial experiments to study the effects of multiple factors.
4. Apply response surface methodology to optimize and interpret second-order experimental models.
5. Use center points, blocking, and split-plot designs to handle complex experimental conditions.
6. Analyze Taguchi designs using signal-to-noise ratios and recommend robust design improvements.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Strategy of Experimentation Typical Applications of Experimental Design Guidelines for Designing Experiments Response Surface Methodology	06	CO1
II	**Fitting Regression Models**	Linear Regression Models Estimation of the Parameters in Linear Regression Models Hypothesis Testing in Multiple Regression Confidence Intervals in Multiple Regression Prediction of new response observation Regression model diagnostics Testing for lack of fit	08	CO2
III	**Two-Level Factorial Designs**	The 2^2 Design The 2^3 Design The General2^k Design	07	CO3

		A Single Replicate of the 2^k Design The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design Split-Plot Designs		
IV	**Two-Level Fractional Factorial Designs**	The One-Half Fraction of the 2^k Design The One-Quarter Fraction of the 2^k Design The General 2^{k-p} Fractional Factorial Design Resolution III Designs Resolution IV and V Designs Fractional Factorial Split-Plot Designs	07	CO4
V	**Response Surface Methods and Designs**	Introduction to Response Surface Methodology The Method of Steepest Ascent Analysis of a Second-Order Response Surface Experimental Designs for Fitting Response Surfaces	07	CO5
VI	**Taguchi Approach**	Crossed Array Designs and Signal-to-Noise Ratios Analysis Methods Robust design examples	04	CO6

References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley

4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2

5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7505	Operations Research	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7505	Operations Research	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the concepts, models, and scope of Operations Research in decision-making.
2. To study linear programming models, duality, sensitivity analysis, and their solution techniques.
3. To understand transportation, assignment, and integer programming problems with solution methodologies.
4. To explore queuing theory models and analyze single and multi-server systems.
5. To apply simulation techniques, including Monte Carlo methods, in decision-making scenarios.
6. To study dynamic programming, game theory, and inventory models for solving real-world optimization problems.

Course Outcomes:

1. Formulate and solve linear programming problems using graphical, simplex, and dual methods.
2. Apply appropriate methods to solve transportation, assignment, and integer

programming problems.

3 Analyze queuing models to evaluate system performance in different configurations.

4 Demonstrate the use of simulation techniques such as the Monte Carlo method in system analysis.

5 Apply dynamic programming methods to solve multi-stage decision problems.

6 Evaluate inventory models and game theory strategies for decision-making in competitive and uncertain environments.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Operations Research**	Introduction, Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming, Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone	14	CO1

		method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.		
II	**Queuing models**	Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05	CO2
III	**Simulation**	Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05	CO3
IV	**Dynamic programming**	Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05	CO4

V	**Game Theory**	Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05	CO5
VI	**Inventory Models**	Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model	05	CO6

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, Kanti Swarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7506	Cyber Security and Laws	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7506	Cyber Security and Laws	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental concepts, history, and global perspective of cybercrime.
2. To explore various cyber offenses and methods used by cybercriminals in different domains.
3. To examine tools, techniques, and attack vectors commonly employed in cybercrimes.
4. To understand the legal aspects of cyberspace, including contracts, security, intellectual property, and criminal law.
5. To study the provisions and amendments of the Indian IT Act, 2000 and 2008.
6. To provide an overview of major information security compliance standards and frameworks.

Course Outcomes:

1. Define and explain various types of cybercrimes and their impact on information security.
2. Identify different cyber offense techniques and evaluate their implications on mobile and wireless devices.
3. Demonstrate the use of cybercrime tools and explain how common attacks such as phishing and SQL injection are performed.
4. Analyze the legal dimensions of cyberspace, including contracts, privacy, and intellectual property rights.
5. Interpret key sections of the Indian IT Act and assess its effectiveness in addressing cybercrimes.
6. Compare and apply information security standards such as SOX, HIPAA, and ISO in organizational contexts.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Cybercrime**	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	04	CO1
II	**Cyber offenses & Cybercrime**	How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in	09	CO2

		Mobile Computing Era, Laptops		
III	**Tools and Methods Used in Cyberline**	Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	06	CO3
IV	**The Concept of Cyberspace**	E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	08	CO4
V	**Indian IT Act.**	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	06	CO5
VI	**Information Security Standard compliances**	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	06	CO6

References:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
6. Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
7. William Stallings, Cryptography and Network Security, Pearson Publication
8. Websites for more information is available on : The Information

Technology ACT, 2008- TIFR : https://www.tifrh.res.in

9. Website for more information , A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer- professionals-33538

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7507	Disaster Management and Mitigation Measures	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7507	Disaster Management and Mitigation Measures	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Course Outcomes:

1. Define and explain the types, causes, and effects of natural and manmade disasters, including global warming and climate change.
2. Analyze the disaster management cycle, including policy, objectives, risks, and the paradigm shift in disaster response strategies.
3. Identify and evaluate the roles of institutions like NDMA and NIDM in disaster preparedness and response.
4. Apply technologies such as GIS, GPS, remote sensing, and internet-based tools for disaster management and communication.
5. Explain and assess financial mechanisms, legal frameworks, and the role of national and international relief agencies.
6. Design and propose structural and non-structural mitigation strategies including community preparedness, training, and awareness programs.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03	CO1

II	**Natural Disaster and Manmade disasters**	Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09	CO2
III	**Disaster Management, Policy and Administration**	Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06	CO3

IV	**Institutional Framework for Disaster Management in India:**	Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06	CO4
V	**Financing Relief Measures**	Ways to raise finance for relief expenditure, role of government agencies and NGO‘s in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO‘s and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	09	CO5

VI	**Preventive and Mitigation Measures**	Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06	CO6

References:

1. _Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. _Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. _Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. _Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. _Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. _Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7508	Energy Audit and Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7508	Energy Audit and Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the present energy scenario and the need for energy conservation and efficient utilization.
2. To explain the principles of energy auditing, energy monitoring, and energy performance evaluation techniques.
3. To impart knowledge on financial analysis tools for assessing energy efficiency projects.
4. To familiarize students with energy conservation measures in electrical systems including lighting, motors, and drives.
5. To provide insights into energy conservation practices in thermal systems, HVAC, boilers, and insulation.
6. To create awareness of sustainable energy use in buildings through ECBC, LEED, and renewable energy integration.

Course Outcomes:

1. Explain the current energy scenario, energy pricing, and energy conservation legislation such as the Energy Conservation Act-2001.
2. Apply principles of energy auditing and analyze energy usage using appropriate instruments and benchmarking techniques.
3. Evaluate energy efficiency projects using financial techniques like payback period, ROI, NPV, and IRR.
4. Demonstrate energy-saving measures in electrical systems such as lighting control, power factor correction, and use of energy-efficient appliances.
5. Analyze thermal system components including boilers, steam systems, and HVAC to identify potential energy conservation opportunities.
6. Design building energy systems considering ECBC compliance, green building principles, and renewable energy sources.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Energy Scenario**	Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04	CO1
II	**Energy Audit Principles**	Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis.	08	CO2

		Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)		
III	**Energy Management and Energy Conservation in Electrical System:**	Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments 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, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10	CO3
IV	**Energy Management and Energy Conservation in Thermal Systems:**	Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10	CO4
V	**Energy Performance Assessment**	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations;	04	CO5

		Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.		
VI	**Energy conservation in Buildings**	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03	CO6

References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7509	Development Engineering	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
OEC7509	Development Engineering	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To gain insight into the structure, characteristics, and dynamics of rural society in India and the scope of rural development.
2. To examine the nature, constraints, and challenges faced in the process of rural development planning and implementation.
3. To understand the impact and significance of the 73rd Constitutional Amendment Act on decentralized planning and rural governance.
4. To explore the integration of democratic processes into rural development strategies through Panchayati Raj Institutions.
5. To engage with the philosophical foundations of human values and their role in shaping personal, professional, and societal ethics.
6. To understand the relevance of human values and ethics in planning institutions and their influence on development-oriented decision-making.

Course Outcomes:

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies

4	Develop acumen for higher education and research.
5	Master the art of working in group of different nature.
6	Develop confidence to take up rural project activities independently

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I		Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08	CO1
II		Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee – linkage between Panchayati Raj, participation and rural development	04	CO2
III		Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special	06	CO3

		component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.		
IV		Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04	CO4
V		Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	10	CO5
VI		Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04	CO6

References:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

R-2025- Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL706	DESIGN OF MECHANICAL SYSTEMS LAB	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
MEL706	DESIGN OF MECHANICAL SYSTEMS LAB	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize with the concept of system and methodology of system design

2. To study system design of various systems such as Gear box, snatch block, belt conveyors, I. C. engine system and pumps

3. To familiarize with the standard codes of professional practices in designing the various systems

Lab Outcomes:

1) Apply the concept of system design
2) Design of Gear box
3) Design of hoisting mechanism of EOT crane.
4) Design belt conveyor systems
5) Design engine components such as cylinder, piston, connecting rod and crankshaft
6) Design pumps for the given applications

List of Experiments. (Computer aided Design and detailed assembly drawing)

Sr No	List of Experiments	Hrs
01	Design of hoisting mechanisms	
02	Design of belt conveyors	
03	Design of Engine	
04	Design of Gear box	
05	Design of pumps	

Sr No	List of Assignments / Tutorials	Hrs
01	Methodology & Morphology of design	
02	Design of gearbox (As mentioned in theory)	
03	Design of Hoisting mechanism	
04	Design of Belt conveyor	
05	Engine design (SI/CI engine)	
06	Design of Pump	

Part C

Students in a group of two to four should be able to apply and integrate the knowledge gained during the course. Design and preparation of working drawings of any system having minimum 5 to 6 components is expected. Course project may be given as development of software program using python, VB, C++, EXCEL etc. for mechanical systems

Text / Reference Books:

1) Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication

2) Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication

3) Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education

4) Machine Design by Pandya & Shah, Charotar Publishing

5) Mechanical Engineering Design by J.E.Shigley, McGraw Hill

6) Machine Design by Reshetov, Mir Publication

7) Machine Design by Black Adams, McGraw Hill.

8) Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill.

9) Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas& Co.

10) Design of Machine Elements by V.M.Faires.

11) Design of Machine Elements by Spotts.

12) Recommended Data Books – Design Data: Data Book of Engineers by PSG College, KalaikathirAchchagam

Online Resources:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112/105/112105268/
2	https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obQzOhJLRt
3	http://www.nptelvideos.in/2012/12/kinematics-of-machines.html

Assessment:

Term Work: Term Work shall consist part (a) + (b) +(c).

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Exercise) + 5 Marks (Assignments)

+ 5 Marks (Course Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL707	Maintenance Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT1 +IAT 2				
MEL707	Maintenance Engineering Lab	--	--	--	--	25	25	50

Lab Objectives:

1) To familiarize with Maintenance Procedures and Strategies.
2) **To acquaint with the process of Condition Monitoring and Machinery Fault Diagnosis.**

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Sr No	List of Experiments	Hrs
01	Identifications of different Tools used for maintenance (Spanner, Plier, Screw Driver, Allen Keys, Puller etc.)	
02	Dismantling and assembly of any one mechanical system (Gearbox, pumps, Injector, Fuel Pump, Tailstock etc.) (One job in a group of 4-5 students)	
03	Case studies based on Maintenance strategies (Breakdown, preventive, predictive and proactive)	
04	Machinery Servicing (Greasing, Oiling, Cleaning etc.)	
05	Condition Monitoring and Machinery Fault Diagnosis – Unbalance	
06	Condition Monitoring and Machinery Fault Diagnosis – Misalignment	
07	Condition Monitoring and Machinery Fault Diagnosis – Bent Shaft	
08	Condition Monitoring and Machinery Fault Diagnosis – Mechanical Looseness	
09	Condition Monitoring and Machinery Fault Diagnosis – Bearing Defects	
10	Condition Monitoring and Machinery Fault Diagnosis – Defects in gears	
11	Condition Monitoring and Machinery Fault Diagnosis – Defects in pumps	
12	Condition Monitoring and Machinery Fault Diagnosis – Defects in fans	
13	Condition Monitoring and Machinery Fault Diagnosis – Defects in blowers	

Note :

1. First four experiments are mandatory. At least four experiments to be performed from the remaining.

2. A visit of students to an automobile service station/any other machinery maintenance workshop shall be arranged as a part of the above exercises.

Assessment:

Distribution of marks for term work

Laboratory work 20 Marks

Attendance 05 Marks

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents

2. Distribution of marks for practical/viva examination shall be as follows:

a. Practical performance 15 marks

b. Viva 10 marks

3. Evaluation of practical examination to be done based on the experiment performed and the output of the experiment during practical examination

4. Students work along with evaluation report to be preserved till the next examination.

References:

1. A.R. Mohanty, "Machine Condition Monitoring: Principles and Practices", CRC Press

2. R.A. Collacott, "Mechanical Fault Diagnosis and Condition Monitoring", Chapman and Hall

NPTEL

https://nptel.ac.in/courses/112105232 – Machinery Fault Diagnosis and Signal Processing, IIT Kharagpur

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL708	Industrial Skills	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1+ IAT 2				
MEL708	Industrial Skills	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarise mechanical engineering students with basiccomputer/IT skillsin the industry.
2. To practise soft skills and communication to be industry-ready.
3. To inculcate critical thinking and problem-solving abilities for efficient team and project outcomes.
4. To be prepared for campus placements by practising aptitude, logical reasoning, Group discussion and personal interview rounds.

Lab Outcomes:

1. Skilfully prepare and edit documents and slides on MS Word and MS PowerPoint etc.
2. Execute functions on MS Excel.
3. Learn how to navigate tasks and execute functions in G-suite.
4. Understand and practice metacognitive skills of creativity and problem solving.
5. Hone team building and leadership skills.

List of Experiments. (Computer aided Design and detailed assembly drawing)

Sr No	List of Experiments	Hrs
I.	**Basics of Computers- Desktop/Laptop operations** **Microsoft Office** MS Word- Assignment to Create and use various commands in a Word document (Page setup, text formatting, templates, SmartArt, Title and Ribbon bar, Editing etc.) MS Excel- Assignment to Create and tabulate a spreadsheet (Excel- data analysis, charts, pivot tables, VBA, etc.) MS- Power point- Assignment to design and use a Presentation Software(MSPPT, Prezi, etc. – Presentation	6
II.	**Aptitude and Logical Reasoning** Aptitude – Aptitude training, types of questions, mock tests Logical Reasoning – Verbal and Non-verbal reasoning, Types of questions, Mock tests	6
III.	**Developing Metacognitive skills** Task orientation and Goal setting (can be based on Final year Project):Creativity and Problem-solving	6
IV.	**Collaborative Techniques:Team building skills** Activities on Team building,Case studies on Leadership, Decision making and Team building	6
V.	**GD – PI** Group Discussion – Factual, Strategic, Abstract, Case study, Picture Based, Personal Interview–Types of Interview Questions, Strategies, Sample answers, Mock Interviews	6

Assignments: Assignments and activities should enable a steady progress in developing the aforementioned skills.A record of the conducted activities can be attached in journal as image printouts, and write up of case studies.

1. Application of MS Office skills (Individual)

Create and edit Word documents

Create and execute MS Excel functions

Create and enhance MS PPT

2. Writing a simple document in LATEX editor and running the typesetter program to produce finished document

3. Aptitude and Logical reasoning tests/practice sheets

Team building skills: Activities/Tasks to be performed as a team of 3 or 4 students.
5. Group Discussions
Case studies on problem-solving to be done as a team activity.
Personal Interview questions log book
Assessment: Total – 50 Marks
Marks distribution will be as follows:
FINAL TERM WORK – 25 Marks
Assignments (Journal) – 20 Marks
Attendance - 05 Marks
ORALS/Written – 25 Marks
1. Aptitude Test (Written) - 15 Marks
2. Mock Interview (Orals) – 10 Marks
Books recommended/References/ Resources:
1. Meenakshi Raman, Prakash Singh. Business Communication, Oxford University Press, 2012
2. Claudyne Wilder. The Presentations Kit: 10 steps for Selling Your Ideas, John Wiley & Sons, 1994.
3. Lesikar, Flatley. Basic Business Communication: Skills for Empowering the Internet Generation, Tata McGraw Hill, 2008.
4. Flavell, J. H. Cognitive development: Past, present, and future. 1992.
5. Thorpe, Edgar and Showick Thorpe. Objective English, Pearson, 2013. (7 th edition Amazon)
6. Thorpe, Edgar. Test of Reasoning: for All Competitive Examination. 7 th edition., Amazon
7. Sinha, Nishit K., Reasoning, Pearson.
8. Aggarwal, R.S., A Modern Approach to Logical Reasoning, S. Chand.
9. Weblinks - https://cambridge-community.org.uk/professional-development/gswmeta/index.html
10. Various Quantitative aptitude books and websites list
11. https://eduly.in/best-quantitative-aptitude-books/
12. https://prepinsta.com/learn-aptitude/

Online Resources:

Sr. No.	Website Name
1	**Creativity https://nptel.ac.in/courses/109101017**
2	**MS Excel https://www.coursera.org/projects/introduction-microsoft-excel**
3	**Problem solving https://www.coursera.org/learn/problem-solving**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL709	Major Project I	-	6	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL709	Major Project I	--	--	--	--	50	--	50

Objectives:

The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification, analyzing the problem and designing solutions.

Outcomes:

1. Students will be able to develop the understanding of the problem domain through extensive review of literature.
2. Students will be able to identify and analyze the problem in detail to define its scope with problem specific data.
3. Students will be able to identify various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.

4. Students will be able to design solutions for real-time problems that will positively impact society and environment.
5. Students will be able to develop clarity of presentation based on communication, teamwork and leadership skills.
6. Students will be able to inculcate professional and ethical behavior.

Guidelines for Major Project:

1. Project Topic Selection and Allocation:

- Project topic selection Process to be defined and followed:
  - Project orientation can be given at the end of sixth semester.
  - Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
  - Student's should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
  - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.
- Topics can be finalized with respect to following criterion:
  - **Topic Selection:** The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
  - **Technology Used:** Use of latest technology or modern tools can be encouraged.
  - Students should not repeat work done previously (work done in the last three years).
- **Project work must be carried out by the group of at least 2 students and maximum 4.**
- The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects)
- The project proposal presentations can be scheduled according to the domains and should be judged by faculty who are expert in the domain.

- Head of department and senior staff along with project coordinators will take decision regarding final selection of projects.
- Guide allocation should be done and students have to submit weekly progress report to the internal guide.
- Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
- In case of industry/ out-house projects, visit by internal guide will be preferred and external members can be called during the presentation at various levels.

2. Project Report Format:

At the end of semester, each group need to prepare a project report as per the guidelines issued.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey
- Survey of Existing systems
- Limitations of Existing systems or research gaps
- Motivation (Challenges that are encouraging to choose the problem)
- Problem Statement and Proposed Solution
- Scope of the system
- Proposed System
    - General Workflow/Block diagram
- Analysis and Modeling (only applicable diagrams)
- Design
    - Architectural View
    - Algorithms/ Methodology

- Experimental Set up
  - Details of Database or details about input to systems or selected data
  - Performance Evaluation Parameters (for Validation)
  - Software and Hardware Set up
- Implementation Plan for Next Semester
  - Timeline Chart for Term1 and Term-II (Project Management tools can be used.)
- Summary
- References

Desirable:

Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects).

3. Term Work:

Distribution of marks for term work shall be done based on following:

Sr. No.	Component	Marks	Justification
1.	Weekly Log Report	10	Evaluates consistency, individual involvement, and regular documentation.
2.	Project Work Contribution	15	Assesses technical input, innovation, teamwork, and problem-solving ability.
3.	Project Report (Spiral Bound, Both Side Print)	10	Judges structure, clarity, formatting, and eco-friendly submission.
4.	Term End Presentation (Internal)	15	Tests presentation skills, concept clarity, Q&A handling, and teamwork.

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. Term work evaluation:

Term work evaluation for Project I should be conducted by **Internal examiner on continuous basis**

throughout the semester.

Suggested quality evaluation parameters are as follows:

- Quality of problem selected
- Clarity of problem definition and feasibility of problem solution
- Relevance to the specialization / industrial trends
- Originality
- Clarity of objective and scope
- Quality of analysis and design
- Quality of written and oral presentation 8. Individual as well as team work

B.E SEM VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC801	Operations Planning and Control	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC801	Operations Planning and Control	20	20	40	60	2.5	--	--	100

Rationale :

This course provides a comprehensive foundation in Production and Operations Management, essential for managing manufacturing and service operations efficiently. Forecasting, capacity, and aggregate planning help in matching demand with resources, while scheduling techniques enhance workflow in both job shop and project environments.

Material Requirement Planning (MRP), ERP systems, and facility layout design streamline production logistics and resource utilization. Line balancing ensures efficient assembly operations, and modern philosophies like JIT, Lean, Agile, and Synchronous manufacturing emphasize waste reduction, flexibility, and responsiveness. This curriculum equips students with the analytical tools and strategic insight necessary for effective decision-making in contemporary production and service systems.

Course Objectives:

1. To provide an exposure to Operations Planning & Control (PPC) and its significance in manufacturing and service organizations.

2. To appraise about need and benefits of planning functions related to products and processes.
3. To provide exposure to production scheduling, sequencing and project management so as to optimize resources.
4. To provide insights into MRP and ERP to minimize the total cost and to manage operations functions in a better way.
5. To demonstrate different techniques used for facility planning and assembly line balancing.
6. To develop an understanding of JIT, Lean, Agile and Synchronous Manufacturing system.

Course Outcomes:

1. Illustrate operations functions and manage operations in a better way.
2. Apply various strategies to develop aggregate production plan based on the demand forecasting.
3. Apply various algorithms in scheduling and sequencing of manufacturing and service operations.
4. Develop Material Requirements Plans (MRP) to estimate the planned order releases.
5. Apply various techniques for facility layout planning and line balancing to optimize the resources.
6. Demonstrate the importance of implementation of JIT, Lean, Agile and Synchronous manufacturing in manufacturing and service organizations.

Prerequisite: Basic knowledge of Industrial Engineering, Fundamentals of Statistics and Mathematics, Analytical thinking and problem-solving

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Production and Operations Strategy**	**1.1 Introduction:** Production and Operations Function, Production systems, make to stock, make to order, assemble to order and Engineer to order, type of layouts, Phases in OPC like Preplanning, Planning, Action & Control. **1.2 Strategic Planning for Operations and Services:** Approaches like Forced Choice model and Operations Model, Quality and Productivity strategy, Technology strategy.	07	CO1

		Operations Strategies for Services, Types or Service Operations: Quasi manufacturing, Customer as participants, Customer as product, Classification of Services, Service capacity.		
II	**Forecasting and Capacity Planning in Operations**	**2.1 Forecasting:** Forecasting and Prediction, need for forecasting, role of forecasting in OPC, Methods of forecasting, Qualitative methods, Quantitative methods like time series analysis, least square method, moving average method, and exponential smoothing method. Forecasting Error; Mean Absolute Deviation, Forecasting Bias **2.2 Capacity Planning:** Measurement of capacity, Measures of operating capacity, Factors influencing effective capacity, factors favoring over capacity and under capacity, short range, medium range and long range capacity planning. Capacity requirement Planning (CRP) **2.3 Aggregate planning:** Concept of aggregate planning, Pure Strategy; Mixed Strategy; Level Strategy, Rough cut capacity planning, Aggregate planning for Services; Optimal Models for Aggregate Planning; Linear Programming; Linear Decision Rules Master Production Schedule	09	CO2
III	**Scheduling Techniques in Manufacturing and Projects**	**3.1 Job shop/Intermittent Manufacturing Scheduling:** Factors influencing scheduling, Inputs for scheduling, Forward Scheduling, Backward Scheduling, Stages in Scheduling: Product sequencing, Loading and Dispatching, dispatching, progress report & expediting and control. Basic scheduling problems, Priority Sequencing, Gantt Charts, Johnson's Rule for optimal sequence of N jobs on 2 machine. Process N Jobs on 3 Machines (N/3 problem) and Jackson	09	CO3

		Algorithm. Processing of 2 Jobs on M Machine (2/M) problem, **3.2 Project scheduling:** Network analysis - PERT & CPM, cost analysis & crashing, resource leveling and smoothening.		
IV	**Material and Enterprise Resource Planning**	**4.1 Material Requirement Planning:** Introduction, Limitations of conventional EOQ, Objectives of MRP, Inputs of MRP-I, Outputs of MRP, MRP lot sizing and Estimation of planned order releases, Manufacturing resource planning (MRP-II) **4.2 Enterprise Resource Planning (ERP):** Evolution, features, purpose of modeling an enterprise, ERP model for OPC, Modules in ERP, ERP Implementation Life Cycle, ERP packages like SAP-R3/Baan/PeopleSoft	07	CO4
V	**Facility Layout and Line Balancing Techniques**	**5.1 Facility layout planning:** Factors influencing Plant Layout, Material Flow Patterns, Tools and Techniques used for Plant Layout Planning. **5.2 Line Balancing:** Objectives, constraints, terminology in assembly line, heuristic methods like Kilbridge-Wester, Largest Candidate rule, Rank positional weight	07	CO5
VI	**Modern Manufacturing Approaches: JIT, Lean, and Agile**	Introduction to JIT system, Lean, Agile and Synchronous manufacturing: Concept, Characteristics, Components and Implementation.	06	CO6

Text / References Books:

1. "Production and Operations Management", K. Aswathappa & K. Shridhara Rao, Himalaya Publishing House, Revised 2nd Edition (2008)
2. "Industrial Engineering and Production Management", Martand Telsang, S. Chand, New Delhi

(2009)

3. "Modern Production Operations Management", Elwood S Buffa and Rakesh K Sarin, 8th Edition, Wiley Eastern, New York (1999) ISBN: 978-0471819059
4. "Production and Operations Management", Panneer Selvan R, 3rd Edition 2002Prentice Hall India, New Delhi, ISBN: 978-8120345553
5. "Production Planning and Control", Samuel Eilon, Universal Publication, ISBN: 9788185027548
6. "Production Planning and Control", L C Jhamb ,12th Edition 2010, Everest Pub House.
7. "Production Planning and Control", W. Boltan-Longman Scientific & Technical (1994), ISBN: 978-0582228207
8. "Production Systems- Planning, Analysis & Control", James. L. Riggs, John, 4th Edition 1987, Wiley & Sons, ISBN: 9780471847939
9. Manufacturing Planning and Control Systems, Thomas E. Vollman, William L. Berry & Others,4th Edition 1997, McGraw Hill Pub, ISBN: 978-0786312092
10. "Manufacturing Process Planning and Systems Engineering", Anand Bewoor, Dreamtech Press 2009, ISBN: 978-8177229967
11. "Production and Operations Management", S.N. Chary, 3rd Edition 2004, TMH publishing company, ISBN: 978-0070583559
12. Modernization & Material Management, L.C. Jhamb - Everest Publishing House

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://youtube.com/playlist?list=PLLy_2iUCG87A-kHGx4YUY97ShTTqBfA6-&feature=shared
2	https://youtube.com/playlist?list=PLSGws_74K01_MBJaKLVaP0iCupVawlL6i&feature=shared

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC821	Composite Materials	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1+ IAT 2					
MEC821	Composite Materials	20	20	40	60	2.5	--	--	100

Rationale:

Composite Materials is introduced in the final semester to equip students with knowledge of advanced materials that offer high strength-to-weight ratios, corrosion resistance, and design flexibility. This subject prepares students for modern engineering challenges in aerospace, automotive, and structural applications, bridging theoretical material science with practical industry needs.

Course Objectives:

1. To study the manufacturing methods of composite material.
2. To study the behaviour of composite materials, both at micro and macro levels.
3. To study the procedure of designing a composite laminate and structure as a whole for the given application.
4. To study the applicability of composite materials for various industrial/loading applications
5. To study the damage detection and damage repair methods for composite materials.

Course Outcomes:

1. Select the type of material for the fibres and matrix in a composite material for the given application.
2. Relate stresses and strains through the elastic constants for a given lamina.
3. Evaluate elastic properties of a lamina based on the properties of its constituents.
4. Predict failure of a lamina under the given loading condition.
5. Select the number of laminae and their stacking sequence in a composite material for the given loading condition.
6. Identify the type of damage occurring in a composite structure and select an appropriate method to repair it.

Prerequisite: Basic understanding of engineering materials and its applications

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction**	Introduction Classifications based on fibres and matrix, Advantages, Applications, Terminology, Manufacturing Methods: Hand layup, Spray layup, Vacuum bagging, Prepregs, Industrial autoclave, Filament winding, Pultrusion, Resin transfer moulding, Vacuum Infusion Processing, Powder metallurgy route for ceramic and metal matrix composites	**08**	**CO1**
II	**Analysis of Lamina**	Analysis of Lamina Hooke's law for different types of materials, Plane stress assumption, Hooke's law for a two-dimensional unidirectional lamina, Relationship of compliance and stiffness matrix to engineering elastic constants of a lamina, Hooke's law for a two-dimensional angle lamina, Engineering constants of an angle lamina	**08**	**CO2**
III	**Lamina Failure Theories**	Introduction, Maximum stress failure theory, Maximum strain failure theory, Tsai- Hill failure	**08**	**CO3**

		theory, Tsai-Wu failure theory, Strength ratio, Failure envelopes		
IV	**Introduction to Micromechanics of Lamina and Laminate Design**	Prediction of mechanical properties of lamina based on properties of its constituents (fibre and matrix), Laminate types and their codes, Overview of laminate design (no problems on this topic)	**08**	**CO4**
V	**Inspection of Composites**	Different types of damages in composites, Non-destructive testing of composites: Ultrasonics inspection, Acoustography, Low frequency Methods, Radiographic inspection, Shearography, Acoustic emission, Thermography	**06**	**CO5**
VI	**Repair of Composites**	Restitution and repair of composites: Selection of Repair method, Repair criteria, Generic repair designs, Matrix cracks, Delamination, Holes and Fiber fracture, Damage removal and surface preparation	**07**	**CO6**

Text Books/ Reference:

1. M.Balasubramanian, "Composites materials processing" ,1st edition, CRC press 2013.
2. A.K. Kaw, "Mechanics of Composite Materials", Taylor and Francis Group, ISBN:

9780815351481
3. Ajay Kapadia, "Non Destructive Testing of Composite Materials", National Composites Network
4. R.B. Heslehurst, "Defects and Damage in Composite Materials and Structures", CRC Press 2014.
5. R.M. Jones, "Mechanics of Composite Materials", 2nd Edition,Taylor and Francis, Inc,ISBN: 9781138571075
6. I.M. Daniel and O. Isai, "Engineering Mechanics of Composite Materials", 2nd Edition 2005,Oxford University Press, ISBN: 9780195150971
7. D. Gay, S.V. Hoe, and S.W. Tsai, "Composite Materials: Design and Applications", 3rd Edition 2014, CRC Press, ISBN: 978-1466584877
8. R.B. Heslehurst, "Defects and Damage in Composite Materials and Structures", CRC Press 2014.
9. M.M. Schwartz, "Composite Materials: Properties, Nondestructive Testing, and Repair", Prentice Hall PTR (1997), ISBN: 9780133000474

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/112104251
2.	https://nptel.ac.in/courses/112104168
3.	https://nptel.ac.in/courses/112104034
4.	https://swayam.gov.in/nd1_noc23_me16/preview
5.	https://swayam.gov.in/nd1_noc22_me01/preview

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC822	Smart Materials	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	IAT 1 + IAT 2					
MEC822	Smart Materials	20	20	40	60	2.5	--	--	100

Rationale:

Smart materials are capable of sensing and responding to external stimuli like stress, temperature, or electric fields. This subject helps students to understand the types, properties, and applications of materials like piezoelectrics, shape memory alloys, ferrofluids, and nanomaterials. It prepares students to use these materials in modern engineering fields such as aerospace, biomedical, robotics, and energy systems.

Course Objectives:

1. To **introduce** the classification and selection criteria of smart materials based on their functions and properties.
2. To **develop** understanding of the fundamental concepts and working principles of various smart materials.
3. To **study** the synthesis, sensing, and actuation mechanisms of piezoelectric, magnetostrictive materials, shape memory alloys, and electroactive polymers.
4. To **explore** the behavior and applications of ferrofluids, magnetorheological fluids, soft matter, carbon nanostructures, and thermoelectric materials.
5. To **examine** smart materials used for energy storage and harvesting applications.
6. To **highlight** the role and applications of composite and nanocomposite materials in smart systems.

Course Outcomes:

1. **Classify** and **select** different types of smart materials for specific engineering applications.
2. **Explain** the key concepts and working principles of various smart material systems.
3. **Analyze** the synthesis, sensing, and actuation mechanisms of piezoelectric, magnetostrictive materials, shape memory alloys, and electroactive polymers.
4. **Evaluate** the functional behavior of ferrofluids, magnetorheological fluids, soft matter, carbon nanostructures, and thermoelectric materials.
5. **Select** and **justify** the use of smart materials in energy storage and energy harvesting systems.
6. **Identify** and **classify** advanced composite and nanocomposite materials based on application needs.

Prerequisite: Basic understanding of engineering materials and its applications

DETAILED SYLLABUS:

R-2025-Mechanical Engineering

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Smart Materials**	Overview of the different types of Smart Materials, Smart materials used in structures, smart material for sensors, actuators controls, memory and energy storage and their interrelationships, concept of High bandwidth- low strain generating materials (HBLS), and Low Bandwidth High Strain Generating Materials (LBHS), Nano Composite Materials	**08**	**CO1**
II	**Important Concepts of Smart Materials**	artificial skins, artificial muscles, biomimetic materials, materials with tuneable responses, nonlinear properties, self-healing materials, adaptive structures, self-replicating materials/structures, self-assembly, inch worm devices, hysteresis, integrated sensing and actuation	**08**	**CO2**
III	**Synthesis, constitutive/governing relationships- Part 1**	Overview of the following materials with focus on synthesis, constitutive/governing relationships, strengths and weaknesses, and applications (both sensing and actuation etc) 1. Piezoelectric Materials 2. Magneto strictive Materials 3. Shape Memory Alloys 4. Electroactive Polymers	**08**	**CO3**

IV	**Synthesis, constitutive/governing relationships- Part 2**	Overview of the following materials with focus on synthesis, strengths and weaknesses, and applications 1.Ferrofluids and Magneto rheological Fluids and applications in dampers 2.Soft Matter and its applications as smart skins, smart textiles etc 3.Carbon Nanotubes and Carbon nanostructures and its applications 4.Thermoelectric Materials and Peltier devices	**07**	**CO4**
V	**Smart Materials for Energy Applications**	Materials used for energy storage, Hydrogen Storage Materials, Energy harvesting, Energy scavenging from vibrations	**06**	**CO5**
VI	**Manufacturing techniques for smart materials**	Micromanufacturing, high resolution lithography, LIGA process, Generative manufacturing processes such as STL, SLS, SPB, BPM, LOM, SGC, FDM, BIS, BPM, Self-assembly process, Ion beam processes,	**08**	**CO6**

Text Books/ Reference:

1. M.V. Gandhi and B.S. Thompson, "Smart Materials and Structures", Chapman & Hall, London; New York, 1992 (ISBN: 0412370107)
2. Mel Scwartz, "Encyclopedia of Smart Materials Vol. I and II", John Wiley & Sons SenolUtku, "Theory of Adaptive Structures : Incorporating Intelligence into Engineered Products", CRC Press (1998), ISBN: 9780849374319
3. A.V. Srinivasan, "Smart Structures: Analysis and Design", Cambridge University Press,Cambridge; New York, 2001 (ISBN: 0521650267)
4. G. Gautschi, "Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission

Sensors, Materials and Amplifiers", Springer, Berlin; New York, 2002 (ISBN:3540422595)

5. K. Uchino, "Piezoelectric Actuators and Ultrasonic Motors", Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114)
6. G. Engdahl, "Handbook of Giant Magneto strictive Materials", Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X)
7. K. Otsuka and C.M. Wayman, "Shape Memory Materials", Cambridge University Press, Cambridge; New York, 1998 (ISBN: 052144487X)
8. Eric Udd, "Fibre Optic Sensors: An Introduction for Engineers and Scientists", John Wiley & Sons, New York, 1991 (ISBN: 0471830070)
9. André Preumont, "Vibration Control of Active Structures: An Introduction", 2nd Edition, Kluwer Academic Publishers, Dordrecht; Boston, 2002 (ISBN: 1402004966)
10. HojjatAdeli, "Control, Optimization, and Smart Structures: High-Performance Bridges and Buildings of the Future", John Wiley, New York, 1999 (ISBN: 047135094X)
11. T.T. Soong, "Passive Energy Dissipation Systems in Structural Engineering", Wiley, Chichester; New York, 1997 (ISBN: 0471968218)

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/112108148
2.	https://nptel.ac.in/courses/112104224
3.	https://swayam.gov.in/nd1_noc21_mm18/preview
4.	https://nptel.ac.in/courses/117106115
5.	https://swayam.gov.in/nd1_noc19_ee55/preview

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC823	Micro Electro Mechanical Systems (MEMS)	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
MEC823	Micro Electro Mechanical Systems (MEMS)	20	20	40	60	2	--	--	100

Rationale:

Most of the engineering branches are being off-spring of manufacturing processes, and the subject Micro Electro Mechanical Systems (MEMS) represent the integration of mechanical elements, sensors, actuators, and electronics on a microscopic scale using semiconductor fabrication techniques. MEMS technology has become an essential field due to its widespread applications in

automotive systems, healthcare, consumer electronics, aerospace, robotics, IoT, and industrial automation.

Course Objectives:

1. To realize the benefits and effects of scaling.
2. To understand properties and crystallography of Silicon
3. To learn the microfabrication techniques
4. To understand the principles and uses of micro systems

Course Outcomes:

1. Apply laws of scaling for development of a MEMS device
2. Understand the materials and their processing to make MEMS
3. Select and use microfabrication techniques for microsystems
4. Understand the development of micro sensors and actuators
5. Analyze microsystems technology for technical feasibility as well as practicality
6. Develop useful applications of MEMS.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to MEMS**	Unique characteristics of MEMS, Microsystems Technology- An Overview, typical MEMS and Microsystem Products, Scaling effects - scaling laws in miniaturization- Application of MEMS	09	CO1
II	**Material for MEMS and manufacturing**	Structure of silicon and other materials - Silicon wafer processing – Bulk Micromachining and Surface micromachining, Wafer-bonding. Thin-film deposition, Lithography, wet etching and dry etching.	07	CO2
III	**Micro-fabrication methods**	LIGA and other molding techniques- Soft lithography and polymer processing- Thick-film processing; Low temperature co-fired ceramic processing.	06	CO3
IV	**MEMS components- micro sensors**	Micro sensors - Basic principles and working of micro sensors- Acoustic wave micro sensors- Bio-medical micro sensors- Bio-sensors- Chemical microsensors – Optical Sensors – Pressure micro sensors- Thermal micro sensors-acceleration micro sensors;	07	CO4
V	**Micro-actuators**	Basic principles and working of micro actuators- Electrostatic micro actuators-	07	CO5

		Piezoelectric micro actuators- Thermal micro actuators- SMA micro actuators- Electromagnetic micro actuators, micro valves, micro pumps.		
VI	**Case studies /research based on MEMS applications**	Case studies /research based on MEMS applications-impact of materials, processes and design, Actuation using Shape Memory Alloys, Medical device, micro pumps	09	CO6

Text Books:

1. MEMS and Microsystems Design and Manufacture by Tai-Ran Hsu, Tata McGraw Hill Publishing Company Ltd.
2. Foundation of MEMS by Chang Liu, Pearson Education

References:

1. Fundamentals of Microfabrication and Nanotechnology, by Marc J. Madou, CRC Press, 2011,ISBN: 9780849331800
2. Micromachined Transducers Sourcebook, by Gregory Kovacs, WCB McGraw-Hill, Boston, 1998, ISBN: 9780071164627
3. Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes, by M.H. Bao, Elsevier, New York, 2000, ISBN: 978-0444505583
4. Microsystem Design, by Stephen D Senturia, Springer Publication, 2000, ISBN: 9780792372462.
5. Micro sensors - Principles and Applications, by Julian W. Gardner, John Wiley & Sons, Inc.1994, ISBN: 9780471941361.

Assessment:

Internal Assessment (IA) for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

- **Question paper format**

1. Question paper will comprise of a total six questions, each carrying 15 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC831	Product Design and Development	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC831	Product Design and Development	20	20	40	60	2.5	--	--	100

Rationale:

This course emphasizes the importance of product development to meet customer needs and market expectations. It integrates engineering and industrial design with systematic design processes and models.

Students learn to apply tools like QFD to translate user needs into technical specifications. Creative thinking methods foster innovation in concept generation. Industrial design principles and DFMA ensure usability, sustainability, and manufacturability. Prototyping techniques bridge the gap between design and real-world application.

Course Objectives:

1. To understand the basic concepts of engineering design and product design & development, focusing on the front-end processes.
2. To demonstrate an understanding of the overview of all the product design & development processes.
3. To demonstrate knowledge of concept generation and the selection of tools.
4. To study the applicability of product design & development in industrial applications.

Course Outcomes:

1. Describe the need, process, and societal relevance of product design and development.
2. Employ design models, concept evaluation methods, and product architecture principles in the development of engineering design solutions
3. Create product design specifications by applying customer needs analysis, QFD, and competitive benchmarking techniques.
4. Demonstrate creative thinking and problem-solving techniques to generate and develop innovative design concepts.
5. Fabricate product design models incorporating industrial design principles, human factors, and environmental considerations.
6. Work collaboratively to apply DFMA principles and prototyping techniques using computer-aided tools for product development.

Prerequisite: Basic knowledge of manufacturing processes and CAD modeling, Knowledge of basic market research methods and product requirement analysis, Basic engineering and design awareness.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Product Design Process and Market Relevance in Engineering**	Need for developing products, The importance of Engineering and Industrial design, The design process, Relevance of product lifecycle issues in design, Societal considerations in Engineering and Industrial Design, Generic product development process, Various phases of product development, Planning for products, Establishing markets - market segments - relevance of market research.	08	CO1
II	**Design Processes: From Concept Generation to Product Architecture**	The design processes, Descriptive and prescriptive design models, Concept development & evaluation, Pugh's total design activity model, Concept generation and selection method, Embodiment design, Product architecture, and Steps in developing product architecture.	08	CO2
III	**Human-Centered Design: Needs, Benchmarking, and QFD**	Identifying customer needs, Voice of Customer (VoC), Customer populations, Hierarchy of human needs, Need gathering methods, Establishing engineering characteristics, Competitive benchmarking, Quality Function Deployment (QFD), House of Quality (HoQ), Product design specification, Development of product	08	CO3

		design with specifications using QFD, Relevant case studies.		
IV	**Creativity and Innovation in Engineering Design**	Creative thinking, Creativity and problem-solving methods, Creative thinking methods, Brainstorming technique, Gorden technique, Check listing technique, Synectic technique, Morphological Analysis, and Attribute Listing technique. Generating design concepts, Systematic methods of designing.	07	CO4
V	**Aesthetic and Functional Aspects of Industrial Design**	Industrial design, Basic forms & elements, Integrating basic forms & elements such as balance, rhythm, proportion, The golden rule of proportions, human factors, and design, User-friendly design, Design for serviceability, Design for environment.	07	CO5
VI	**Rapid Prototyping and DFMA in Modern Product Design**	Concept of Design for Manufacturing and Assembly (DFMA). Role of computers in product design and manufacturing process, Prototyping techniques such as Stereolithography (SLA), Selective laser sintering (SLS), Fused disposition Modelling (FDM), Laminated object manufacturing (LOM), 3-D printing, and Ballistic Particle Manufacturing (BPM).	07	CO6

Text Books:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development," 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9.
2. Kevin Otto, Kristin Wood, "Product Design," Indian Reprint 2004, Pearson Education, ISBN

9788177588217.

References Books:

1. Clive L. Dym, Patrick Little, "Engineering Design: A Project-based Introduction," 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.
2. George E. Dieter, Linda C. Schmidt, "Engineering Design," 4th Edition, McGraw-Hill International Edition, 2009, ISBN 978-007-127189-9.
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process," 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses
1	https://youtube.com/playlist?list=PLSGws_74K018yZOnbSaqWJZ837QyBB7vu&feature=shared – Product Design and Development, IIT, Roorkee
2	https://youtube.com/playlist?list=PLp6ek2hDcoNALWidcTcFur34atzXNYHjD&feature=shared - Product Design and Development, IIT, Delhi

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC832	Design for X	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
MEC832	Design for X	20	20	40	60	2	--	--	100

Rationale:

Most of the engineering branches are being off-spring of applied sciences and mathematics, and the subject *Design of X* develops the ability to apply scientific, mathematical, and engineering principles to design safe, reliable, and efficient components and systems.

Course Objectives:

1. To acquaint the learners with the concept of design for manufacturing and assembly.
2. To acquaint the learners with the concept of design for reliability and maintainability.
3. To study the product development economics.
4. To develop the ability to apply engineering principles and standards in systematic product design.
5. To enhance creativity and problem-solving skills for innovative product development.
6. To enable the use of modern design tools, methods, and techniques for improving product performance and life cycle.

Course Outcomes:

1. Apply design concepts and guidelines for manufacturing and assembly.
2. Demonstrate the concept of value analysis and its relevance.
3. Understand the economics of product development.
4. Apply design concepts for reliability and maintainability.
5. Utilize modern design tools and techniques for effective product development.
6. Analyse and evaluate product designs for improved performance, safety, and cost-effectiveness

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Design for Manufacture**	General design principles for manufacturability-strength and mechanical factors, mechanisms selection, evaluation method, Process capability-Feature tolerances Geometric tolerances-Assembly limits—Datum features-Tolerance stacks	06	CO1
II	**Design for Assembly**	Assembly processes-Handling and insertion process-Manual, automatic and robotic assembly-Cost of Assembly-Number of Parts-DFA guidelines	08	CO2
III	**Value Engineering**	Introduction to Value Engineering and Value Analysis, Value types-functional—operational— aesthetic, Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.	08	CO3

IV	**Product Development Economics**	Elements of Economics Analysis-Quantitative and qualitative analysis-Economic Analysis Process-Estimating magnitude and time of future cash inflows and outflows Sensitivity analysis-Project trade-offs-Trade-offs rules-Limitation of quantitative analysis-Influence of qualitative factors on project success	08	CO4
V	**Concept of Reliability**	Introduction: The study of Reliability and Maintainability, Concepts, Terms and Definitions, Applications, The Failure Distribution: The reliability Function, Mean Time to Failure, Hazard Rate Function, Bathtub Curve, Conditional Reliability	06	CO5
VI	**Maintainability**	Analysis of down time, Report Time Distribution, Stochastic Point Processes, Reliability under Preventive Maintenance, State-Dependent System with Repair, Design for Maintainability	06	CO6

References:

1. Harry Peck, Designing for Manufacture, Pitman Publications, 1983.
2. George E. Dieter, Engineering Design, McGraw- HillInt Editions,2000
3. S.S.Iyer, Value Engineering, New Age International, 2000
4. Charles E. Ebeling, an Introduction to Reliability and Maintainability Engineering, TMH2000. Production Technology – HMT handbook Online References:

Assessment:

Internal Assessment (IA) for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

- **Question paper format**

1. Question paper will comprise of a total six questions, each carrying 15 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

B.E. Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEC833	Total Quality Management	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs.)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
MEC833	Total Quality Management	20	20	40	60	2.5	--	--	100

Rationale:

This course introduces the fundamentals and evolution of Quality Management and TQM. It emphasizes customer satisfaction, supplier collaboration, and cost of quality for performance improvement. Students learn key quality philosophies, TQM principles, and tools like PDCA and QC/QA tools. Concepts of Statistical Quality Control, control charts, and sampling plans are covered.

Continuous improvement methods such as TPM, QFD, Kaizen, and Taguchi are included. The course also explores ISO certifications and quality awards. Emerging trends like Six Sigma, sustainability, and quality analytics are discussed. Application across manufacturing, services, and modern sectors is highlighted.

Course Objectives:

1. To understand the importance of Quality Management and principles of TQM.
2. To understand seven basic QC tools and advanced QM tools.
3. To understand the concept of Statistical Quality Control.

4. To understand the concept of Continuous Improvement and TQM implementation.
5. To understand different Quality Systems and Quality Standards.
6. To understand the future trends in TQM and TQM strategies.

Course Outcomes:

1. Apply QM and principles of TQM in organizational development process.
2. Apply the QC & QM tools in process improvement.
3. Apply SQC techniques to improve process quality.
4. Apply Six Sigma project in TQM Implementation.
5. Apply QMS and Certification for Quality Accreditation.
6. Apply the advanced tools for Quality Sustainability.

Prerequisite: Basic knowledge of manufacturing processes, engineering materials, statistical methods

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Quality Management**	**Introduction to Quality Management:** **A)** Definitions of Quality, product quality and service quality; the evolution of quality; need for Quality Management, Quality statements and Policy, Customer orientation & satisfaction, Customer complaints, customer retention; Supplier partnership, Supplier rating & selection, CSI, Costs of Quality, Prevention, appraisal and failure aspects, Use of COQ for improving quality and performance, Designing for quality, Quality of design, Quality of conformance. **B)** Basic concepts of TQM, TQM framework, Contributions of Deming, Juran	08	CO1

		and Crosby, Juran Triology , PDCA Cycle, Barriers to TQM; TQM principles; Strategic Quality Planning; Quality councils; employee involvement, motivation; Empowerment; Team and Teamwork; recognition and reward, performance appraisal.		
II	**QC Tools**	**QC Tools:** **A) Seven QC Tools:** Check Sheet, Histogram, Pareto Chart, Fishbone Diagram, Run Charts, Scatter Diagram, Process Flow Chart. **B) Seven QM Tools:** Program Decision Process Chart, Tree Diagram, Affinity Diagram, Prioritization Matrix, etc. Bench Marking Types – Process, Product, Quality Improvement Tools: Why-Why Analysis, Root Cause Analysis, Poka Yoke (Mistake Proofing)	08	CO2
III	**Statistical Quality Control**	**Statistical Quality Control:** 100% Inspection versus Sampling Inspection, Reasons for SQC. **A) Acceptance Sampling:** Concept of Producer Risk and Consumers Risk. Operating Characteristics Curve. Sampling Plan – Single Sampling Plan versus Double Sampling Plan. Design Sampling Plan on the basis of MIL, ASQ Standards. **B) Statistical Process Control:** Variations – Concept, Causes – Random & Assignable, Difference – Process in Control versus Process is Capable, Control Charts, X-Bar, R, P and C Charts, Process Capability (Cp) & Process Capability Index (Cpk), Sigma Limits. Applications of Control Charts in Mass Production, Process Production.	08	CO3
IV		**A) Continuous Improvement:** Quality Circles, Quality Function Development		

	Continuous Improvement & TQM Implementation	(QFD), Taguchi quality loss function, Parameter Design, Robust Design; TPM- concepts, 5S, Kaizen, FMEA- stages, Zero Defect. **B) TQM Implementation**: Manufacturing and Service sectors, Introduction to Six Sigma: Definition, Concept, Methodology. Six Sigma Approaches – Design for Six Sigma (DFSS) Approach & DMAIC Approach, Six Sigma Tools: Applications to manufacturing and service sector including IT, ITeS, and E Com.	07	CO4
V	**Quality Management System & Certification**	**Quality Management System & Certification:** **A) QMS**: Elements and documentation, Quality auditing, Necessity for Certification & Certification Process, Benefits of Certification. Certifying Bodies & Accreditation Agencies, ISO 9000-2015 (5th Edition), Introduction to TS16949: Technical Specifications, QS9000, ISO14000- concepts, requirements and benefits. Case studies of TQM implementation in manufacturing and service sectors including IT and Environmental management systems- ISO 14000 Series Standards, Integration of ISO 14000 with ISO 9000. **B) Quality Awards:** Malcom Baldrige National Quality Award and Rajiv Gandhi National Quality award.	07	CO5

VI	**Future Trends in TQM**	**Future Trends in TQM:** Strategic approach to leadership, Customer centric endeavors, Involvement & empowerment of all employee's / stake holders, Decision making based on real time facts, Win-Win policy with suppliers, New paradigms of Green & sustainability, TQM beyond Manufacturing i.e. Healthcare, Education, Finance. Accountability through new tools and technologies, Quality Analytics.	07	CO6

Text Books:

1. Besterfield D. H. et al.: Total quality Management, 3rd Edition, Pearson Education Asia, 2006.
2. Janakiraman B. and Gopal R.K.: Total Quality Management, Prentice Hall India, 2006.
3. Poornima M. Charantimath: Total Quality Management, 2nd Edition, Pearson Education Asia, 2006.
4. N. Logothetis: Managing for Total Quality, 6th Edition, Prentice Hall of India Pvt. Ltd. 2003.
5. Suganthi L. and Samuel A.: Total Quality Management, Prentice Hall India, 2006.
6. Evans J.R. and Lindsay W.M.: The Management and Control of Quality, 8th Edition, 1st Indian Edition, Cengage Learning, 2012.

References Books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses

1	https://youtube.com/playlist?list=PLPjSqITyvDeUUUwunyiwq41yJZofQEzMI&feature=shared – Total Quality Management-I, IIT, Kanpur
2	https://youtube.com/playlist?list=PLueDbnzoKDZ-ZIJigjav-j8ZWz5CEoz-0&feature=shared - Total Quality Management-II, IIT, Kanpur

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8401	Project Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT- 2	IAT-1+IAT-2					
OEC8401	Project Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce students to the fundamentals of project management and the importance of a structure approach in handling unique projects.
2. To develop an understanding of project management concepts, frameworks, and industry best practices.
3. To provide hands-on exposure to various tools and techniques used in planning, executing, and monitoring projects.
4. To explain the complete Project Management Life Cycle, including initiation, planning, execution, monitoring, and closure.
5. To enable students to identify and address project risks, scope, cost, time, and quality constraints.
6. To prepare students for real-world project environments by enhancing their decision-making, leadership, and team collaboration skills.

Course Outcomes:

1. Apply appropriate selection criteria to evaluate and choose the most suitable project from multiple alternatives.
2. Develop a Work Breakdown Structure (WBS) and construct a project schedule based on it.
3. Analyze project risks by identifying potential opportunities and threats, and formulate strategic responses.
4. Apply project monitoring and control techniques, including Earned Value Management (EVM), to assess and forecast project performance.
5. Document and communicate key findings and experiences from various project phases for continuous improvement.
6. Demonstrate the ability to integrate planning, execution, and evaluation skills for successful project completion.

Prerequisite: Basic knowledge of software engineering, management principles, and analytical skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**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, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	5	CO1
II	**Initiating Projects**	How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	6	CO2

III	**Project Planning and Scheduling**	Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	8	CO3
IV	**Planning Projects**	Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan 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	6	CO4

V	**Executing Projects**	Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit **Project Contracting** Project procurement management, contracting and outsourcing	8	CO5
VI	• **Project Leadership and Ethics**	Introduction to project leadership, ethics in projects, Multicultural and virtual projects • **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; Project management templates and other resources; Managing without authority; Areas of further study	6	CO6

Text Books:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mante7th Edition, Wiley India
2. Project Management,Gido Clements, Cengage Learning

3. Project Management,Gopalan, Wiley India

References:

1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide),

Online Reference :

1. Project Management Institute (PMI) – https://www.pmi.org

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8402	Finance Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8402	Finance Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To provide an overview of the Indian financial system, including its structure, instruments and markets.
2. To introduce fundamental concepts such as the time value of money, risk, and return.
3. To explain the principles and practices of corporate finance.
4. To understand the components and management of working capital.
5. To explore various sources of finance available to businesses.
6. To study financial decision-making areas such as capital structure and dividend policy.

Course Outcomes :

1. Understand the structure and functioning of the Indian financial system and its key components.
2. Apply the concept of the time value of money in evaluating financial decisions.
3. Analyze risk and return to support sound investment decisions.
4. Demonstrate knowledge of corporate finance principles in business contexts.
5. Effectively manage working capital to maintain business liquidity and operations.
6. Make informed decisions related to capital structure and dividend distribution.

Prerequisite: Basic knowledge of accounting, economics, and business mathematics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Overview of Indian Financial System:**	Characteristics, Components and Fun ctions of 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:**	6	CO1

		Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges		
II	**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.	6	CO2
III	**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.	9	CO3

IV	**Capital Budgeting**	Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **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.	10	CO4
V	**Sources of Finance**	Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **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	5	CO5

		Optimal Capital Structure		
VI	**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	3	CO6

Text Books:

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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8403	Entrepreneurship Development and Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8403	Entrepreneurship Development and Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamentals of entrepreneurship and its role in business development.
2. To develop understanding of various forms of business ownership and entrepreneurial functions.
3. To provide insights into the Indian entrepreneurial ecosystem and its regulatory environment.
4. To explain the concept and structure of Entrepreneurship Development Programs (EDP).
5. To familiarize students with the significance and functioning of Micro, Small, and Medium Enterprises (MSMEs).

6. To enable students to analyze the contribution of government and financial institutions in promoting entrepreneurship.

Course Outcomes (Learner will be able to):

1. Understand the core concepts of entrepreneurship and various business ownership models.
2. Prepare and evaluate business plans covering key managerial and financial aspects.
3. Interpret relevant laws and legal procedures applicable to Indian entrepreneurs.
4. Analyze government policies and institutional support systems for entrepreneurs and MSMEs.
5. Apply knowledge of EDPs and their role in skill development and business support.
6. Recognize challenges in entrepreneurship and propose suitable strategies for business growth and sustainable.

Prerequisite: Basic knowledge of business studies and economics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping

I	**Overview Of Entrepreneurship**	Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	4	CO1
II	**Business Plans And Importance Of Capital To Entrepreneurship:**	Preliminary and Marketing Plans Management and Personnel, Start-up Cos and Financing as well as Projected Financia Statements, Legal Section, Insurance Suppliers and Risks Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development Starting a New Business,	9	CO2

		Buying an Existing Business, New Produc Development, Business Growth and th Entrepreneur Law and its Relevance Business Operations		
III	**Women's Entrepreneurship Development**	Women's Entrepreneurship Development, Socialentrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	5	CO3
IV	**Indian Environment for Entrepreneurship**	key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	8	CO4
V	**Effective Management of Business**	Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	8	CO5

VI	**Achieving Success In The Small Business**	stages of the small business life cycle, four type of firm-level growth strategies, Options harvesting or closing small business Critical Success factors of small business	5	CO6

Text Books:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shepherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House

References:

1. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
2. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
3. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
4. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication

Online References:

1. Laghu Udyog Samachar
2. www.msme.gov.in
3. www.dcmesme.gov.in
4. www.msmetraining.gov.in

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8404	Human Resource Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8404	Human Resource Management	20	20	40	60	2	--	--	100

Course Objectives:

1. To introduce students to the fundamental concepts and principles of Human Resource Management (HRM).
2. To explain key HRM techniques and practices used in modern organizational settings.
3. To provide a comprehensive understanding of HRM functions such as recruitment, selection, training, and performance management.
4. To explore the challenges and changes in HRM in the context of evolving organizational dynamics.
5. To familiarize students with the latest trends and technological advancements in HRM.
6. To develop awareness of interpersonal and intergroup behavioral skills essential for

future engineers, managers, and leaders.

Course Outcomes :

1. Understand the core concepts and techniques of Human Resource Management.
2. Analyze various HRM functions and apply them in the context of organizational processes.
3. Evaluate the challenges and opportunities in HRM in today's rapidly changing business environment.
4. Identify and interpret current developments and trends in HRM practices.
5. Demonstrate effective interpersonal and team-building skills within professional settings.
6. Integrate behavioral understanding with HRM concepts to contribute effectively as future professionals.

Prerequisite: Basic understanding of management principles, organizational behavior, and communication skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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,	5	CO1

		Empowerment, TQM, Managing ethical issues		
II	**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		

III	**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.		
IV		• Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.		
V	**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		
VI	**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 difference in employee motivation		
		HR & MIS: Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **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 **Labor Laws & 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		

Text Books:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013.
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing 3.Aswathapa, Human resource management: Text & cases, 6th edition, 2011

References:

1. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 5th Ed, 2015, Himalaya Publishing, 15th edition, 2015
2. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013,

Himalaya Publishing
3. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8405	Professional Ethics and Corporate Social Responsibility (CSR)	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8405	Professional Ethics and Corporate Social Responsibility (CSR)	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental principles of professional ethics in business.
2. To develop an understanding of ethical decision-making and moral responsibility in organizational settings.

3. To recognize the scope and significance of Corporate Social Responsibility (CSR) in modern business.
4. To understand the rights and duties of businesses toward various stakeholders.
5. To explore the role of law in shaping and enforcing CSR practices.
6. To promote ethical leadership and responsible corporate behavior.

Course Outcomes :

1. Understand and apply the principles of professional ethics in business contexts.
2. Identify and evaluate the rights and responsibilities of businesses in a societal framework.
3. Analyze various aspects and dimensions of corporate social responsibility.
4. Demonstrate awareness of legal and regulatory aspects related to CSR.
5. Make ethically sound decisions in professional and organizational settings.
6. Promote socially and environmentally responsible behavior as future professionals and leaders.

Prerequisite: Basic knowledge of business management, ethics, and legal framework

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Professional Ethics and Business:**	The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	4	CO1
II	**Professional Ethics in the Marketplace:**	Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	8	CO2

III	**Professional Ethics of Consumer Protection:**	Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	6	CO3
IV	**Introduction to Corporate Social Responsibility:**	Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	5	CO4
V	**Corporate Social Responsibility:**	Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	8	CO5

VI	**Corporate Social Responsibility in Globalizing India:**	Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	8	C06

Text Books:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.

References:

1. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
2. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Online References:

1. https://www.ethics.org – The Ethics & Compliance Initiative (ECI)
2. https://www.csrwire.com – News and reports on Corporate Social Responsibility.
3. https://www.globalreporting.org – Global Reporting Initiative (GRI) for CSR frameworks

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8406	Research Methodology	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8406	Research Methodology	20	20	40	60	2.5	--	--	100

Course Objectives:

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1. To introduce the basic concepts and significance of research in academic and professional contexts.
2. To explain the research process, including various types and approaches to research.
3. To guide students in identifying suitable research problems and formulating research questions.
4. To develop skills in designing effective research strategies and methodologies.
5. To familiarize students with data collection methods and tools.
6. To provide an understanding of data analysis, interpretation, and reporting of research findings.

Course Outcomes :

1. Understand and apply the fundamental principles of research and the research process.
2. Identify and define research problems relevant to their domain.
3. Design a structured research plan with appropriate methodologies.
4. Collect, organize, and analyze data accurately using suitable tools.
5. Interpret and evaluate research data to derive meaningful conclusions.
6. Effectively present and communicate research findings in a clear and logical manner.

Prerequisite: Basic understanding of research methodology, including types of research, hypothesis formulation, and data collection techniques.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction and Basic Research Concepts**	Research – Definition; Concept of Construct Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology Need of Research in Business and Social Sciences Objectives of Research Issues and Problems in Research Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	4	CO1
II	**Types of Research**	**Types of Research** • Basic Research • Applied Research • Descriptive Research • Analytical Research • Empirical Research Qualitative and Quantitative Approache	4	CO2

III	Research Design and Sample Design	Research Design – Meaning, Types and Significance Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	10	CO3
IV	**Research Methodology**	Meaning of Research Methodology Stages in Scientific Research Process: Identification and Selection of Research Problem Formulation of Research Problem Review of Literature Formulation of Hypothesis Formulation of research Design Sample Design Data Collection Data Analysis Hypothesis testing and Interpretation of Data Preparation of Research Report	10	CO4
V	**Formulating Research Problem**	.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of	8	CO5

		data, Generalization and Interpretation of analysis		
VI	**Outcome of Research**	Preparation of the report on conclusion reached Validity Testing & Ethical Issues Suggestions and Recommendation	6	CO6

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. .Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8407	IPR and Patenting	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8407	IPR and Patenting	20	20	40	60	2	--	--	100

Course Objectives:

1. To provide a fundamental understanding of the intellectual property rights (IPR) protection system.
2. To explain various types of intellectual property such as patents, copyrights, trademarks, and designs.
3. To promote awareness of Indian IPR laws and their relevance in business and innovation.
4. To familiarize students with international IPR treaties and procedures (e.g., WIPO, TRIPS).
5. To acquaint students with patent search tools, databases, and techniques.
6. To explain the procedures for filing patent applications and other IPR registrations.

Course Outcomes:

1. Understand and identify various forms of intellectual property assets.
2. Explain the legal framework of IPR in India and globally.
3. Conduct basic patent and IPR-related searches using appropriate tools.
4. Describe the procedures involved in patent filing and other IPR applications.
5. Evaluate the role of IPR in fostering innovation and protecting inventions.
6. Assist individuals and organizations in building IPR awareness and compliance capabilities.

Prerequisite: Basic understanding of legal concepts and fundamentals of innovation or product Development.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Intellectual Property Rights (IPR)**	Meaning of IPR, Different category of IP instruments - Patents, rademarks,Copyrights Industrial Designs, Plant variety protection Geographical indications,Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of Development	5	CO1

II	**Enforcement of Intellectual Property Rights**	Introduction, Magnitude of problem, Factor that create and sustain counterfeiting/piracy International agreements, International organizations (e.g. WIPO, WTO) active in IP enforcement Indian Scenario of IPR:Introduction, History o IPR in India, Overview of IP laws in India Indian IPR, Administrative Machinery, Majo international treaties signed by India Procedur for submitting patent an Enforcement of IPR a national level etc.	7	CO2

III	**Emerging Issues in IPR**	Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	5	CO3
IV	**Basics of Patents**	Definition of Patents, Conditions o patentability Patentable and non-patentable inventions, Type of patent applications (e.g Patent of addition etc) Process Patent an Product Patent, Precaution while patenting Patent specification Patent claims Disclosure and non-disclosures, Patent rights nd infringement, Method of getting a patent	7	CO4
V	**Patent Rules**	Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	8	CO5
VI	**Procedure for Filing a Patent (National an Internationa** l	Legislation and Salient Features, Patent Search Drafting and Filing Patent Applications Processing of patent, Patent Litigation, Paten Publication, Time frame and cost, Paten Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	7	CO6

REFERENCES:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell.
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO 7.Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
7. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
8. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
9. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
10. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
11. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company

12. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting ,Interpretation of Patent Specifications and Claims, New India Publishing Agency.
13. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
14. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8408	Digital Business Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8408	Digital Business Management	20	20	40	60	2	--	--	100

Course Objectives:

1. To introduce students to the fundamental concepts of digital business.
2. To provide an understanding of the evolution and scope of e-commerce in the digital age.
3. To explore various models, tools, and platforms used in digital business environments.
4. To explain the components, infrastructure, and technologies that support e-business.
5. To analyze strategies for developing and managing successful e-business initiatives.
6. To encourage entrepreneurial thinking through the creation of digital business plans.

Course Outcomes :

1. Understand and define key concepts and drivers of digital business.
2. Distinguish between different types of e-commerce and their business models.
3. Apply digital tools and technologies for managing online business operations.
4. Analyze and evaluate e-business strategies and their implementation.
5. Demonstrate familiarity with legal, ethical, and security issues in digital business.
6. Design and present a comprehensive e-business plan.

Prerequisite: Basic knowledge of internet technologies, business processes, and information systems.

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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Digital Business-	Introduction, Background and current statu E-market places, structures, mechanism economics and impacts difference between physical economy an digital economy,	9	CO1
		rivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Socia media, BYOD,and Internet o Things(digitally intelligen machines/services) pportunities and Challenges in Digita Business,		

II	Overview of E-Commerce	-Commerce- Meaning, Retailing i e commerce-products and services consumer behavior, market research an advertisemen 2B-E-commerce-selling and buying i private e-markets, public B2B exchange and support services, e-supply chains Collaborative Commerce, Intra business E and Corporate portals ther E-C models and application innovative EC System-From E- governmen and learning to C2C, mobile commerce an pervasive computing C Strategy and Implementation-EC strateg and global EC, Economics and Justificatio of EC, Using Affiliate marketing to promot your e-commerce business, Launching successful online business and EC project Legal, Ethics and Societal impacts of EC	6 C	CO2
III	Digital Business Support services	ERP as e –business backbone, knowledge Tope Apps, Information and referral system	6	CO3

		pplication Development: Building Digital business Applications and Infrastructure		
IV	Managing E-Business-	naging Knowledge, Management skills fo e- business, Managing Risks in e –business ecurity Threats to e-business -Securit Overview, Electronic Commerce Threats Encryption, Cryptography, Public Key an Private Key Cryptography, Digita Signatures, Digital Certificates, Securit Protocols over Public Networks: HTTP SSL Firewall as Security Control, Publi Key nfrastructure (PKI) for Security, Prominen Cryptographic Applications	6	CO4
V	E-Business Strategy-	-Business Strategy-E-business Strateg formulation- Analysis of Company Internal and external environment Selectio of strategy, E-business strateg into Actio challenges and E-Transition Process of Digital Transformation)	4	CO5
VI	**Materializing e-business:**	**Materializing e-business: From Idea to Realization-** Business plan preparation **Case Studies and presentations**	8	CO6

REFERENCES:

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8409	Environmental Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+IAT-2					
OEC8409	Environmental Management	20	20	40	60	2	--	--	100

Course Objectives:

1. To introduce students to the fundamentals of environmental science and the significance of environmental management in current industrial and social contexts.
2. To create awareness of global environmental challenges and the role of human activities in causing environmental degradation.
3. To develop a scientific understanding of ecological principles and ecosystem dynamics, including interdependencies among living organisms.
4. To familiarize students with the role of government and industries in environmental management and regulation.
5. To provide knowledge of environmental quality management systems, including ISO standards and Environmental Management Systems (EMS).

6. To acquaint students with major environmental legislations and legal frameworks for sustainable and responsible development.

Course Outcomes:

1. Understand the importance of environmental management and sustainable development in addressing contemporary environmental challenges.
2. Analyze major global environmental issues such as global warming, acid rain, and biodiversity loss and their impact on ecosystems.
3. Explain key ecological concepts including ecosystems, limiting factors, food chains, and interdependencies in nature.
4. Evaluate the role of government and industries in implementing environmental management strategies and regulatory policies.
5. Demonstrate knowledge of environmental quality standards such as Total Quality Environmental Management, ISO 14000, and EMS certification.
6. Interpret the provisions and implications of major environmental legislations like the EPA, Water and Air Acts, and Wildlife Protection Act.

Prerequisite:Basic understanding of science and awareness of current environmental issues.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction and Definition of Environment:	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	10	CO1

II	Global Environmental concerns	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	6	CO2
III	Concepts of Ecology	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	5	CO3
		Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality and Management Corporate Environmental Responsibility		
		Total Quality Environmental Management, ISO-14000, EMS certification.		
		General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.		

IV	Scope of Environment Management	Role and functions of Government as a planning and regulating agency nvironment Quality Management and Corporate Environmental Responsibility	10	CO4
V	Quality Environmental Management,	Total Quality Environmental Management, ISO-14000, EMS certification.	5	CO5
VI		general overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	3	CO6

REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL805	Product Design and Development	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL805	Product Design and Development	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize concepts in PD&D for practical implementation.
2. To acquaint with the applicability of PD&D in industrial applications.

Lab Outcomes:

1. Identify the need for developing products
2. Select suitable PD&D processes.
3. Apply the creativity & industrial design methods to design & develop the chosen product.
4. Work collaboratively in a team to complete a PD&D project.
5. Effectively communicate the results of projects and other assignments both in a written and oral

format.

Prerequisite: Basic knowledge of manufacturing processes and CAD modeling, Knowledge of basic market research methods and product requirement analysis, Basic engineering and design awareness

List of Assignments:

Total **3 to 4 assignments** have to be given.
Assignments **III and IV are compulsory** and shall be **treated like mini-projects**. Two more could be covered from the remaining as case studies.

I. Based on Module No. 1 and 2.

1. Select any one consumer product, such as
    a) a mobile
    b) a laptop
    c) a pencil sharpener
    d) a table and chair
    e) a stool
    f) a bicycle
    g) a pen
    h) a storage device of any household items
    i) a cupboard etc….. anything

Assume that you want to go for re-development of any one of the products. How would you tackle by answering any 3 or 4 points that are given below?

Q1. How do you identify the need for developing the product?

Q2. What are the changes that you would like to incorporate?

Q3. Would it be Engineering Design or Industrial design factors or both?

Q4. What are the generic PD&D processes that you would like to adopt?

Q5. What are the methods that you would adopt for Market research?

Q6. If you would like to develop which design process you would like to adopt?

Q7. If you select descriptive design… then why? If you select prescriptive design… then why?

Q8. What are the steps that you would like to adopt while developing the product?

II. Based on Module No. 3.

2. Select any one consumer product, such as

a) a mobile

b) a laptop

c) a pencil sharpener

d) a table and chair

e) a stool

f) a bicycle

g) a pen

h) a storage device of any household items

i) a cupboard etc….. anything

Assume that you want to go for re-development of any one of the above products. How would you tackle by answering any 3 or 4 points that are given below?

Q1. How do you identify the customer needs for developing the product?

Q2. How do you ascertain/select the attributes that are to be tackled?

Q3. Would you like to go for Engineering Design factors or Industrial design factors or both?

Q4. How do you develop a correlation matrix?

Q5. How do you "Construct House of Quality"?

Q6. What are the generic PD&D processes that you would like to adopt in re-designing it using House of quality?

Q7. What are the methods that you would adopt for Market acceptance?

Q8. How do you document the entire design process?

III. Based on Module No. 4.

3. Select any one consumer product, such as

a) a mobile
b) a laptop
c) a pencil sharpener
d) a table and chair
e) a stool
f) a bicycle
g) a pen
h) a storage device of any household items
i) a cupboard etc….. anything

Assume that you want to go for re-development of any one of the above products.

How would you apply the creativity method to design the chosen product using any one creativity methods? Develop the product and document the entire process by answering some of the questions as shown in I or II.

IV. Based on Module No. 5.

4. Select any one consumer product, such as
   a) a mobile
   b) a laptop
   c) a pencil sharpener
   d) a table and chair
   e) a stool
   f) a bicycle
   g) a pen
   h) a storage device of any household items
   i) a cupboard etc….. anything

Assume that you want to go for re-development of any one of the above products.

How would you apply the principles of Industrial Design methods to design the chosen product?
Develop the product and document the entire process by answering some of the questions as shown in I or II.

V. Based on Module No. 6

5. Select any one consumer product, such as
    a) a mobile
    b) a laptop
    c) a pencil sharpener
    d) a table and chair
    e) a stool
    f) a bicycle
    g) a pen
    h) a storage device of any household items
    i) a cupboard etc..... anything

Assume that you want to go for re-development of any one of the above products.
How would you apply the principles of DFMA to design the chosen product?
Develop the exploded view of the product and document the entire process by answering some of the questions as shown in I or II.

Text / References Books:

1. Baker, M. & Hart S. (2007), Product Strategy and Management, (2nd. Ed.) Edinburgh: Pearson Education.
2. Ulrich, K. & Eppinger, S. (2012), Product Design and Development. (5th. Ed.) Los Angeles: McGraw Hill Education.
3. Yousef Haik, T. M. M. Shahin (2010), Engineering Design Process, (2nd. Ed. Reprint), Cengage

Learning, ISBN 0495668141.

4. Kevin Otto, Kristin Wood (2004), Product Design, (Indian Reprint), Pearson Education, ISBN 9788177588217.

Assessment:

Term work:

The distribution of marks for term work shall be as follows:

Assignments/Case studies:	**10 marks**
Mini Project:	**10 marks**
Attendance:	**05 marks**

End Semester Practical/Oral Examination:

1. Pair of Internal and External Examiner should conduct practical/viva based on contents.
2. **Distribution of marks for practical/viva examination shall be as follows:**
   - **Practical performance: 15 marks**
   - **Oral: 10 marks**
3. Evaluation of practical examination to be done based on the practical performed.
4. Students work along with evaluation reports to be preserved till the next examination.

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C)
MEL806	Laboratory based on IoT	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL806	Laboratory based on IoT	--	--	--	--	25	25	50

Lab Objectives:

1. **To learn microcontroller programming using 8051 and Arduino Development Board.**
2. **To acquaint with interfacing of simple peripheral devices to a microcontroller.**
3. **To acquaint with exchange of data using wireless communication.**
4. **To familiarize with logging the data on cloud platform.**
5. **To learn different transfer protocols**
6. **To familiarize different open-source dashboards**

Lab Outcomes:

1. **Develop** simple embedded applications using 8051 and Arduino microcontrollers. *(Apply)*
2. **Interface** peripheral devices such as sensors and actuators with microcontrollers. *(Apply)*
3. **Utilize** microcontroller-based embedded platforms for implementing IoT solutions. *(Apply)*
4. **Demonstrate** wireless data communication using wireless peripherals (e.g., Bluetooth, Wi-Fi). *(Understand / Apply)*
5. **Configure** cloud platforms to **collect and log** sensor data effectively. *(Apply / Analyze)*
6. **Troubleshoot** and **debug** basic issues in microcontroller-based embedded systems. *(Analyze)*

List of Experiments.

Sr No	List of Experiments	Hrs
01	Interfacing experiments using 8051 Trainer kit and interfacing modules a. display (LCD/LED/Seven Segment) b. Stepper / DC Motor	2
02	Introduction to Arduino platform and programming	4
03	Simple Applications using Arduino Development Board (Any two) a. Simple LED Blinking using development board b. Building IOT Smart Switch using IOT c. Pulse Width Modulation d. Analog to Digital / Digital to Analog Conversion	4
04	Interfacing Arduino with a Sensor (Any one): Temperature Sensor / PIR/ Ultrasonic sensor/ IR Sensor/ Flame Sensor/ MQ6 Sensor/ Humidity sensor/ Raindrop Sensor, magnetometers, cameras, accelerometers etc.	4
05	Interfacing Arduino with an Actuator (Any One): Motors / solenoids / Controllers etc.	4
06	Communication using Wireless Medium (Any One): WiFi / Bluetooth / Zigbee / RFID etc.	8
07	Setting up and Cloud Platform and logging Sensor Data on the platform.	6

Text Books / References:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, *The 8051 Microcontroller and Embedded Systems: Using Assembly and C,* Pearson Education, 2nd Edition
2. Simon Monk, *Programming Arduino: Getting Started with Sketches* McGraw-Hill Education, 2nd Edition
3. Raj Kamal, *Internet of Things: Architecture and Design*, McGraw-Hill Education, 1st Edition

Online Resources:

Sr. No.	Website Name
1	https://www.tinkercad.com
2	https://spoken-tutorial.org/watch/Arduino/Introduction+to+IoT/English/
3	https://toptechboy.com/#google_vignette

Assessment:

Term Work: Term Work shall consist of at least 7 practicals based on the above list. Also, Term work Journal must include one project based on IoT

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Project) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MEL807	Major Project II	-	12	-	-	4	-	4

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
MEL807	Major Project II	--	--	--	--	100	50	150

Objectives:

The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification to successful completion of the project by implementing the solution.

Outcomes:

1. Students will be able to implement solutions for the selected problem by applying technical and professional skills.
2. Students will be able to analyze impact of solutions in societal and environmental context for sustainable development.
3. Students will be able to collaborate best practices along with effective use of modern tools.
4. Students will be able to develop proficiency in oral and written communication with effective

leadership and teamwork.

5. Students will be able to nurture professional and ethical behavior.
6. Students will be able to gain expertise that helps in building lifelong learning experience.

Guidelines:

1. **Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.**

2. **Project Report Format:**

At the end of semester, each group need to prepare a project report as per the guidelines issued by the University of Mumbai. Report should be submitted in hardcopy. Also, each group should submit softcopy of the report along with project documentation, implementation code, required utilities, software and user Manuals.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey/ Existing system
- Limitation Existing system or research gap
- Problem Statement and Objective
- Proposed System
  - Analysis/Framework/ Algorithm
  - Design details
  - Methodology (your approach to solve the problem) Proposed System
- Experimental Set up
  - Details of Database or details about input to systems or selected data
  - Performance Evaluation Parameters (for Validation)
  - Software and Hardware Set up
- Results and Discussion

- Conclusion and Future Work
- References
- Appendix – List of Publications or certificates

Desirable:

- Students should be encouraged
  - to participate in various project competition.
  - to write minimum one technical paper & publish in good journal.
  - to participate in national / international conference.

3. Term Work:

Distribution of marks for term work shall be done based on following:

Sr. No.	Component	Marks	Justification
1.	Weekly Log Report	15	Tracks regularity, effort, and individual contributions throughout the semester.
2.	Completeness of the project and Project Work Contribution	40	Evaluates innovation, technical depth, execution, teamwork, and project outcomes.
3.	Project Report (Black Book) (both side print)	20	Assesses structure, documentation quality, technical content, and eco-friendly submission.
4.	Term End Presentation (Internal)	25	Judges communication skills, understanding of the project, visual aids, and handling of queries.

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. Oral & Practical:

Oral &Practical examination (Final Project Evaluation) of Project II should be conducted by **Internal and External examiners at the end of the semester**.

Suggested quality evaluation parameters are as follows:

- Relevance to the specialization / industrial trends
- Modern tools used
- Innovation
- Quality of work and completeness of the project
- Validation of results
- Impact and business value
- Quality of written and oral presentation
- Individual as well as team work Quality of written and oral presentation
- Individual as well as team work