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

B. Tech. Program (Mechanical Engineering)

Shri Vile Parle Kelavani Mandal's Dwarkadas J. Sanghvi College of Engineering

(Autonomous College affiliated to the University of Mumbai)

Scheme and detailed syllabus (DJS22)

Final Year B. Tech

In

Mechanical Engineering

(Semester VII)

Revision: 0 (2025)

With effect from the Academic Year: 2025-2026

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
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Scheme for Final Year of B.Tech. Program in Mechanical Engineering: Semester VII (Autonomous-DJS22) (Academic Year 2025-2026)

Sr. No.	Course Code	Courses	Teaching Scheme (hrs.)				Continuous Assessment (A) (Marks)			Semester End Assesment (B) (Marks)					(A+B)	Total Credits	
			Th	P	T	Credits	Th	T/W	Total CA (A)	Th / Cb	O	P	O & P	Total SEA (B)			
1	DJS22MEC701	Design of Mechanical Systems	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL701	Design of Mechanical Systems Laboratory	--	2	--	1	--	25	25	--	25	-		25	50	1	
2	DJS22MEC702	Production Planning and Control	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL702	Production Planning and Control Laboratory	--	2	--	1	--	25	25	--	25	-	--	25	50	1	
3 @	DJS22MEC7011	Flexible Manufacturing Systems	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL7011	Flexible Manufacturing Systems Laboratory	--	2	--	1	--	25	25	--	--	-	--	--	25	1	
	DJS22MEC7012	Design of Automotive Systems	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL7012	Design of Automotive Systems Laboratory	--	2	--	1	--	25	25	--	--	-	--	--	25	1	
	DJS22MEC7013	Piping Engineering	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL7013	Piping Engineering Laboratory	--	2	--	1	--	25	25	--	--	-	--	--	25	1	
	DJS22MEC7014	Bionics Engineering	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL7014	Bionics Engineering Laboratory	--	2	--	1	--	25	25	--	--	-	--	--	25	1	
	DJS22MEC7015	Computational Fluid Dynamics	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL7015	Computational Fluid Dynamics Laboratory	--	2	--	1	--	25	25	--	--	-	--	--	25	1	
	DJS22MEC7016	Business Model Design	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL7016	Business Model Design laboratory	--	2	--	1	--	25	25	--	--	-	--	--	25	1	
	DJS22MEC7017	Soft Computing	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL7017	Soft Computing laboratory	--	2	--	1	--	25	25	--	--	-	--	--	25	1	
4 @	DJS22MEC7021	Digital Manufacturing	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**3**
	DJS22MEC7022	Automotive Materials and Manufacturing															
	DJS22MEC7023	Design for X															
	DJS22MEC7024	Renewable Energy Systems															
	DJS22MEC7025	Startup Registration and Development															
	DJS22MEC7026	Big Data Analytics															
5#	DJS22ILO7011	Product Life Cycle Management	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**3**
	DJS22ILO7012	Management Information System															
	DJS22ILO7013	Operations Research															
	DJS22ILO7014	Cyber Security and Laws															
	DJS22ILO7015	Personal Finance Management															
	DJS22ILO7016	Energy Audit and Management															
	DJS22ILO7017	Disaster Management and Mitigation Measures															
	DJS22ILO7018	Science of Well-being															
	DJS22ILO7019	Research Methodology															
	DJS22ILO7020	Public Systems and Policies															
6	DJS22MEP704	Project Stage I	-	4	--	2	--	50	50	--	--	-	50	50	100	2	**2**
		Total	**15**	**10**	**0**	**20**	**175**	**125**	**300**	**325**	**50**	**0**	**50**	**425**	**725**	**20**	

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

Prepared by Checked by Head of the Department Principal

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

Sr. No.	Course Code	Courses	Teaching Scheme (hrs.)				Continuous Assessment (A) (Marks)			Semester End Assesment (B) (Marks)					(A+B)	Total Credits	
			Th	P	T	Credits	Th	T/W	Total CA (A)	Th / Cb	O	P	O & P	Total SEA (B)			
1	DJS22MEC801	Industrial Engineering and Management	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**3**
2 @	DJS22MEC8011	Automation and IoT	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL8011	Automation and IoT Laboratory	--	2	--	1	--	25	25	--	25	-	--	25	50	1	
	DJS22MEC8012	Motorsports Engineering	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL8012	Motorsports Engineering Laboratory	--	2	--	1	--	25	25	--	25	-	--	25	50	1	
	DJS22MEC8013	Process Equipment Design	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL8013	Process Equipment Design Laboratory	--	2	--	1	--	25	25	--	25	-	--	25	50	1	
	DJS22MEC8014	Air Handling Unit	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL8014	Air Handling Unit Laboratory	--	2	--	1	--	25	25	--	25	-	--	25	50	1	
	DJS22MEC8015	Startup Sustainability	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL8015	Startup Sustainability Laboratory	--	2	--	1	--	25	25	--	25	-	--	25	50	1	
	DJS22MEC8016	Business Analytics	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**4**
	DJS22MEL8016	Business Analytics Laboratory	--	2	--	1	--	25	25	--	25	-	--	25	50	1	
3 @	DJS22MEC8021	Sustainable manufacturing	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**3**
	DJS22MEC8022	Hydrogen Powered Vehicles															
	DJS22MEC8023	Energy Audit and Management															
	DJS22MEC8024	Startup Scalability															
	DJS22MEC8025	Digital Twin															
4#	DJS22ILO8021	Project Management	3	--	--	3	35	--	35	65	--	-	--	65	100	3	**3**
	DJS22ILO8022	Entrepreneurship Development and Management															
	DJS22ILO8023	Corporate Social Responsibility															
	DJS22ILO8024	Human Resource Management															
	DJS22ILO8025	Corporate Finance Management															
	DJS22ILO8026	Logistic and Supply Chain Management															
	DJS22ILO8027	IPR and Patenting															
	DJS22ILO8028	Digital Marketing Management															
	DJS22ILO8029	Environmental Management															
	DJS22ILO8030	Labour and Corporate Law															
5	DJSMEP802	Project Stage II	-	12	--	6	--	100	100	--	--	-	100	100	200	6	**6**
		Total	**12**	**14**	**0**	**19**	**140**	**125**	**265**	**260**	**25**	**0**	**100**	**385**	**650**	**19**	

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

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Continuous Assessment (A):

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

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

Semester End Assessment (B):

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

Prepared by Checked by Head of the Department Principal

Program: Mechanical Engineering	Final Year B. Tech	Semester: VII
Course: Design of Mechanical Systems (DJS22MEC701)		
Course: Design of Mechanical Systems Laboratory (DJS22MEL701)		

Pre-requisites:
Knowledge of Material Technology, Mechanics of Materials and Design of Machine Elements.

Objectives:

1. To acquaint with functional and strength design principles of important machine elements used in mechanical systems.
2. To study the detailed design procedure of the different types of machine elements used in mechanical systems.
3. To familiarize selection of standard elements such as rolling contact bearings.
4. To study system design of various systems such as Gearbox, snatch block, belt conveyors and pumps.

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

1. Design gears based on the given conditions and develop multispeed gearboxes for a specified machine tool application.
2. Select bearings for a given application.
3. Design hoisting mechanism of an Electric overhead traveling crane.
4. Design belt conveyor systems.
5. Design pumps for a given application.

Design of Mechanical Systems (DJS22MEC701)		
Unit	**Description**	**Duration**
1	**Design of Gears** Design of spur, helical, bevel and worm gears with strength, wear and thermal considerations.	**10**
2	**Rolling Contact Bearings** Types of bearing, designation, selection of rolling contact bearings based on constant / variable load (includes deep groove ball bearing, cylindrical roller, spherical roller, taper roller, self-aligning bearing and thrust bearing). **Sliding Contact Bearings:** Design of hydro dynamically lubricated bearings (self-contained), Introduction to hydrostatic bearings, Types and selection of Mechanical seals	**9**
3	**Introduction to Mechanical System Design** **Design of Gear Box:** Design of gear box (multi speed) for machine tool applications (Maximum two stages and nine speeds) Determination of variable speed range, Graphical representation of speeds, Structure diagram, Ray diagram, Selection of optimum ray diagram, Estimation of numbers of teeth on gears (Excluding Deviation diagram, Layout of gear box).	**4**
4	**Design of Hoisting mechanism:** Introduction to material handling system, Design of EOT crane system: Snatch Block assembly, Selection of wire rope, Design and selection of sheave pulley, axle	**7**

	and bearings, Design of nut, Selection of thrust bearing, Design of cross-piece with trunnion, Design of shackle plate, Design of rope drum, drum shaft and bearing, Selection of motor. (Excluding Selection of hook).	
5	**Design of Belt Conveyors:** Design of belt conveyor system for specified material and capacity: Selection of belt, Selection of motor, Design of drive pulley assembly, Design of driven pulley assembly, Design of over running idler assembly, Design of under running idler assembly.	**5**
6	**Design of Gear Pump:** Introduction of Gear pump, Design of gear pump for specified discharge and speed etc., Selection of motor, Design of gear, Selection of bearing, Design of bolts, Design of suction and delivery pipe.	**4**
	Total	**39**

Design of Mechanical Systems Laboratory (DJS22MEL701)	
Sr. No.	**Experiment Title**
A	**Design and detailed assembly drawing (computer aided drawing on A3 size sheets) of minimum two design problems, from the following:**
	1.Design of hoisting mechanisms
	2.Design of belt conveyors
	3.Design of pumps
B	**Exercises on following topics in the form of design calculations with sketches and / or drawings.**
	1. Design of Gears
	2. Rolling contact bearings/ Sliding contact bearing
	3.Design of gearbox
C	**Course Project**
	Students in a group (2 to 4 students) 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.

Books Recommended:

Textbooks:

- Richard G. Budynas and J. Keith Nisbett, Shigley's Mechanical Engineering Design, McGraw-Hill Education, New York, 2024.
- V. B. Bhandari, Design of Machine Elements, McGraw-Hill Education, New Delhi, 2021.
- S. P. Patil, Mechanical System Design, Jaico Publishing House, Mumbai, 2004.
- B. Sharma and H. Purohit, Design of Machine Elements, Prentice Hall India, New Delhi, 2008.
- Robert L. Norton, Machine Design - An Integrated Approach, Pearson Education, Upper Saddle River, NJ, 2006.
- J.E. Shigley, Mechanical Engineering Design, McGraw Hill, New York, 2009.

Reference Books:

- S. K. Basu and D. K. Pal, Design of Machine Tools, CBS Publishers & Distributors, New Delhi,

2018.

- N. K. Mehta, Machine Tool Design, McGraw-Hill Education, New Delhi, 2012.
- PSG College of Technology, Design Data: Data Book of Engineers, Kalaikathir Achchagam, Coimbatore, 2023.
- S. S. Khandare and A. V. Kale, Design of Engine Parts, Charotar Publishing House, Anand, 2008.
- Pandya & Shah, Machine Design, Charotar Publishing, Anand, 2020.
- Reshetov, Machine Design, Mir Publication, Moscow, 2019.
- Black & Adams, Machine Design, McGraw Hill, New York, 2021.
- Mahadevan, Design Data Book,CBS Publishers & Distributors Pvt Ltd,2013

Program: Mechanical Engineering	Final Year B. Tech	Semester: VII
Course: Production Planning and Control (DJS22MEC702)		
Course: Production Planning and Control Laboratory (DJS22MEL702)		

Pre-requisites: Nil

Objectives:

1. To provide an exposure to Production Planning & Control (PPC) and its significance in Manufacturing Industries.
2. To give insight into the ongoing & futuristic trends in the Material Management and Inventory Control.
3. To appraise about need and benefits of planning functions related to products and the processes.
4. To give exposure to production scheduling and sequencing to optimize the resources.
5. To give exposure to latest trend in PPC.

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

1. Illustrate production-planning functions and manage manufacturing functions in a better way.
2. Forecast the demand of the product and prepare an aggregate plan.
3. Develop the skills of Material Planning, Inventory Management Model and Control.
4. Develop the competency in scheduling and sequencing of manufacturing operations.
5. Understand the significance of implementation of ERP.

Production Planning and Control (DJS22MEC702)		
Unit	**Description**	**Duration**
1	**Manufacturing systems -** Components and types, Transformation from Industry 1.0 to Industry 4.0. Manufacturing Systems- projects & jobbing products, batch, mass / flow production, continuous / process production, Introduction to JIT, Lean Production, FMS, Agile Manufacturing, etc. PPC – Need and functions of PPC, relationship of PPC with other departments. Factors influencing PPC in the organization, Organization of PPC- status of PPC department, internal structure, degree of centralization, PPC as an integrated approach. Prerequisites of PPC - data pertaining to design, equipment, raw materials, tooling, performance standards, labor & operating systems. Order preparation- works order preparation for various manufacturing methods, subsidiary orders, shop or production orders, inspection orders and stores issue orders, etc.	8
2	**Forecasting, Aggregate planning, Capacity planning** Forecasting for operations- requirements for forecasting, importance of forecasting, basic categories of forecasting methods, qualitative methods, quantitative methods, accuracy and control of forecasts. Aggregate planning: Concept of aggregate planning, decision rules, strategies and methods.	6

	Capacity Planning: Measurement of capacity, Measures of capacity, Factors influencing effective capacity, short range, medium range and long-range capacity planning, rough cut capacity planning.	
3	**Material Planning** Role of Materials Management- materials and profitability, Purchase functions, Procurement procedures including bid systems, Vendor selection and development, Vendor rating, ethics in purchasing. Roles and responsibilities of purchase professionals. Concepts of lead-time, purchase requisition, purchase order, amendments, forms used and records maintained.	5
4	**Independent Demand Inventory Models -** The nature and importance of inventories, requirements for effective inventory management, types of inventory models, Deterministic models, Quantity discount models, re-order point, concept of safety stock, Dynamic Models, Probabilistic models. **Dependent Demand Inventory models–MRP:** An overview of material requirements planning, MRP inputs, MRP outputs MRP processing, MRP in service, benefits, requirement of MRP and MRP II systems.	8
5	**Job Shop Scheduling and Project Scheduling** Introduction to Job Sequencing, Objectives, Sequencing Problems, Solution to Sequencing Problem, processing of n Jobs on 1 machine, Johnson's Rule for optimal sequence of processing n jobs on 2 machines (n/2 problem), processing of n Jobs on 3 Machines (n/3 problem) and processing of 2 Jobs on m Machine (2/m) problem. Inputs for scheduling, loading and scheduling devices, factors influencing scheduling, scheduling techniques, use of Gantt Charts and basic scheduling problems. Concepts of project planning, monitoring and control, Project scheduling by using elements of network analysis –PERT and CPM, cost analysis and crashing, resource leveling.	7
6	**Enterprise Resource Planning (ERP)** ERP Introduction, Benefits, Origin, Evolution and Structure, Conceptual Model of ERP, the Evolution of ERP, the Structure of ERP. ERP- Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications. ERP Implementation Basics, ERP Implementation Life Cycle, ERP & E-Commerce, Future Directives- in ERP, ERP and Internet, Critical success and failure factors, Integrating ERP into organizational culture.	5
	Total	**39**

List of Assignments:

1. Assignment on Manufacturing System and Importance of PPC department.
2. Assignment on Forecasting Techniques and Capacity Management.
3. Assignment on Material Management and Scientific Inventory Control.
4. Assignment on Job Shop and Project scheduling.
5. Assignment on structure, modules and implementation of an ERP.

Production Planning and Control Laboratory (DJS22MEL702)

Lab Work:

1. Case-study presentation on Manufacturing System and Importance of PPC department.
2. Case-study presentation on Forecasting Techniques and Capacity Management.
3. Case-study presentation on Material Management and Scientific Inventory Control.
4. Case-study presentation on Job Shop and Project scheduling.
5. Case-study presentation on structure, modules and implementation of an ERP.

Books Recommended:

Text books:

- L. C. Jhamb, Production Planning and Control, Everest Publishing House, 2016.
- L. C. Jhamb, Inventory Management, Everest Publishing House, 2013.
- D. S. Hira and P. K. Gupta, Problems in Operations Research (Principles and Solutions), S Chand Publications, 2010.
- Rahul V. Altekar, Enterprise-wide Resource Planning: Theory and Practice, PHI Publication, 2004.

Reference Books:

- Samuel Eilon, Elements of Production Planning and Control, Universal Publishing Corporation, 2015.
- W. Bolton, Production Planning and Control, Pearson Education Limited, 1994.
- James L. Riggs, Production Systems - Planning, Analysis & Control, John Wiley & Sons, 2018.
- Thomas E. Vollman, William L. Berry & Others, Manufacturing Planning and Control Systems, Galgotia Publishers, 1984.
- Anand Bewoor, Manufacturing Process Planning and Systems Engineering, Dreamtech Press, 2019.
- S. N. Chary, Production and Operations Management, TMH Publishing Company, 2019.

Program: Mechanical Engineering	Final Year B. Tech	Semester: VII
Course: Flexible Manufacturing System (DJS22MEC7011)		
Course: Flexible Manufacturing System Laboratory (DJS22MEL7011)		

Pre-requisites: Nil

Objectives:

1. To introduce the basic concepts of flexible manufacturing system(FMS) like material handling, loading, scheduling, storage etc.
2. Developing skills to design and optimize manufacturing cells.
3. Incorporate advanced tools like Petri nets enabling students for modeling manufacturing processes, enhancing system analysis and decision-making.

Outcomes:

1. Students will have a solid foundation in the evolution, principles, and economic justification of FMS, along with the role of CIM (Computer Integrated Manufacturing) in enhancing flexibility. Also will be able to distinguish between job shop, batch production, and mass production systems
2. Students will be able to design efficient workstations, integrate automated systems like AGVS and ASRS, and manage storage and work-in-progress inventories in FMS.
3. Students will be able to form part families, apply part classification systems, design machine cells, and use clustering algorithms to enhance manufacturing efficiency.
4. Students will be capable of applying algorithms to assess FMS flexibility and determine the necessary resources to support manufacturing cells.
5. Students will learn how to use Petri nets to model and analyze complex manufacturing systems, improving production planning, system coordination, and resource utilization.

Flexible Manufacturing System (DJS22MEC7011)		
Unit	**Description**	**Duration**
1	**1.1 Introduction –** FMS evolution, need for flexibility, economic justification of FMS, role of CIM in FMS, case studies. **1.2 Production systems in FMS** - Types of Production-Job Shop, Batch and Mass production; Organization and information processing in manufacturing - Plant layout - Batch production – Work in progress inventory.	09
2	**FMS components** - Workstations, Computer control system (data file, reports, hardware and software development), types of automated guided vehicle system (AGVS)and automated storage retrieval system (ASRS), carousel storage system, WIP storage, analysis of AGV and AS/RS systems.	09
3	**Cellular manufacturing** - Formation of part families, Part classification, Coding system optiz, Machine cells design, clustering methods, modern algorithms, benefits of GT, system planning, cell characteristic - system definition and sizing, human resources and its objective, staffing, supervisor role.	09
4	**Evaluation of FMS –** Algorithms for cell evaluations, measure of flexibility.	04

5	**Production control in FMS –** scheduling in FMS, line balancing in FMS and inventory control in FMS. Applications of Petri net methodology to manufacturing systems.	08
	Total	**39**

Flexible Manufacturing System Laboratory (DJS22MEL7011)	
Sr. No.	**Experiment Title**
1	Determine the components and configuration of the FMS to simulate machines, robots, conveyors, automated Guided Vehicles (AGVs), and storage.
2	Define various inputs to be given to FMS system - product types, production rates, machine setup times, processing times.
3	Simulation on software (Arena, Simul8, FlexSim) , create a digital model of the flexible manufacturing system and set up various operational parameters.
4	Analyze system performance measures with given production schedules.
5	Optimize the material handling system by testing different transport methods (e.g., conveyor vs. AGVs), using simulation software
6	Implement scheduling algorithms such as First-Come-First-Served (FCFS), Shortest Job First (SJF), or Priority Scheduling in a simulated FMS setup.
7	Use Value Stream Mapping (VSM) to identify and eliminate waste in the FMS setup.

Books Recommended:

References Books

1. B. S. Nagendra Parashar, Cellular Manufacturing System –An integrated approach, PHI learning private ltd, 2009.
2. Mikell Groover., Automation Production Systems &Computer Integrated manufacturing, PHI, 4th edition, 2016.
3. H. K. Shivananda, "Flexible manufacturing Systems", Dhanpat Rai publications, New Delhi, 2006.
4. N. K. Jha, Handbook of Flexible manufacturing system, Academic press Inc., 1991.
5. William W. Luggen., Flexible Manufacturing Cells and Systems, Prentice Hall, NJ, 1991.

Program: Mechanical Engineering	Final Year B.Tech	Semester: VII
Course: Design of Automotive Systems (DJS22MEC7012)		
Course: Design of Automotive Systems Laboratory (DJS22MEL7012)		

Pre-requisites:

1. Engineering mechanics; Machine design; Material science; Thermodynamics
2. Fundamentals of electronics, and electrical engineering.

Objectives:

1. To impart fundamental knowledge of automotive system design, including material selection and optimization techniques.
2. To develop competency in designing critical engine components such as cylinders, pistons, crankshafts, and valve mechanisms.
3. To enable students to design and analyze power transmission components, including clutches, gearboxes, and driveline systems.
4. To familiarize students with braking and suspension system design, including performance considerations and material selection.
5. To introduce modern automotive technologies such as ABS, ESC, CVTs, and advanced driveline configurations for improved vehicle performance.

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

1. Demonstrate an understanding of the fundamental principles of automotive system design and component optimization.
2. Apply engineering principles to design and analyze key engine and power transmission components.
3. Develop clutch and transmission system designs based on torque transmission requirements and material properties.
4. Design braking and suspension systems, considering safety, performance, and material constraints.
5. Evaluate driveline components, including propeller shafts, differentials, and axle designs, for various vehicle configurations.
6. Analyze and propose improvements for vehicle systems using modern automotive technologies, enhancing efficiency and performance.

Design of Automotive Systems (DJS22MEC7012)		
Unit	**Description**	**Duration**
1	**Design of Engine Components** • Engine Design (Petrol and Diesel): Design of cylinder, Design of piston with pin and rings, Design of connecting rod, Design of crank shaft with bearings • Valve mechanism design: push-rods, valves, valve springs, tappets, and rocker arms (theory only).	**7**
2	**Design of Clutches** • Selection criteria, torque transmission capacity, and lining materials. • Design requirements of friction clutches. • Design of single plate, and multi-plate clutches.	**6**

3	**Design of Transmissions System** • Design considerations and material selection. • Types of gearboxes: sliding mesh, constant mesh, synchromesh, and epicyclic gearboxes. • Design of synchromesh gearbox.	**6**
4	**Design of Powertrain** • Powertrain types, Design approaches for IC engine based vehicles and EVs. Layouts of electric and hybrid electric powertrains and their design approaches and considerations. • Design of Propeller shaft design for bending, torsion, and rigidity. • Universal joints, slip joints, and differential design.	**6**
5	**Braking Systems** • Design of internal expanding shoe brakes and disc brakes. • Braking force calculation and thermal considerations. • Materials for Brake Lining.	**7**
6	**Suspension Systems** • General design considerations of suspension systems. • Design of MacPherson strut suspension system. • Air (pneumatic) and hydro-elastic suspension systems (theory).	**7**
	Total	**39**

Design of Automotive Systems Laboratory (DJS22MEL7012)	
Sr. No.	**Experiment Title**
	Study-Type/ Case-Study-based Experiments (Theoretical and Conceptual Learning)
1	Study the design and materials of various engine components (cylinder, piston, crankshaft) from different vehicle models.
2	Compare the working principles, advantages, and disadvantages of different transmission systems (manual, automatic, CVT).
3	Research and present a report on the evolution of braking systems, including ABS and ESC technologies.
4	Study the design and characteristics of different suspension systems (leaf spring, coil spring, air suspension) in various vehicles.
	Numerical Analysis/ Simulation-based Experiments (Python/ MATLAB/ Simulink, etc.)
5	Simulate the performance of an IC engine under varying loads and speeds using software.
6	Simulate the effect of different gear ratios on vehicle acceleration and fuel economy.
7	Simulate the torque distribution in an AWD system under different road conditions.
8	Simulate the dynamic behavior of a suspension system over rough terrain using MATLAB or ADAMS.
	Design-Based Experiments
9	Design a braking system for a passenger car
10	Design transmission system for a two-wheeler
11	Design a suspension system for a bus.
12	Design a clutch system for a heavy duty trucks.
	Performance-Based Experiments (Hands-on and Simulation Tools)
13	Performance evaluation of a single-plate clutch system.

14	Braking performance and thermal response analysis.
15	Propeller shaft torsional and bending rigidity test.
16	Suspension system response and ride comfort testing (MacPherson Strut).

A minimum of eight experiments from the above-suggested list (02 from each group) or any other experiment based on the syllabus will be included, which would help the learner to apply the concept.

Books Recommended:

Textbooks:

- Kirpal Singh, Automobile Engineering Volume 1, Standard, 2000.
- R. K. Rajput, A Text Book of Automobile Engineering, Laxmi Publication, 2008.
- V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill, 2010.
- Tom Denton, Automobile Mechanical and Electrical Systems, CRC Press, 2017.
- G. K. Awari, V. S. Kumbhar, R. B. Tirpude, Automotive Systems: Principles and Practices, CRC Press, 2021.
- Günther Prokop, Hermann Winner, and Markus Maurer, Automotive Systems Engineering II, Springer International Publishing, 2017.
- Kirpal Singh, Automobile Engineering Volume 2, Standard, 1993.

Reference Books:

- Design Data Book by P.S.G. College of Technology, Coimbatore, 2022.
- S. S. Khandare and A. V. Kale, Design Data Book – Design of Engine Parts, 2018.
- Tom Denton, Advanced Automotive Fault Diagnosis, Taylor & Francis, 2006.
- Tom Denton, Automobile Electrical and Electronic Systems, CRC Press, 2017.
- Hermann Winner, and Markus Maurer, Automotive Systems Engineering, Springer Berlin Heidelberg, 2013.
- Mark van den Brand, Yanja Dajsuren, Automotive Systems and Software Engineering: State of the Art and Future Trends, Springer International Publishing, 2019.
- Harald Naunheimer, Bernd Bertsche, Joachim Ryborz, Peter Fietkau and Wolfgang Novak, Automotive Transmissions Fundamentals, Selection, Design and Application, Springer Berlin Heidelberg, 2010.
- John C. Dixon, Suspension Geometry and Computation, Wiley, 2009.
- Julian Happian-Smith, An Introduction to Modern Vehicle Design, Elsevier Science & Technology Books, 2001.

Web References:

- Fundamentals of Automotive Systems (https://nptel.ac.in/courses/107106088).
- Ergonomics In Automotive Design (https://nptel.ac.in/courses/107103084).

Program: Mechanical Engineering	Final Year B.Tech	Semester: VII
Course: Piping Engineering (DJS22MEC7013)		
Course: Piping Engineering Laboratory (DJS22MEL7013)		

Pre-requisites:

1. Fundamentals of mechanical elements

Objectives:

1. To study components, materials and standards of piping systems
2. To study piping layout and drawings
3. To study basic loading conditions and failure nodes.
4. To study compliance and regulatory requirements for piping systems.

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

1. Discuss needs and requirements of a piping system.
2. Design and analyze piping parts and its layout.
3. Analyze the piping materials, codes, stress- strain and their flexibility.
4. Select and analyze a pipe network for specified application.
5. Calculate pressure drop in piping system using fluid mechanics fundamentals.

Piping Engineering (DJS22MEC7013)		
Unit	**Description**	**Duration**
1	**Introduction of Piping systems and Components:** Importance of piping engineering in Industrial application. Types of pipes and their systems, fittings, flanges, valves, their types and their selection with sizes. Expansion of joints and flexible connectors. Pipe supports, types, selection and design.	10
2	**Piping materials:** Material selection, including metals, plastics and composites. Material properties and characteristics. Material specifications and material data sheets. Material testing and quality assurance. Materials of piping required for transportation of gas like H2.	06
3	**Piping design:** Piping codes and standards. Piping layout and routing principles, Isometric drawings, piping drawings & graphics and Piping design for different plants. Software used for Piping and Instrumentation diagram (P&IDs). Maintain P&ID symbols and legends. Geotagging and aligning diagrams. Design of basic piping parts. Basic formulae. Pipe sizing methods. Pressure drop based pipe sizing. Piping design for transportation of gas like H2. Use of Generative technology in Piping design.	13
4	**Piping stress analysis:** Basic stress and strain in piping systems. Piping Flexibility Analysis. Concepts of flexibility analysis with software usage. Introduction on CAESAR II and Autopipe software.	07

5	**Piping Code compliance and regulatory requirements:** Compliance with piping codes and standards. Regulatory requirements. Inspection and testing procedures.	03
	Total	**39**

Piping Engineering Laboratory (DJS22MEL7013)	
Sr. No.	**Experiment Title**
	Study-Type/ Case-Study-based Experiments (Theoretical and Conceptual Learning)
1	Analysis of stress induced in piping systems using software like CAESAR II.
2	Analyze vibrations in piping systems to identify potential problems and ensure safe operation.
3	Simulation of the thermal expansion and contraction of pipes to assess their behavior under temperature variations.
4	Simulation of pressure test and leak test of piping systems.
5	Case study on safety training required in piping systems.
6	Simulation of different flow conditions in piping systems.
7	Calculation head loss due to friction, velocity or pressure drop using the Darcy-Weisbach equation.
8	Calculation of the required pipe size and flow velocity based on flow rate and fluid properties in piping system.
9	Designing piping layouts using software like AutoCAD.

Recommended books:

1. M.W. Kellogg Co. Design of Piping Systems. Wiley, 1961.
2. Silowash, Brian. Piping Systems Manual. McGraw Hill Professional, 2009.
3. Peng, Liang-Chuan and Tsen-Loong Peng. Pipe Stress Engineering. ASME press, 2009.
4. Menon, Shashi. Piping calculations manual. McGraw Hill Professional, 2004.
5. Wilson, B. Detail Engineering and Layout of piping systems, 2011.

Program: Mechanical Engineering	Final Year B.Tech	Semester: VII
Course: Bionics Engineering (DJS22MEC7014)		
Course: Bionics Engineering Laboratory (DJS22MEL7014)		

Pre-requisites:

1. Fundamentals of Mechanical Engineering.
2. Fundamentals of Design, Manufacturing, Assembly.

Objectives:

1. To introduce the fundamentals of bionics and biomimetics in engineering applications.
2. To develop an understanding of bio-inspired design methodologies and their practical applications.
3. To explore the mechanical properties of biological materials and their relevance to engineering.
4. To examine biomimetic manufacturing techniques for sustainable and efficient production.
5. To investigate bio-inspired locomotion and robotic systems for engineering applications.
6. To analyze real-world applications of bionics in aerospace, automotive, biomedical, and renewable energy sectors.

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

1. Explain the core principles of biomimetics and how biological systems inspire engineering solutions
2. Apply biomimetic design methodologies to develop innovative mechanical systems.
3. Analyze the mechanical properties of biological materials and their applications in engineering.
4. Evaluate biomimetic manufacturing techniques, including 3D printing and self-assembly methods.
5. Develop bio-inspired robotic mechanisms by applying principles of natural locomotion and Assess the impact of bionic innovations in aerospace, automotive, biomedical, and renewable energy fields.

Bionics Engineering (DJS22MEC7014)		
Unit	**Description**	**Duration**
1	**Introduction to Bionics & Biomimetic** • Definition, scope, and importance of bionics in engineering • Historical background and key advancements • Nature-inspired design principles • Biological systems as models for engineering solutions	**6**
2	**Fundamentals of Bio-Inspired Design** • Fundamentals of Bio-Inspired Design • Biomimetic design methodology • Case studies in bio-inspired mechanical systems • Structural and functional adaptations in nature • Computational approaches in bio-inspired design	**10**
3	**Materials & Mechanics in Bionics** • Biological materials and their mechanical properties • Smart materials inspired by nature (e.g., self-healing, shape memory) • Nanomaterials and their bio-inspired applications • Soft robotics and bio-inspired actuation	**6**

4	**Biomimetic Manufacturing & Fabrication Techniques** • Bio-inspired 3D printing and additive manufacturing • Nano- and micro-fabrication techniques • Self-assembly and biofabrication • Sustainable and green manufacturing approaches inspired by nature	**7**
5	**Bio-Inspired Motion & Robotics** • Locomotion principles in biological systems • Bio-inspired robotic mechanisms (e.g., insect-inspired robots, snake robots) • Fluid dynamics in natural locomotion (e.g., fish, birds) • Energy-efficient motion strategies from nature **Applications of Bionics in Engineering** • Aerospace: Bio-inspired wings, drag reduction techniques • Automotive: Nature-inspired aerodynamics and materials • Biomedical: Prosthetics, exoskeletons, and tissue engineering • Renewable Energy: Bio-inspired energy harvesting (solar panels, wind turbines)	**10**
	Total	**39**

Bionics Engineering Laboratory (DJS22MEL7014)	
Sr. No.	**Experiment Title**
	Study-Type/ Case-Study-based Experiments (Theoretical and Conceptual Learning)
1	Biomimetic Surface Experiment (Lotus Effect & Shark Skin)
2	Bio-Inspired Structural Strength (Honeycomb vs. Conventional Structures)
3	Bio-Inspired Aerodynamics (Kingfisher Beak & Bullet Train Nose)
4	Soft Robotics & Bio-Inspired Actuation (Octopus-Inspired Grippers)
5	Biomimetic Energy Harvesting (Butterfly Wing-Inspired Solar Panels)
6	Locomotion Analysis in Bio-Inspired Robotics (Snake vs. Quadruped Robots)
7	Biomimetic Cooling System (Termite Mound-Inspired Ventilation)
8	Bio-Adhesion Study (Gecko Feet-Inspired Dry Adhesives)
9	Case Study Presentation on Biomimetic Innovations

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

Books Recommended:

Textbooks:

- Yoseph Bar-Cohen, Biomimetics: Nature-Based Innovation, CRC Press, 2011.
- Wole Soboyejo and Leo Daniel, Bioinspired Structures and Design: Butterfly Wings, Lotus Leaves, and Other Natural Wonders, Cambridge University Press, 2018.
- Janine M. Benyus, Biomimicry: Innovation Inspired by Nature, Harper Perennial, 2002.
- Junzhi Yu, Bioinspired Robotics: Mechanisms and Control, Elsevier, 2022.
- Nathan F. Lepora, Anna Mura, and Tony J. Prescott (Eds.), Biomimetic and Biohybrid Systems, Springer, 2013.

Reference Books:

- Alicia Kim, Bioinspired Engineering, Wiley, 2021.

- Chad S. Korach, Mechanics of Biological Systems and Materials, Springer, 2015.
- Lígia Rodrigues and Manuela E. Gomes (Eds.), Bioinspired Materials for Medical Applications, Woodhead Publishing, 2017.
- Xin-She Yang, Nature-Inspired Optimization Algorithms, Elsevier, 2014.

Web References:

- Introduction to Biomimicry (https://onlinecourses.nptel.ac.in/noc22_ge24/preview)
- Wyss Institute for Biologically Inspired Engineering – Harvard University (https://wyss.harvard.edu)
- Journal of Bionic Engineering – Springer (https://www.springer.com/journal/42235)
- Biomimicry Institute (https://biomimicry.org)
- Biological Inspired Design – Georgia Tech (https://bid.isye.gatech.edu)
- MIT Biomimetics Robotics Lab (http://biomimetics.mit.edu)

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Program: Mechanical Engineering	Final Year B.Tech	Semester: VII
Course: Computational Fluid Dynamics (DJS22MEC7015)		
Course: Computational Fluid Dynamics Laboratory (DJS22MEL7015)		

Pre-requisites:

1. Fundamentals of Engineering Mechanics and Applied Mathematics
2. Fundamentals of Fluid Mechanics and Heat Transfer.

Objectives:

1. To understand the basics of CFD and its working methodology
2. To gain knowledge about the governing equations applicable for CFD problems
3. To study various concepts related to Turbulence
4. To understand the working of Finite Difference method and its application to CFD problems.
5. To evaluate and solve problems of conduction, convection and diffusion in 1D using Finite Volume Method
6. To explore the various boundary conditions and solution algorithms.

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

1. Understand the concept and Methodology working of CFD.
2. Understand the governing equations applicable in CFD problems.
3. Recognize the application of turbulence model for various CFD Problems
4. Analyse and solve 1D problems of Conduction, Convection and diffusion using Finite Volume Method
5. Explain the various boundary conditions.
6. Explain the various solution algorithms

Computational Fluid Dynamics (DJS22MEC7015)		
Unit	**Description**	**Duration**
1	**Introduction to CFD** What is CFD, Scope and Application of CFD, Methods of Predictions like Experimental and theoretical, Working of Commercial CFD Software's, Solution methodology: Pre-processing, Solver, Post processing, Types of Grids and their application.	4
2	**Mathematical description of Physical Phenomenon** Governing Differential Equations, Meaning of Differential equation, The Continuity Equation, Momentum equation, Energy Equation, General Differential Equation.	6
3	**Turbulence Modelling and Finite Difference Method** Introduction to Turbulence Modelling, Turbulence Models, The Time-Averaged Equation for Turbulent Flow.	6
4	**Finite Volume Method applied to Heat Conduction, Convection and Diffusion** Steady One-dimensional Conduction, Convection, Diffusion, Unsteady One-dimensional Conduction, Introduction to two and three-dimensional Situations.	13
5	**Boundary Conditions** Types of Boundary Conditions and their applications, Initial and Boundary Conditions, Initial and Boundary Value problems.	4
6	**Solution Algorithms for Pressure Velocity Coupling** Staggered Grid, SIMPLE Algorithm, SIMPLEC Algorithm.	6
	Total	**39**

Computational Fluid Dynamics Laboratory (DJS22MEL7015)	
Sr. No.	**Experiment Title**
	Simulations using ANSYS Workbench
1	Introduction to Ansys Spaceclaim, Meshing and Fluent
2	Mixing elbow for fluid under steady incompressible conditions
3	Double Pipe Counterflow Heat Exchanger
4	Wind Pipe
	Python Programming
1	Introduction to Grid Generation. Solving algebraic equations
2	Solution to 1 D Steady Conduction
	Mini Project

A minimum of five experiments from the above-suggested list and a Mini Project would help the learner to apply the concept.

Books Recommended:

Textbooks:

- H. K. Versteeg, W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson, England, 2007.

Reference Books:

- D. A. Anderson, I. I. Tannehill, and R. H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Hemishphere Publishing Corporation, New York, USA, 1984.
- P. Niyogi, M. K. Laha, S. K. Chakrabarty, Introduction to Computational Fluid Dynamics, Pearson Education, India, 2006.
- K. Muralidhar, and T. Sundararajan, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 2003.
- P. S. Ghoshdasdidar, Computer Simulation of Flow and Heat Transfer, Tata McGraw-Hill Publishing Company Ltd, 2017.

Prepared by Checked by Head of the Department Principal

Program: Mechanical Engineering	Final Year B. Tech.	Semester: VII
Course: Business Model Design (DJS22MEC7016)		
Course: Business Model Design Laboratory (DJS22MEL7016)		

Pre-requisite: Nil

Objectives:

1. Understanding business model frameworks.
2. Analyse value creation strategies.
3. Assess revenue and cost structures.
4. Evaluate customer segmentation and market fit.
5. Integrate innovation into business models.

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

1. Illustrate the components of a business model.
2. Analyse market needs and develop value propositions.
3. Evaluate cost and revenue structures for financial sustainability.
4. Assess customer segmentation strategies for market alignment.
5. Apply innovation-driven strategies to enhance business models.

Business Model Design (DJS22MEC7016)		
Unit	**Description**	**Duration**
1	**Introduction to Business Models** Definition and Importance Components of a Business Model Case Studies on Successful Business Models	**8**
2	**Value Creation and Market Positioning** Identifying Customer Needs Competitive Advantage and Differentiation Market Research and Business Fit	**8**
3	**Revenue and Cost Considerations** Revenue Models and Pricing Strategies Cost Structure and Financial Sustainability Key Financial Metrics	**6**
4	**Customer Segmentation and Market Alignment** Identifying Target Segments Business Model Adaptation for Different Markets Consumer Behavior and Decision MakingCollaborative Business Models	**6**
5	**Business Model Development** Developing and Structuring Business Models Leveraging Technology in Business Models Business Model Evolution in Emerging Industries Digital Transformation Strategies	**6**
6	**Business Model Validation** Business Model Testing and Refinement	**5**

	Risk Assessment and Contingency Planning Final Business Model Development and Evaluation	
	Total	**39**

Business Model Design Laboratory (DJS22MEL7016)

Sr. No.	Exercise	Detailed Description
1	Business Model Analysis	Study and evaluate business models of successful companies using real-world case studies. Identify key components such as value proposition, revenue streams, and customer segments.
2	Customer Value Proposition Mapping	Develop customer value propositions for a selected business idea. Define key benefits offered to customers and create differentiation strategies.
3	Business Model Canvas Development	Construct a Business Model Canvas for a proposed startup, detailing key partners, activities, customer relationships, cost structure, and revenue models.
4	Revenue and Cost Structure Analysis	Identify and analyze various revenue streams and cost drivers for a given business idea. Assess financial sustainability and explore monetization strategies.
5	Market Opportunity Identification	Conduct primary and secondary market research to validate business ideas. Identify customer needs, potential market size, and growth opportunities.
6	Competitive Analysis and Positioning	Assess competition in a given industry. Identify direct and indirect competitors, analyze market positioning, and develop differentiation strategies.
7	Business Model Testing and Validation	Apply structured testing frameworks (e.g., Lean Startup methodology) to refine business assumptions. Conduct customer interviews and prototype testing.
8	Scalability and Sustainability Assessment	Evaluate the long-term scalability and sustainability of a business model. Assess factors such as resource allocation, market expansion potential, and financial growth.
9	Innovative Business Model Design	Design a business model for an emerging industry or disruptive technology. Develop creative approaches to solving market problems.
10	Final Business Model Presentation	Prepare and present a refined business model to a panel. Justify business assumptions, financial projections, and growth strategies. Receive feedback for improvement.

Continuous Assessment:

1. Assignment on Each Module (total 6 Assignment)

Books Recommended:

- Baisya, Rajat K. Indian Entrepreneurship: Analysis of Business Practices. SAGE Publications, New Delhi, 2021.
- Blank, Steve, and Bob Dorf. The Startup Owner's Manual. K&S Ranch Publishing, Pescadero, 2012.

- Desai, Vasant. Entrepreneurship Development in India. Himalaya Publishing House, Mumbai, 2019.
- Joshi, M.V. Entrepreneurship Development and Startup India. Himalaya Publishing House, Mumbai, 2020.
- Kumar, S. Ramesh. Business Development: A Comprehensive Approach. McGraw Hill, New Delhi, 2018.
- Osterwalder, Alexander. Value Proposition Design. Wiley, New Jersey, 2014.
- Osterwalder, Alexander, and Yves Pigneur. Business Model Generation. Wiley, New Jersey, 2010.
- Prasad, Rohit. Start-up Sutra: What the Angels Won't Tell You About Business and Life. Hachette India, New Delhi, 2013.
- Purohit, Prachi. Startup India: The Complete Guide to Launching and Managing a Business. Notion Press, Chennai, 2021.
- Ries, Eric. The Lean Startup. Crown Business, New York, 2011.
- Thiel, Peter. Zero to One. Crown Business, New York, 2014.
- Van der Pijl, Patrick. Business Model Shifts. Wiley, New Jersey, 2020.

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Program: Mechanical Engineering	Final Year B.Tech	Semester: VII
Course: Soft Computing (DJS22MEC7017)		
Course: Soft Computing Laboratory (DJS22MEL7017)		

Pre-requisites:

1. Mathematics and Statistics.
2. Programming and Computational Tools.
3. Mechanical Engineering Fundamentals.
4. Control Systems and Automation *(Desirable but not mandatory)*.

Objectives:

1. To introduce the fundamental concepts of soft computing and its applications in engineering and optimization problems.
2. To provide a deep understanding of fuzzy logic systems, including fuzzy sets, membership functions, fuzzy inference, and defuzzification techniques.
3. To explore the principles of evolutionary computing, including genetic algorithms (GA), evolutionary strategies, and their applications in problem-solving.
4. To understand artificial neural networks (ANNs), their architectures, training techniques, and applications in predictive modeling and classification.
5. To introduce swarm intelligence algorithms such as Particle Swarm Optimization (PSO) and Ant Colony Optimization (ACO) and their applications in engineering.
6. To develop problem-solving skills using hybrid soft computing techniques, integrating fuzzy logic, neural networks, and evolutionary algorithms for real-world applications.

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

1. Explain the fundamental concepts of soft computing and differentiate it from conventional computing techniques.
2. Apply fuzzy logic concepts, including fuzzy inference and defuzzification techniques, to solve decision-making problems in engineering.
3. Implement evolutionary computing techniques, including genetic algorithms, to optimize complex engineering problems.
4. Design and train artificial neural networks for pattern recognition, classification, and predictive analytics.
5. Utilize swarm intelligence and probabilistic models to solve multi-objective optimization problems.
6. Integrate multiple soft computing techniques to develop hybrid intelligent systems for practical applications in mechanical and manufacturing engineering.

Soft Computing (DJS22MEC7017)		
Unit	**Description**	**Duration**
1	**Introduction to Soft Computing and Optimization** • Concept of Soft Computing: Definition, characteristics, and advantages over hard computing. • Applications of Soft Computing: Engineering applications • Optimization Fundamentals: Global and local optima, Problem formulation; Review of basic calculus concepts (Convex functions, Eigenvalue Decomposition, Singular Value Decomposition); Classification of optimization problems in machine learning.	7

	• Optimization Methods: Linear Programming: Graphical method, Simplex method, Duality; Unconstrained Optimization: Gradient-based methods, Cauchy's steepest descent, Newton's method, Conjugate gradient method; Constrained Optimization: Direct methods, Penalty function methods, Steepest descent method.	
2	**Fuzzy Logic and Applications** • Fuzzy Set Theory: Fuzzy sets, Operations, Membership functions; Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inference; Defuzzification Techniques: Methods and applications. • Fuzzy Logic Controller (FLC): Design, Rule base, Inference mechanism; Applications in control systems and decision-making.	6
3	**Artificial Neural Networks (ANNs)** • Introduction to ANN: Biological vs. Artificial neurons, ANN architecture; Types of ANN: Feedforward, Recurrent; Activation functions: Linear, Sigmoid, Tanh. • Training Techniques: Supervised and unsupervised learning; Backpropagation algorithm. • Applications of ANN: Pattern recognition, Control systems, Fault detection.	6
4	**Evolutionary Computing and Genetic Algorithms (GA)** • Evolutionary Computation Concepts: Evolutionary processes, Evolutionary algorithms, Evolutionary programming. • Genetic Algorithm (GA) Framework: Working principle, Encoding, Fitness function; Selection techniques (Roulette wheel, Tournament selection); Crossover techniques, Mutation techniques. • Multi-objective Genetic Algorithms (MOEA): Pareto optimization, Crowding distance, Ranking methods. • Applications of GA: Engineering optimization problems.	7
5	**Swarm Intelligence and Reinforcement Learning** • Swarm Intelligence Concepts: Features and principles; Algorithms: Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC); Applications in engineering optimization. • Reinforcement Learning (RL): Basic concepts, Policy, Reward function, Value function; RL approaches: Value-based, Policy-based, Model-based; Q-learning algorithm; Comparison between RL and supervised learning.	7
6	**Probabilistic Models and Applications in Engineering** • Markov Models: Markov decision process, State transitions; Hidden Markov Models (HMM); Applications in mechanical engineering. • Probabilistic Design in Mechanical Systems: Stress-strength models, Reliability estimation; Probability distributions in failure modeling • Applications of Soft Computing in Engineering: Predictive maintenance, Fault detection; Image-based part classification, Process optimization; Tuning of control algorithms.	6
	Total	**39**

Soft Computing Laboratory (DJS22MEL7017)	
Sr. No.	**Experiment Title**
Group A – Any five assignments (one from each group) for a data set using a suitable software package/ programming language	
Group 1	**Fuzzy Logic Systems** 1. Implementation of Fuzzy Membership Functions (Triangular, Trapezoidal, Gaussian) 2. Fuzzy Set Operations (Union, Intersection, Complement) 3. Fuzzy Relation and Composition (Max-Min and Max-Product Composition) 4. Defuzzification Techniques (Centroid, Bisector, Mean of Maximum) 5. Design and Simulation of a Fuzzy Logic Controller (FLC) for Temperature Control
Group 2	**Genetic Algorithms (GA) and Evolutionary Computing** 1. Implementation of Genetic Algorithm (GA) for Function Optimization 2. Solving the Traveling Salesman Problem (TSP) using Genetic Algorithm 3. Multi-Objective Genetic Algorithm (MOGA) for Pareto Optimization 4. Implementing Crossover and Mutation Techniques in GA 5. Design and Optimization of a Mechanical Component using Genetic Algorithm
Group 3	**Artificial Neural Networks (ANN)** 1. Implementation of Single-Layer Perceptron for Binary Classification 2. Backpropagation Algorithm for Training a Multi-Layer Perceptron (MLP) 3. Handwritten Digit Recognition using ANN (MNIST Dataset) in Python 4. Design and Training of an ANN-based Predictive Maintenance Model 5. Comparison of Supervised vs. Unsupervised Learning in Neural Networks
Group 4	**Swarm Intelligence Techniques** 1. Implementation of Particle Swarm Optimization (PSO) for Function Minimization 2. Solving Optimization Problems using Ant Colony Optimization (ACO) 3. Implementation of Artificial Bee Colony (ABC) Algorithm for Optimization 4. Comparison of PSO, ACO, and GA for Engineering Design Problems 5. Hybrid Soft Computing Approach: Integrating Fuzzy Logic and Neural Networks for Control Applications
Group 5	**Probabilistic Models & Applications in Engineering** 1. Implementation of Markov Decision Process (MDP) for System State Prediction 2. Hidden Markov Model (HMM) for Predictive Maintenance in Mechanical Systems 3. Reliability Estimation of Mechanical Components using Stress-Strength Models 4. Failure Probability Modeling using Monte Carlo Simulation 5. Image-Based Part Classification using Machine Learning
Group B (Mandatory) One mini project (in a group of 2 students) based on the above contents and using the mechanical engineering application dataset.	

Books Recommended:

Textbooks:

- Mangey Ram, and Suraj B. Singh, Soft Computing: Techniques om Engineering Sciences, De Gruyter, 2020.
- S. Chakraverty, Deepti M. Sahoo, and Nisha R. Mahato, Concept of Soft Computing: Fuzzy and ANN Programming, Springer Nature Singapore, 2019.
- Ashish M. Gujarathi, B. V. Babu," Evolutionary Computation: Techniques and Applications", CRC Press 2016.

- Tettamanzi Andrea, Tomassini and Marco, Soft Computing Integrating Evolutionary, Neural and Fuzzy Systems, Springer, 2001.
- Singiresu S Rao, Engineering Optimization Theory and Practice, John Wiley & Sons, Inc, 2019
- Parag Kulkarni and Prachi Joshi, "Artificial Intelligence – Building Intelligent Systems", PHI learning Pvt. Ltd., 2015

Reference Books:

- Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
- X. Yao," Evolutionary Computation: Theory and Applications", World Scientific Publ. Co., Singapore, 1999.
- Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
- Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.
- Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.
- Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.

Web References:

- Introduction to Soft Computing (https://nptel.ac.in/courses/106105173)
- Soft Computing Techniques (https://nptel.ac.in/courses/111105614)

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Program: Mechanical Engineering	Final Year B.Tech.	Semester: VII
Course: Digital Manufacturing (DJS22MEC7021)		

Pre-requisites:

1. Fundamentals of CAD/CAM.

Objectives:

1. To focus on equipping the students with the knowledge and skills to leverage digital technologies in the manufacturing process.
2. To gain knowledge about digital procurement, predictive maintenance and predictive quality in digital manufacturing process.
3. To study various cyber threats in digital manufacturing.
4. To gain knowledge about various methods to mitigate the cyber security threats in digital manufacturing.
5. To study usage AI and ML Technology in manufacturing to enhance its performance.

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

1. Explain the various steps involved in digital manufacturing and smart factory concepts.
2. Apply the predictive quality and predictive maintenance concepts in manufacturing process.
3. Analyse the benefits of digital procurement in manufacturing process.
4. Identify and evaluate cyber security issues in digital manufacturing environment.

Digital Manufacturing (DJS22MEC7021)		
Unit	**Description**	**Duration**
1	**Introduction to Digital Manufacturing and Production in Digital Era** • Evolution of conventional to digital Manufacturing (DM), introduction to digital transformation and drivers for digital transformation in manufacturing. • Planning: Optimization, Rough cut Capacity Planning (RCCP) and Labour planning. • Execution: Process parameters, Enterprise Data Management (EDM), Run time errors and documentation. • Technology: Robotic Process automation (RPA) and 3 DP (three dimensional printing). • Smart factory concepts . • Digital Twins: Learning about creating digital replicas of physical assets and processes to simulate and optimize performance.	10
2	**Predictive Quality** • Classification of predictive analysis. Steps involved in implementing of predictive analytics in the organization. Data collection and integration of the data. Real time data monitoring, Analysis and modelling of the data using Emerging tools (Industrial IoT, ML, statistical modelling, neural networks and AI). Use of models to predict quality issues and setting up the alert. • Benefits of predictive quality analysis in manufacturing. • Case study discussion on implementation of Predictive Quality in an industry.	10

3	**Predictive Maintenance (PdM)** • Definition of PdM. Types of PdM. Difference between predictive and preventive maintenance. Steps used in PdM. • Collection of the data on parameters like vibration, temperature, humidity, pressure and noise using and transmission of the real time data for analysis using IOT. • Analysis of the data using AI and ML tools and creation of models to predict the life span of the machines. Setting up the alert for maintenance issues. • Benefits of PdM in manufacturing. • Discussion on case study.	7
4	**Digital Procurement** • Definition of digital procurement. Types of procurement. 5 R's in procurement. Digital procurement strategy and steps. Procurement to pay cycle (P2P). • Use of online platforms for supplier selection, bidding and contract management. • Analysis of procurement data to identify trends, optimize spending and improve decision-making using ML. • Use of AI for price prediction, supplier selection and risk assessment. • Use of digital tools for managing contracts, tracking compliance and mitigating risks. • Benefits of digital procurement.	6
5	**Cybersecurity/ Big Data Security in Digital Manufacturing** • Introduction, basic cybersecurity concepts, threats, vulnerabilities and attacks relevant to digital manufacturing. • **Network and System Security: S**ecurity of networks i.e. wireless security, firewalls, intrusion detection systems (IDS) and intrusion prevention systems (IPS) in relevance to the digital factory environment. • **Industrial Control Systems (ICS) Security:** SCADA (Supervisory Control and Data Acquisition) systems, PLC (Programmable Logic Controller) networks and other critical ICS components. • **Data Security:** Protection of sensitive data i.e. intellectual property, customer data and operational data, through data encryption, access control, and data loss prevention (DLP) techniques in digital manufacturing. • Mitigation of cyber security risks.	6
	Total	**39**

Books Recommended:

Textbooks:

- Sunil Mudumala, Leading Digital Transformation in Manufacturing Industry 4.0.
- J. Paulo Davim , Kaushik Kumar, Divya Zindani , J. Paulo Davim, Digital Manufacturing and Assembly Systems in Industry 4.0, Taylor and Francis, 2021.
- Dipti Bandi, Digital Procurement unlocked, Notion press, 2023.
- Mark J. Barrenechea, Tom Jenkins, Digital Manufacturing, Waterloo, 2018
- Florian Schupp, Heiko Wöhner, Digitalization in Procurement, Springer, 2024.

- Chandrakant D. Patel, Chun-Hsien Chen, Digital Manufacturing, Elsevier, 2024.

Reference Books:

- Andries Feikema, Digital Transformation in Procurement, Koganpage, 2025.
- Lane Thames, Dirk Schaefer, Cybersecurity for Industry 4.0, Springer, 2017.
- R Sujatha, G Prakash, Noor Zaman Jhanjhi, Cyber Security Applications for Industry 4.0, Chapman & Hall, 2024.

Program: Mechanical Engineering	Final Year B.Tech	Semester: VII
Course: Automotive Materials and Manufacturing (DJS22MEC7022)		

Pre-requisites: Nil

Objectives:

1. To provide an understanding of advanced materials, including composites and specialty materials in automotive applications.
2. To introduce the mechanical behavior, constitutive models, and applications of polymers and composite materials in automotive design.
3. To explore smart materials, sensors, and actuators, and their integration into automotive structures.
4. To study the criteria for material selection in automotive design based on strength, cost, formability, and machinability.
5. To understand the impact of globalization on automotive manufacturing and supply chain management.

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

1. Explain the significance of advanced materials in vehicle design and performance.
2. Understand the viscoelastic behavior of polymers under different loading conditions.
3. Evaluate design and manufacturing challenges in integrating smart materials.
4. Identify suitable materials for automotive components based on mechanical and economic factors.
5. Analyze strategies for product-process-business integration in a globalized economy.

Automotive Materials and Manufacturing (DJS22MEC7022)		
Unit	**Description**	**Duration**
1	**Overview of materials used in automotive systems:** Traditional vs. advanced materials, Metallic and non-metallic composites: Properties, applications in structural and non-structural components, Specialty materials: High-strength steels, lightweight alloys (Al, Mg, Ti), shape memory alloys, and ceramics, Nanotechnology in automotive systems: Nano-coatings, nanocomposites, nano-lubricants, energy storage and thermal management, Environmental and sustainability considerations in advanced material selection.	6
2	**Composite Materials:** Composite materials, including naturally occurring substances such as wood and bone, and engineered materials from concrete to carbon fiber reinforced epoxies. Design and analysis of composite components in automotive applications. Natural composites (e.g., wood, bamboo) and bio-based composites in green automotive design.	6
3	**Smart Materials and Structures:** Theoretical aspects of smart materials, sensors and actuator technologies. It will also cover design, modeling and manufacturing issues involved in integrating smart materials and components with control capabilities to engineering smart structures.	7
4	**Materials in Manufacturing and Design:** Material selection based on cost, strength, formability and machinability. Advanced strength analysis of heat-treated and cold-formed parts including axial, bending, shear and cyclic deformation. Correlations of functional specifications and process capabilities	6

5	**Laser Materials Processing:** Application of lasers in materials processing and manufacturing. Laser principles and optics. Fundamental concepts of laser/material interaction. Laser welding, cutting, surface modification, forming, and rapid prototyping.	8
6	**Assembly Modeling for Design and Manufacturing:** Assembly on product and process, Assembly representation, Assembly sequence, Datum flow chain, Geometric Dimensioning and Tolerance, Tolerance analysis, Tolerance synthesis, Robust design, Joint design and joining methods, Stream of variation, Auto body assembly case studies.	6
	Total	**39**

Book Recommended:

Textbooks:

- S. Kalpakjian and S. R. Schmid, Manufacturing Engineering and Technology, Pearson Education South Asia Pte Limited, 2013.Education.
- William D. Callister, William D. Callister, Jr., and David G. Rethwisch, Materials Science and Engineering: An Introduction, Wiley, 2008.
- M. P. Groover, Fundamentals of Modern Manufacturing: Processes, and Systems, Wiley, 1996.
- W. F. Smith, J. Hashemi, and F. Presuel-Moreno, Foundations of Materials Science and Engineering, McGraw-Hill, 2018.

Reference Books:

- David R. H. Author Jones and M. A. Asbhy, Engineering Materials, Butterworth-Heinemann, 1996.
- C. K. Chawla Composite Materials: Science and Engineering, Springer, 2012.
- R. F. Gibson, Principles of Composite Material Mechanics, CRC Press, 2016.
- F. C. Campbell (Jr.), and F. C. Campbell, Manufacturing Processes for Advanced Composites," Elsevier, 2003.
- A. B. Strong, Plastics: Materials and Processing, Pearson Prentice Hall, 2006.
- W. M. Steen, Laser Material Processing, Springer, 2013.

Program: Mechanical Engineering	Final Year B.Tech.	Semester: VII
Course: Design for X (DJS22MEC7023)		

Pre-requisites:

1. Fundamentals of Mechanical Engineering.
2. Fundamentals of Design, Manufacturing, Assembly.

Objectives:

1. To Understand the fundamental principles of Design for X (DfX) and its role in product development.
2. To gain knowledge about DfX methodologies to optimize designs for manufacturability, cost, reliability, sustainability, safety, and maintainability.
3. To Develop analytical skills to assess trade-offs between different DfX factors and make informed design decisions.
4. To Gain knowledge of industry best practices, tools, and techniques used in DfX.
5. To Explore emerging trends and future advancements in DfX, including additive manufacturing, IoT integration, and sustainability-driven designs.

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

1. Explain the fundamental principles of DfX and its role in optimizing product design for various factors such as manufacturability, reliability, cost, and sustainability.
2. Apply Design for Manufacturability (DfM) principles to optimize material selection, process constraints, and design simplification for efficient manufacturing.
3. Analyze product designs to minimize assembly complexity, reduce part count, and optimize cost through effective DfA and DfC strategies.
4. Evaluate reliability and sustainability factors in product design using techniques such as Failure Modes and Effects Analysis (FMEA) and Life Cycle Assessment (LCA).
5. Integrate safety, maintainability, and serviceability considerations into product design to enhance usability, longevity, and compliance with industry standards.
6. Develop an optimized product design by integrating multiple DfX principles and using digital tools such as CAD, simulation, and AI-driven optimization.

Design for X (DJS22MEC7023)		
Unit	**Description**	**Duration**
1	**Introduction to Design for X** *Definition and Philosophy of DfX:* Understanding "X" as a variable representing key design considerations, Holistic and proactive approach to engineering design, Emphasis on life-cycle thinking. *Importance of DfX in Product Development:* Enhancing product quality, usability, and competitiveness, Reducing time-to-market and development cost, Supporting innovation while mitigating risks. Role of DfX in the Product Development Cycle: Integrating DfX early in the concept and design stages. Cross-functional collaboration (design, manufacturing, supply chain, sustainability, etc.). Aligning with customer requirements and business goals. *Overview of Key DfX Disciplines:*	8

	Design for Manufacturability (DfM), Design for Assembly (DfA), Design for Cost (DfC), Design for Reliability (DfR), Design for Sustainability (DfS) , Design for Safety (DfSa), Design for Maintainability & Serviceability (DfM&S) *Case studies on successful DfX applications:* Real-world examples of successful DfX applications from industries like automotive, aerospace, electronics, and consumer goods. Analysis of the impact of DfX on cost, quality, time, and environmental performance.	
2	**Design for Manufacturability (DfM)** *Principles of Manufacturability:* Designing products for ease, efficiency, and cost-effectiveness in manufacturing, Avoiding overly complex geometry and unnecessary features, *Material Selection and Process Constraints:* Matching materials to manufacturing processes and product requirements, Consideration of formability, machinability, weldability, etc. *Tolerance Analysis and Design Simplification:* Importance of tolerancing in manufacturability and quality, GD&T basics and statistical tolerance stacking, Simplifying part geometry to reduce processing steps. *Design Guidelines for Key Manufacturing Processes:* Casting: Uniform wall thickness, draft angles, and riser design. Machining: Tool access, fixturing, and reducing setup changes. Injection Molding: Parting lines, flow paths, undercuts, and sink marks. Sheet Metal: Bend radii, material usage, and nesting. Additive Manufacturing: Layer orientation, support structures, and topology optimization. *Tools and Techniques:* DFM/DFA software tools (DFMPro, DesignSpark, etc.), Case examples of design changes that improved manufacturability.	7
3	**Design for Assembly (DfA)** *Principles of Assembly Efficiency:* Minimizing assembly time, tools, and labor, Reducing orientation sensitivity. *Minimizing Part Count and Fasteners:* Use of multifunctional and self-locating parts, Snap-fits, interlocking components, and integrated designs. *Modular Design and Standardization:* Plug-and-play components, Reusability across product lines and platforms. *Automated Assembly Considerations:* Robotics and automation-friendly design, Avoiding small, fragile, or asymmetrical parts. **Design for Cost (DfC):** *Cost Modelling Techniques:* Parametric costing, activity-based costing. Material and Process Cost Trade-offs: Evaluating performance vs. cost. Design Simplifications for Cost Reduction: Standard components, simplified assemblies. *Life Cycle Cost Analysis:* CAPEX, OPEX, maintenance, and end-of-life.	8
4	**Design for Reliability (DfR)** *Failure Modes and Effects Analysis (FMEA):*	8

	Systematic identification and ranking of potential failure modes, Risk Priority Number (RPN) and mitigation strategies. *Reliability Prediction and Testing Methods:* MTBF (Mean Time Between Failures), Weibull analysis, Accelerated life testing, environmental testing. *Fatigue, Wear, and Durability:* Stress-life and strain-life approaches, Material selection and design against degradation. *Redundancy and Fault-Tolerant Design:* Backup systems, graceful degradation, Criticality analysis and design for safe failure. **Design for Sustainability (DfS):** *Environmental Impact:* Energy consumption, emissions, waste, Life Cycle Assessment (LCA): Cradle-to-grave and cradle-to-cradle models, Sustainable Materials and Processes: Bio-based materials, green manufacturing, *Circular Economy:* Reuse, remanufacturing, recycling, and take-back systems.	
5	**Design for Safety (DfS)** Compliance with Safety Standards (ISO, OSHA, CE marking, etc.), Human Factors & Ergonomics (User interaction, comfort, and errors), Hazard Analysis Techniques (HAZOP, FTA (Fault Tree Analysis), ETA (Event Tree)), Fail-Safe and Foolproof Design (Interlocks, alarms, and error-proofing (Poka-yoke)). **Design for Maintainability & Serviceability (DfM&S):** Ease of Inspection and Diagnostics (Access to critical components, onboard diagnostics), Modularity and Repairability (Plug-and-play modules, standardized connectors), Spare Parts and Accessibility Considerations (Common fasteners, openable enclosures), Predictive Maintenance and IoT Integration (Real-time monitoring, analytics-driven alerts). **Integrated DfX Approach:** Cross-functional Optimization (Balancing manufacturability, cost, reliability, and sustainability), Trade-off and Decision-Making Techniques (Pareto analysis, QFD, TRIZ, multicriteria decision analysis). **Digital Tools and Software:** CAD/CAM/CAE integration for DfX analysis, PLM (Product Lifecycle Management) platforms, AI and machine learning in design optimization. **Industry Trends and Future Directions:** Smart manufacturing, Industry 4.0, digital twins, DfX in circular economy and net-zero goals, Role of generative design and design automation.	8
	Total	**39**

Books Recommended:

Reference Books:

- George Q. Huang, *Design for X: Concurrent Engineering Imperatives*, Springer London, 1996.
- Geoffrey Boothroyd, Peter Dewhurst, and Winston Knight, *Product Design for Manufacture and Assembly*, CRC Press, 2010.

- Gerhard Pahl and Wolfgang Beitz, *Engineering Design: A Systematic Approach*, Springer London, 2007.
- David M. Anderson, *Design for Manufacturability: How to Use Concurrent Engineering to Rapidly Develop Low-Cost, High-Quality Products for Lean Production*, CRC Press, 2014.
- Bryan R. Fischer, *Mechanical Tolerance Stackup and Analysis*, CRC Press, 2011.
- Peter Sandborn, *Cost Analysis of Electronic Systems*, World Scientific Publishing, 2013.
- E. E. Lewis, *Reliability Engineering*, Dover Publications, 1996.
- Patrick D. T. O'Connor and Andre Kleyner, *Practical Reliability Engineering*, Wiley, 2012.
- David T. Allen and David R. Shonnard, *Sustainable Engineering: Principles and Practice*, Pearson Education, 2011.
- Louis J. Gullo and Jack Dixon, *Design for Safety*, Wiley, 2018.
- Mark S. Sanders and Ernest J. McCormick, *Human Factors in Engineering and Design*, McGraw-Hill, 1993.
- B. S. Dhillon, *Maintainability, Maintenance, and Reliability for Engineers*, CRC Press, 2006.
- Andrew Kusiak, *Concurrent Engineering: Contemporary Issues and Modern Design Tools*, Wiley, 1993.

Web References:

- Dassault Systèmes (https://www.3ds.com/store/cad/design-for-x)
- ANSYS (https://www.ansys.com/en-in/blog/what-is-dfx)

Program: Mechanical Engineering	Final Year B.Tech.	Semester: VII
Course: Renewable Energy Systems (DJS22MEC7024)		

Pre-requisite:

1. Knowledge of Energy science, Energy sources.
2. Fundamentals of Thermodynamics, Heat Transfer and Fluid mechanics.

Objectives:

1. To study working principles of various renewable energy sources and their utilities.
2. To study economics of harnessing energy from renewable energy sources.
3. To gain the knowledge of renewable energy conversion systems design.
4. To develop skills to analyse industry and domestic applications of RES.

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

1. Explain the need of different renewable energy sources.
2. Discuss importance of renewable energy sources.
3. Discuss various renewable energy sources in Indian context.
4. Calculate and analyse utilization of solar and wind energy.
5. Illustrate design of biogas plant.
6. Explain basics of hydrogen energy.

Renewable Energy Systems (DJS22MEC7024)		
Unit	**Description**	**Duration**
1	**Introduction to Energy Sources** Renewable and non-renewable energy sources, Energy policy and sustainability, Energy Consumption as a measure of Nation's development; Strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources, Present status and current installations, Emerging and future energy technologies, various MNRE programmes.	4
2	**Solar Energy** Merits and demerits, Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar Angles, sunrise, sunset and day length, Principle of solar energy conversion. Types of Solar Energy Technologies. Components of a Solar Power System. Solar Energy collection devices and Classification: Flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond, solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, Solar Photovoltaic systems & applications. Solar Energy in the Global Context. Future of Solar Energy.	9
3	**Wind Energy** Principle of wind energy conversion; Basic components of wind energy conversion systems; Wind turbine technologies, wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of Aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection Considerations. Global Wind Energy Development. Future Trends in Wind Energy.	.8

4	**Energy from Biomass** Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of biogas, utilization of biogas. **Hydrogen Energy:** Methods of Hydrogen production, Hydrogen Storage, Fuel Cells and Types of Fuel Cells.	7
5	**Energy from the Ocean** Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy.	6
6	**Geothermal Energy** Estimation and nature of geothermal energy, geothermal sources and Resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and Application of geothermal energy, prospects of geothermal energy in India.	5
	Total	**39**

Books Recommended:

Text Books:

- G. D. Rai, Non-conventional energy sources, 6th edition, Khanna Publishers, 1988.
- S. P. Sukhatme, and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, 4th edition, TMH, 2017.
- H. P. Garg, and Jai Prakash, Solar Energy: Fundamentals and Applications, 1st revised edition, TMH, 1997.
- Joshua Earnest, Wind Power Technology, PHI Learning, 2014.
- J. W. Twidell, and Anthony D. Weir, Renewable Energy Sources, ELBS Publication, 1986.
- D. Begamudre, Energy Conversion Systems, R. New Age International (P) Ltd., Publishers, 1998.
- C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, 3rd Edition, PHI Learning, 2013.

Reference Books:

- D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.
- Mukund R. Patel, Wind and Solar Power Systems, 2nd edition, CRC Press, 2005.
- J. F. Manwell, J. G. McGowan, and A. L. Rogers, Wind Energy Explained: Theory, Design and Application, John Wiley and Sons, 2009.

Program: Mechanical Engineering	Final Year B. Tech.	Semester: VII
Course: Startup Registration and Development (DJS22MEC7025)		

Pre-requisite: Nil

Objectives:

1. To Understand the startup registration process, legal structures, and compliance requirements.
2. To analyze government incentives, policies, and funding opportunities for startups.
3. To develop key business registration documents and compliance reports.
4. To assess intellectual property protection and its impact on startups.
5. To evaluate financial planning, fundraising, and investment strategies.
6. To ensure taxation, auditing, and regulatory compliance for startups.

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

1. Differentiate between various startup legal structures and their compliance requirements.
2. Evaluate government schemes, startup incentives, and funding policies.
3. Prepare and assess essential business registration documents.
4. Apply intellectual property protection strategies for business innovation.
5. Develop financial models and fundraising strategies for startup sustainability.
6. Ensure compliance with taxation, auditing, and corporate legal frameworks.

Startup Registration and Development (DJS22MEC7025)		
Unit	**Description**	**Duration**
1	**Introduction to Startup Registration** Definition, Types, and Importance of Startups Legal Structures: Proprietorship, LLP, Pvt. Ltd., Public Ltd. Steps for Business Registration Case Studies on Startup Registrations	8
2	**Government Policies and Incentives for Startups** Overview of Startup India, MSME, and Other Government Schemes Tax Benefits, Grants, and Financial Incentives Public and Private Funding Support Case Studies on Startups Using Government Incentives	8
3	**Business Compliance and Documentation** Important Documents: MoA, AoA, GST Registration, UDYAM Certification Business Licenses, Permits, and Compliance Reports Understanding Business Ethics and Legal Challenges	6
4	**Intellectual Property Rights (IPR) for Startups** Types of Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets Legal Framework and Filing Procedures (Startup India/IP India Portals) Strategic Use of IP in Startup Growth and Fundraising Licensing, Commercialization, and IP Monetization Techniques Legal Aspects and Compliance for Engineering Startups Case Studies on Startup IP Protection	6

5	**Fundraising and Investment Strategies** Seed Funding, Angel Investors, Venture Capital, Crowdfunding Investor Relations and Pitching Techniques Understanding Term Sheets and Equity Dilution Case Studies on Startup Fundraising	6
6	**Taxation, Compliance, and Business Growth** GST, Corporate Tax, and Financial Reporting Auditing and Legal Risk Management Business Growth and Exit Strategies (Mergers, Acquisitions, IPOs) Final Startup Business Plan Development	5
	Total	**39**

Continuous Assessment:

- Two term tests will be conducted during the semester; a presentation based on syllabus can be conducted instead of any one-term test.
- Assignment on Each Module (total 6 Assignment)

Books Recommended:

- Purohit, Prachi. Startup India: The Complete Guide to Launching and Managing a Business. Notion Press, Chennai, 2021.
- Joshi, M.V. Entrepreneurship Development and Startup India. Himalaya Publishing House, Mumbai, 2020.
- Pathak, Akhileshwar. Legal Aspects of Business. McGraw Hill, New Delhi, 2018.
- Hegde, Dinesh S. Indian Startups and their Funding Journey. Springer, New Delhi, 2021.
- Sharma, Rajat. Business Laws for Entrepreneurs. Pearson, New Delhi, 2019.
- Blank, Steve, and Bob Dorf. The Startup Owner's Manual. K&S Ranch Publishing, Pescadero, 2012.
- Feld, Brad, and Jason Mendelson. Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist. Wiley, New Jersey, 2019.
- Desai, Vasant. Entrepreneurship Development in India. Himalaya Publishing House, Mumbai, 2019.

Program: Mechanical Engineering	Final Year B.Tech	Semester: VII
Course: Big Data Analytics (DJS22MEC7026)		

Pre-requisites:

1. Mathematics and Statistics.
2. Programming Fundamentals.
3. Fundamentals of Data Science and Machine Learning.
4. Mechanical Engineering Knowledge.

Objectives:

1. To study the fundamentals of big data analytics and its significance in mechanical engineering applications.
2. To explain various data acquisition, storage, and pre-processing techniques used in mechanical systems.
3. To explore statistical and machine learning techniques to analyze mechanical engineering data.
4. To impart the fundamentals of large datasets from mechanical systems using big data tools and frameworks such as Hadoop and Spark.
5. To evaluate the effectiveness of predictive maintenance and fault diagnosis models in mechanical engineering.
6. To be able to develop data-driven solutions for mechanical engineering problems using big data analytics techniques.

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

1. Explain big data concepts and their applications in mechanical engineering.
2. Use data collection, storage, and pre-processing techniques for handling mechanical engineering data.
3. Apply machine learning models to predict failures and optimize mechanical system performance.
4. Analyze large-scale mechanical engineering datasets using big data tools like Apache Spark and Hadoop.
5. Evaluate different predictive analytics techniques for reliability assessment and fault detection in mechanical systems.
6. Design a data-driven project related to mechanical engineering problems using big data analytics techniques.

Big Data Analytics (DJS22MEC7026)		
Unit	**Description**	**Duration**
1	**Introduction to Big Data and Analytics** • Definition and Characteristics of Big Data (Volume, Velocity, Variety, Veracity, and Value) • Importance of Big Data in Mechanical Engineering • Data Sources in Mechanical Engineering: IoT sensors, CAD/CAE simulations, Manufacturing, Maintenance logs • Big Data vs. Traditional Data Processing • Data security, risk mitigation, and life cycle assessment • Case Studies: Predictive Maintenance in Industrial Machines	6

2	**Data Acquisition, Storage, and Preprocessing** • Data Collection Methods: Sensors, IoT, SCADA, PLM Systems • Data Storage Technologies: SQL vs NoSQL, Hadoop, HDFS, Apache Spark • Data Preprocessing: Cleaning, Transformation, Feature Engineering • Handling Missing Data and Outliers • Introduction to Time-Series Data Processing in Mechanical Systems	6
3	**Statistical Analysis and Machine Learning** • Descriptive Statistics: Mean, Median, Standard Deviation, Correlation • Regression Models: Linear, and Multiple, Regression for Mechanical Data • Classification Algorithms: Decision Trees, Support Vector Machines (SVM), k-NN • Clustering Techniques: k-Means, DBSCAN, Hierarchical Clustering	9
4	**Big Data Tools and Frameworks** • Introduction to Hadoop and MapReduce • Apache Spark for Real-time Data Processing • Python Libraries for Big Data: Pandas, NumPy, SciPy, Scikit-learn • Cloud Computing and Big Data: AWS, Google Cloud, Microsoft Azure • Hands-on Session: Processing Mechanical Sensor Data using Spark	6
5	**Applications in Mechanical Engineering** • Big Data in Manufacturing: Smart Factories, Industry 4.0, Digital Twins • Condition Monitoring and Predictive Maintenance using IoT Data • Fault Detection and Diagnosis in Mechanical Systems • Big Data in CFD and FEA Simulations: Data-driven Optimization • Hands-on Project: Analyzing Vibration Data for Predictive Maintenance	6
6	**Case Studies and Emerging Trends** • AI-Driven Predictive Analytics in Mechanical Engineering • Applications in Autonomous Vehicles and Robotics • Supply Chain Optimization in Manufacturing • Ethical and Security Concerns in Big Data Applications • Future Trends: Quantum Computing, Edge Computing, and Big Data	6
	Total	**39**

Books Recommended:

Textbooks:

- M.Thangaraj, S. Suguna, G. Sudha, Big Data Analytics: Concepts, Techniques, Tools and Technologies, PHI Learning Pvt. Ltd., 2022.
- B. L. S. Prakasa Rao, S. B. Rao, and Saumyadipta Pyne, Big Data Analytics: Methods and Applications, Springer India, 2016.
- EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley, 2014.
- David Loshin, Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, Morgan Kaufmann, 2013.

Reference Books:

- Edward L. Robinson, Data Analysis for Scientists and Engineers, Princeton University

Press, 2016.

- Parikshit N. Mahalle, Pravin P. Hujare, and Gitanjali Rahul Shinde, Predictive Analytics for Mechanical Engineering: A Beginners Guide, Springer Nature Singapore, 2023.
- Venkat Ankam, Big Data Analytics, Packt Publishing, 2016.
- Dina Darwish, Big Data Analytics Techniques for Market Intelligence, IGI Global, 2023.
- Francesco Corea, Big Data Analytics: A Management Perspective, Springer International Publishing, 2016.
- Mohammed Guller, Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis, Apress, 2015.

Web References:

- Algorithms for Big Data (https://nptel.ac.in/courses/106106142).
- Big Data Computing (https://nptel.ac.in/courses/106104189).

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Product Life Cycle Management (DJS22ILO7011)		

Pre-requisite: Knowledge of basic concepts of Management.

Objectives:

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.

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

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLMfeasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components,machining and manufacturing plant.

Product Life Cycle Management (DJS22ILO7011)		
Unit	**Description**	**Duration**
1	**Introduction to Product Lifecycle Management (PLM)** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities ofGlobalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLMInitiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM	09
2	**Product Design** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, 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	08
3	**Product Data Management (PDM)** Product and Product Data, PDM systems andimportance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	08

	Virtual Product Development Tools For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modelling and simulations in Product Design, Examples/Case studies	
4	**Integration of Environmental Aspects in Product Design** Sustainable Development Design for Environment, Need for Life Cycle Environmental Strategies, 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.	07
5	**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 Frameworkfor LCCA, Evolution of Models for Product Life Cycle Cost Analysis	07
	Total	39

Books Recommended:

Text books:

- Product Lifecycle Management: Paradigm for 21st Century Product Realization, John Stark, Springer-Verlag, 2004.
- Product Design for the environment-A life cycle approach, Fabio Giudice, Guido La Rosa, Antonino Risitano, Taylor & Francis 2006.

Reference Books:

- Product Life Cycle Management‖, Saaksvuori Antti, Immonen Anselmie, Springer, Dreamtech.
- Product Lifecycle Management: Driving the next generation of lean thinking, Michael Grieve, Tata McGraw Hill, 2006.
- Product Life-Cycle Management: Geometric Variations, François Villeneuve, Luc Mathieu, Max Giordano, Wiley, 2010.

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Management Information System (DJS22ILO7012)		

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meetthe needs of the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

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

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses.

Management Information System (DJS22ILO7012)		
Unit	**Description**	**Duration**
1	**Foundation Concepts:** Information Systems in Business, Functional Area Information System**,** The Components of Information Systems**,** Impact of IT on organizations and society, Organizational Strategy, Information systems for strategic advantage.	03
2	**Information Technologies:** Hardware and Software **Computer Systems:** End User and Enterprise Computing **Computer Peripherals:** Input, Output, and Storage Technologies **Application Software:** End User Applications **System Software:** Computer System Management **Data Resource Management:** Technical Foundations of Database Management, Managing Data Resources, Big data, Data warehouse and Data Marts**,** Knowledge Management **Networks:** The Networked Enterprise (Wired and wireless), Pervasive computing, Cloud Computing models	07
3	**MIS Tools and applications for Decision making:** ERP and ERP support of BusinessProcess Reengineering, **Business intelligence (BI):** Managers and Decision Making, BI for Data analysis and Visualization **Artificial Intelligence Technologies in Business**	08
4	**Security and Ethical Challenges:** Security, Ethical, and Societal Challenges of IT Security Management of Information Technology	06
5	**Social Computing (SC):** Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C, Mobile commerce.	07

6	**Information System within Organization:** Acquiring Information Systems and Applications: Various System development life cycle models. **Enterprise and Global Management of Information Technology:** Managing Information Technology, Managing Global IT.	08
	Total	39

Books Recommended:

Reference Books:

- Management Information Systems, 11th edition by James A O'Brien, George M., RameshBehl.
- Kelly Rainer, Brad Prince, Management Information Systems, Wiley.
- K.C. Laudon and J.P. Laudon, Management Information Systems: Managing theDigital Firm, 10th Ed., Prentice Hall, 2007.
- D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization,Prentice Hall, 2008

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Operations Research (DJS22ILO7013)		

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

Objectives:

1. To formulate a real-world decision problem as a mathematical programming model.
2. To learn the mathematical tools that are employed to solve mathematical programmingmodels.

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

1. Convert a real-world problem in to a Linear Programming Problem and analyse the solution obtained using Simplex method or other algorithms.
2. Identify real-world problems as Transportation Problem and Assignment Problem and Solve the decision problem by choosing appropriate algorithm.
3. Identify the decision situations which vary with time and analyse them using principle of dynamic programming to real life situations.
4. Explain reasons of formation of queues, classify various queuing systems and apply parameters defined for various queuing systems for decision making in real life situations.
5. Understand the concept of decision making in situation of competition and recommend strategies in case of two-person zero sum games.
6. Describe concept of simulation and apply Monte Carlo Simulation technique to systems suchas inventory, queuing and recommend solutions for them.
7. Understand need for right replacement policy and determine optimal replacement age.

Operations Research (DJS22ILO7013)		
Unit	**Description**	**Duration**
1	**Introduction to Operations Research:** Concept of decision making. Definition of OR.Formulation of decision problem as OR model, Concept of Optimization, **Linear Programming Problem:** Mathematical Formulation. Finding optimal solution -Graphical method, Simplex Method, Big M-method, Two Phase Method. Duality, Primal – Dual construction, Symmetric and Asymmetric Dual. Dual Simplex Method.	10
2	**Assignment Problems:** Mathematical Formulation, Finding optimal solution HungarianMethod **Transportation problem:** Mathematical Formulation, Finding initial basic feasible solution – Northwest corner rule, row minima, column minima, least cost method andVogel's approximation method. Optimality test: the stepping stone method and MODI method. Improving the solution.	08
3	**Dynamic Programming**: Bellman's Principle of optimality - Applications of dynamic programming- Employment smoothening problem, capital budgeting problem, shortestpath problem, cargo loading problem	05
4	**Queuing Models:** Characteristics of queuing models. Single Channel – Single and multi-phase servers, Poisson arrivals, exponential servicetime - with infinite population and finite population models – with infinite and finite capacity. Multichannel – Single phase server - Poisson arrivals, exponential service time	10

	withinfinite population. **Game Theory:** Introduction. Minimax & Maximin Criterion and optimal strategy. Solution of games with saddle points, rectangular games without saddle points - 2 x 2games, dominance principle. Approximate methods - Iterative method, m x 2 & 2 x n games -Graphical method andmethod of sub-games. Expressing game as LPP.	
5	**Simulation:** Definition. Types of simulation models. Monte Carlo simulation technique. Applications of simulation - Inventory and Queuing problems. Simulation Languages. **Replacement Models:** Replacement of items that deteriorate with time - when money value is not counted and counted, Replacement of items that fail suddenly – individualand group replacement policy.	06
	Total	39

Books Recommended:

Text books:

- Operations Research, Sharma J. K., Trinity Press
- Operations Research, Gupta P. K., Hira D. S., S. Chand Limited

Reference Books:

- Operations Research - An Introduction; Taha, H.A.; Prentice Hall
- Operations Research: Principles and Practice; Ravindran, A, Phillips, D. T and Solberg, J. J.; John Willey and Sons
- Introduction to Operations Research; Hiller, F. S. and Liebermann, G. J.; Tata McGraw Hill
- Operations Research Principles and Practice; Pradeep Prabhakar Pai; Oxford University Press
- Operations Research, R. Panneerselvam, PHI Publications.
- Operations Research, A. M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education.
- Operations Research; Kanti Swarup, P. K. Gupta and Man Mohan; Sultan Chand & Sons

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Cyber Security and Laws (DJS22ILO7014)		

Objectives:

1. To understand and identify different types cybercrime and cyber offences.
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

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

1. Understand the different types of cybercrime and security issues E Business.
2. Analyses different types of cyber threats and techniques for security management.
3. Explore the legal requirements and standards for cyber security in various countries to regulate cyberspace.
4. Impart the knowledge of Information Technology Act and legal frame work of right to privacy,data security and data protection.

Cyber Security and Laws (DJS22ILO7014)		
Unit	**Description**	**Duration**
1	**Introduction to Cybercrime**: Cyber Crime, Cyber Law, Cyber Security, History of Cyber Crime, Hacking, Data Theft, Cyber Terrorism, Virus & Worm's, Email Bombing, Pornography, online gambling, Forgery, Web Defacements, Web Jacking, Illegal online Selling, Cyber Defamation, Software Piracy, Electronics/ Digital Signature, Phishing, Password Cracking, Key loggers and Spywares, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Over Flow,, Phishing Identity Theft (ID Theft) ,How criminal plan the attacks, Social Engineering, Cyber stalking.	10
2	**Cyber Threats Analysis** Knowledge of Dynamic and Deliberate TargetingKnowledge of Indications and Warning Knowledge of Internal Tactics to Anticipate and/or, Emulate Threat Capabilities andActions Knowledge of Key Cyber Threat Actors and their EquitiesKnowledge of Specific Target Identifiers and Their Usage	06
3	**Electronic Business and legal issues** Evolution and development in Ecommerce, Policy Frameworks for Secure Electronic Business, paper vs paper less contracts, E-Commerce models- B2B, B2C, E security. E- Payment Mechanism; Payment through card system, E-Cheque, E-Cash, E-PaymentThreats & Protections, Security for E-Commerce.	06
4	**Indian IT Act** Cyber Crime and Criminal Justice, Penalties, Adjudication and Appeals Under the IT Act,2000, IT Act. 2008 and its Amendments **Security aspect in cyber Law** The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The IntellectualProperty Aspect in Cyber Law, The Evidence Aspect in Cyber Law,The Criminal Aspectin Cyber Law.	08

5	**Security Industries Standard Compliances** IT Security v/s IT Compliance, Cyber Security Standards, critical security controls for cyber security, GRC (Governance, Risk Management, and Compliance), SOX, GLBA, HIPAA, ISO/IEC 27001, NIST Cyber Security Framework (CSF), PCI-DSS. OWASP Top Ten Project, GDPR (General Data Protection Regulation), NIST (National Institute of Standards and Technology), CIS Controls (Center for Internet SecurityControls)	09
	Total	39

Books Recommended:

Reference Books and Material:

- Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
- The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
- The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
- E-Commerce Security and Privacy", Anup K. Ghosh, Springer Science and Business Media,2012
- Izzat Alsmadi , The NICE Cyber Security Framework Cyber Security Intelligence andAnalytics, Springer
- Cyber Law & Cyber Crimes, Advocate Prashant Mali; Snow White Publications, Mumbai
- Nina Godbole, Information Systems Security, Wiley India, New Delhi
- Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
- William Stallings, Cryptography and Network Security, Pearson Publication
- Websites for more information is available on : The Information Technology ACT, 2008-TIFR : https://www.tifrh.res.in
- Website for more information, A Compliance Primer for IT professional: https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer- professionals-33538

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Personal Finance Management (DJS22ILO7015)		

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

Objectives:

1. To create awareness and educate consumers on access to financial services.
2. To make the students understand the basic concepts, definitions and terms related to direct taxation.
3. To help the students compute the Goods and Service Tax (GST) payable by a supplier after considering the eligible input tax credit.
4. To familiarize the students with microfinance for accelerating the expansion of local microbusinesses.

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

1. Use a framework for financial planning to understand the overall role finances play in his/her personal life.
2. Compute income from salaries, house property, business/profession, capital gains and incomefrom other sources.
3. Compute the amount of CGST, SGST and IGST payable after considering the eligible input tax credit.
4. Understand how Microfinance can help in financial inclusion.

Personal Finance Management (DJS22ILO7015)		
Unit	**Description**	**Duration**
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. Financial Instruments and Financial Markets, Financial inclusion. **Introduction to Personal Finance:** Person Financial Planning in Action, Money Management Skills, Taxes in YourFinancial Plan, Savings and Payment Services. Consumer Credit: Advantages, Disadvantages, Sources and Costs.	07
02	**Personal Financial Management** **Loans:** Home, Car, Education, Personal, Loan against property and Jewel loan. **Insurance:** Types of Insurance – ULIP and Term; Health and Disability Income Insurance, Life Insurance. **Investment:** Investing Basics and Evaluating Bonds, Investing in Stocks and Investingin Mutual Funds, Planning for the Future.	07
03	**Income Tax** **Income Tax Act Basics-** Introduction to Income Tax Act, 1961 **Heads of Income and Computation of Total Income and Tax Liability-** Heads of Income and Computation of Total Income under various heads, Clubbing Provisions, Set off and Carry forward of Losses, Deductions, Assessment of Income and tax liability of different persons. **Tax Management, Administrative Procedures and ICDS -** TDS, TCS and Advance Tax Administrative Procedures, ICDS.	07

04	**Goods and Services Tax** GST Constitutional framework of Indirect Taxes before GST (Taxation Powers of Union & State Government); Concept of VAT: Meaning, Variants and Methods; MajorDefects in the structure of Indirect Taxes prior to GST; Rationale for GST; Structure of GST (SGST, CGST, UTGST & IGST); GST Council, GST Network, State Compensation Mechanism, Registration. **Levy and Collection of GST:** Taxable event- "Supply" of Goods and Services; Place of Supply: Within state, Interstate, Import and Export; Time of supply: Valuation for GST- Valuation rules, taxability of reimbursement of expenses; Exemption from GST: Small supplies and Composition Scheme: Classification of Goods and Services	09
05	**Introduction to Micro – finance** Micro-Finance: Definitions, Scope & Assumptions, Types of Microfinance, Customersof Micro-finance, Credit Delivery Methodologies, SHG concept, origin, Formation &Operation of Self Help Groups (SHGs). **Models in Microfinance -** Joint Liability Groups (JLG), SHG Bank Linkage Model and GRAMEEN Model: Achievements & Challenges, **Institutional Mechanism** Current Challenges for Microfinance, Microfinance Institutions (MFIs): Constraints &Governance Issues, Institutional Structure of Microfinance in India :NGO-MFIs, NBFC-MFIs, Co-operatives, Banks, Microfinance Networks and Associations; Demand& Supply of Microfinance Services in India, Impact assessment and social assessments of MFIs.	09
	Total	39

Books Recommended:

Reference Books:

- Banking and Financial Sector Reforms in India , by Asha Singh, M.S. Gupta, Serials Publication.
- Indian Banking Sector: Essays and Issues (1st) , by M.S. Gupta & J.B. Singh, Serials Publication.
- Basics Of Banking & Finance , by K.M. Bhattacharya O.P. Agarwal , Himalaya PublishingHouse
- Agricultural Finance And Management, by S. Subba Reddy , P. Raghu Ram .
- The Indian Financial System And Development , by Dr.Vasant Desai, Himalaya PublishingHouse; Fourth Edition
- Income Tax Management , Simple Way of Tax Management, Tax Planning and Tax Saving, By Sanjay Kumar Satapathy
- Direct Tax System Income Tax by Dr. R. K. Jain, SBPD Publications.
- Simplified Approach to GST Goods and Services Tax, By S K Mishra, EducreationPublishing.
- Introduction to Microfinance, By Todd A Watkins , World Scientific Publishing Company

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Energy Audit and Management (DJS22ILO7016)		

Objectives:

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To identify and describe the basic principles and methodologies adopted in energy audit ofa utility
3. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
4. To relate the data collected during performance evaluation of systems for identification ofenergy saving opportunities.

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

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit ofa utility.
3. To describe the energy performance evaluation of some common electrical installationsand identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations andidentify the energy saving opportunities.
5. To analyze the data collected during performance evaluation and recommend energy saving measures.

Energy Audit and Management (DJS22ILO7016)		
Unit	**Description**	**Duration**
01	**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.	05
02	**Energy Audit:** 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. Technical and economic feasibility, Classification of energy conservation measures. Safety considerations during energy audit. **Financial analysis techniques:** Simple payback period, NPV, Return on investment (ROI) Internal rate of return (IRR).	09
03	**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, compressor, fan and blower. industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution	09

	system, Steam leakages, Steam trapping, Condensate and flash steam recovery system. Waste heat recovery, use of insulation- types and application. Energy conservation opportunities in: Boiler system. Refrigeration system and HVAC system.	
05	**Energy conservation in Buildings**: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources, Energy sources andenergy management in electric vehicles.	06
	Total	39

Books Recommended:

Reference Books:

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

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Disaster Management and Mitigation Measures (DJS22ILO7017)		

Objectives:

1. To provide basic understanding hazards, disaster and various types and categories 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 roles and responsibilities of individual and various organization during andafter disaster.
5. To appreciate the significance of GIS, GPS in the field of disaster management.
6. To understand the emergency government response structures before, during and afterdisaster.

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

1. Know natural as well as manmade disaster and their extent and possible effects on theeconomy.
2. Know the institutional framework and organization structure in India for disastermanagement and get acquainted with government policies, acts and various emergency laws.
3. Get to know the simple dos and don'ts in such extreme events and build skills to respond accordingly.
4. Understand the importance of disaster prevention and various mitigation measure with the exposure to disasters hotspots across the globe.

Disaster Management and Mitigation Measures (DJS22ILO7017)		
Unit	**Description**	**Duration**
1	**General Information about Disaster:** Brief concept of Hazards, definition and types of Disasters – Natural, Man-made, and hybrid, Groups of Disasters- Natural and Technological, global Scenario, Significance of studying various aspects of disasters, effects of disasters, India's vulnerability to disasters,Impact of disaster on National development. Study of Natural disasters: Flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion etc. Study of Human/Technology Induced Disasters: Chemical, Industrial and Nuclear disasters, Internally displaced persons, road and train accidents Fire Hazards, terrorism, militancy, Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
2	**Disaster Management:** Brief Introduction, Disaster management cycle, Evolution of Disaster and Disaster management in India, Disaster management acts, policies and guidelines, laws of emergencies etc. Prior, During and Post disaster management activities: (Preparedness, strengthening emergency centers, Logistics, optimum resource management, emergency response and relief, Training, Public awareness, Research, Reconstruction of essential services and livelihood restoration.	08
3	**Institutional framework and Mechanism for disaster management in India:** Institutions in India for dealing with various disasters, Organizational structure,	07

	functionsand responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, roles and responsibilities of central andstate government during and after disaster, NGO's involved in disasters and their task, Jobscarried out by armed forces. Financial Relief During disaster (State, National and International Disaster Assistance)	
4	**Disaster risk reduction and Mitigation Measures:** Need of disaster prevention and mitigation, mitigation guiding principles, challengingareas, structural and non-structural measures for disaster risk reduction. Mitigation measures for flood, earthquake, cyclone monitoring, air quality, water quality,climate change, land use, winter storms and aquatic biology etc. Use of information management, GIS, GPS and remote sensing Mitigation measure. Do's and don'ts in case of disasters and effective implementation of relief aids.	08
5	**Case studies on disaster (National /International):** Case study discussion of Hiroshima – Nagasaki (Japan), India – Tsunami (2004), Bhopalgas tragedy, Kerala and Uttarakhand flood disaster, Cyclone Phailin (2013), Fukushima Daiichi nuclear disaster (2011), 26th July 2005 Mumbai flood, Chernobyl meltdown and so on. (Discuss case studies on disaster with respect to reason for the disaster, incidents, effects of disaster, present scenario and safety measures taken)	07
	Total	39

Books Recommended:

Reference Books and Reports:

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

(Learners are expected to refer reports published at national and international level and updated information available on authentic web sites)

Prepared by Checked by Head of the Department Principal

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Science of Well-being (DJS22ILO7018)		

Objectives:

1. To create consciousness about importance of holistic health and physical as well as mentalwell-being.
2. To make learners aware of the concepts of Happiness, Gratitude, Self-Compassion, Empathyetc.
3. To introduce the learners to the means of mental and physical well-being, ill effects of mal-practices like alcoholism, smoking etc.
4. To equip the learners to manage and cope up with stress in their daily living.

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

1. Describe concepts of holistic health and well-being, differentiate between its true meaningand misconceptions and understand the benefits of well-being.
2. Recognize meaning of happiness, practice gratitude and self-compassion and analyzeincidents from one's own life.
3. Understand the causes and effects of stress, identify reasons for stress in one's ownsurrounding and self.
4. Recognize the importance of physical health and fitness, assess their life style and come upwith limitations or effectiveness.
5. Inspect one's own coping mechanism, assess its effectiveness, develop and strategize for betterment and execute it.

Science of Well-being (DJS22ILO7018)		
Unit	**Description**	**Duration**
1	**Health and well-being:** The concept of health, dimensions of health, the notion of well- being, various facets of well-being, relation between health and well-being. Concept of holistic health, its principles and importance, concept and benefits of holistic care, misconceptions about holistic health approach, the application of a true holistic approach to our well-being.	06
2	**Concepts of happiness:** Happiness: what is it and how do we measure it? Philosophical perspectives on happiness, Happiness: Nature or Nurture? Happiness in the modern world: impediments and accelerators, Narrow vs. Broad Band Approaches to Happiness, Benefits of Happiness, Self-Compassion and Gratitude. Misconceptions of happiness.	08
3	**Stress and mental health/well-being**: Nature and concept of stress, meaning and definitions of stress, types of stress, meaning of stressors, types of stressors, symptoms ofstress, effects of stress, different models of stress. Sources of stress and how does stress cause illness, various sources of stress, delineate between external and internal sources of stress, differentiate between continuous and discrete stressors, the effects of these stressors on health and well-being, diversity of stressors and their health consequences, relation between stress and illness from different perspectives association between stress related physiological mechanisms and different illnesses.	09

4	**Physical Well-being / Health management:** concept of health behaviours, dimensions ofhealth behaviours. Health enhancing behaviors: Exercise and Weight control, application and importance of these health enhancing behaviours. Health protective behaviors and illness management: concept of illness management, effectiveness of illness management. Concept of Nutrition, Role of Nutrition, Components of Nutrition, concept of Malnutrition,Health compromising behaviours: Alcoholism, Smoking and its effects on health.	08
5	**Dealing with Difficult Times / Coping mechanisms:** The concept of chronic stress, Health and safety risks of chronic stress, Forms and Treatment of chronic stress, Coping with Acute and Chronic stress, theories of the stress-illness link, role of stress in mental disorders. Concept of coping, Ways of coping and stress management, basic knowledge about stressmanagement, various techniques of stress management, stress management programs. Mental strengths and virtues, Hope, Optimism, Resilience – concept, pathways and models, Meditation and Self-introspection.	08
	Total	39

Books Recommended:

Textbooks:

- The Science of well-being by Felicia Huppert, Nick Baylis, Barry Keverne; OxfordUniversity Press
- Health and Well-Being: Emerging Trends by S. Ojha, U. Rani Srivastava, Shobhna Joshi,Global Vision Publishing House
- Positive psychology: The scientific and practical explorations of human strengths by Shane
- J. Lopez, Jennifer Teramoto Pedrotti, Charles Richard Snyder; Sage Publications.

Reference Books:

- The pursuit of happiness and the realization of sympathy: Cultural patterns of self, social relations,and well-being by Kitayama, S., & Markus, H. R, Culture and subjective well-being, The MIT Press.
- Man Adapting by Dubos, R; New Haven: Yale University Press.
- Happiness a history by McMahon D. M., Atlantic Monthly Press.
- Well-being: The foundations of hedonic psychology by D. Kahneman & E. Diener & N. Schwarz,New York: Russell Sage
- Selye H. The Stress of Life. New York; McGraw-Hill; 1984.

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Research Methodology (DJS22ILO7019)		

Pre-requisites: Basic Knowledge of Probability and Statistics.

Objectives:

1. To understand Research and Research Process
2. To acquaint learners with identifying problems for research and develop research strategies
3. To familiarize learners with the techniques of data collection, analysis of data and interpretation

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

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings
5. Write report about findings of research carried out.

Research Methodology (DJS22ILO7019)		
Unit	**Description**	**Duration**
1	**Basic Research Concepts:** Meaning of research, Objectives of research, Types of research, Significance of research; Research process.	07
2	**Research Methodology:** Identification of research problem, Literature review, Formulation of hypothesis, Formulation of Research design.	09
3	**Research and Sample Design:** Meaning of research and sample design, Need of research design, Features of good researchdesign, Important concepts, Different research designs, Types of sampling designs	09
4	**Data Collection and Data Analysis:** Types of data, Methods for collecting data: Experiments and surveys, Collection of primaryand secondary data, Hypothesis testing and interpretation of Data	09
5	**Interpretation and Report Writing:** Interpretation and drawing conclusions on the research, Preparation of the report, EthicalIssues	05
	Total	39

Books Recommended:

Reference Books:

- Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS PublishersDistributors.
- Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, WileyEastern Limited.
- Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd Edition),Singapore, Pearson Education

Prepared by Checked by Head of the Department Principal

Program: Common for All Programs	Final Year B.Tech	Semester: VII
Course: Public Systems and Policies (DJS22ILO7020)		

Pre-requisites: Basic Knowledge of Social science and Current affairs

Objectives:

1. To analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
2. To understand public systems in a fast-changing environment in the global context.
3. To provide an in-depth understanding of the ills prevailing in the society and aids to identifythe solutions for them.
4. To explain public policy and its operations with special focus on policy relating to Government finance.
5. To analyze and evaluate the impact of the public policy on firms and economy at large.

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

1. Understand the importance of public systems in a fast-changing environment in the global context.
2. Analyze the transformations in public systems with emphasis on current initiatives and emerging challenges in the field.
3. Explain public policy and its operations with special focus on policy relating to Government finance.
4. Make policies and know about the happenings in the world, in the nation and those in their locality.
5. Analyze and evaluate the impact of the public policy on firms and economy at large and work under various fields as policymakers.

Public Systems and Policies (DJS22ILO7020)		
Unit	**Description**	**Duration**
1	**Introduction and Overview of Public Systems:** Ideology of Public Systems; Mechanistic and Organic view of Society and Individuals, The Legal Framework; Federal Government; State and Local Governments, Government growth; The size ofGovernment.	09
2	**Public Sector in the Economics Accounts:** Public Sector in the circular flow; PublicSector in the National Income Accounts.	06
3	**Public Choice and Fiscal Politics:** Direct Democracy; Representative Democracy; The Allocation Function; The Distribution Function; The Stabilization Function; Coordination of Budget Functions; The Leviathan Hypothesis.	07
4	**Introduction and Overview of Public Policy:** Markets and Government; Social goods and Market failure, Public expenditure and its evaluation; Cost Benefit Analysis, Publicpolicy and Externalities, Taxation Policy and its impact, Income distribution, redistribution and social security issues Fiscal & Budgetary Policy, Fiscal Federalism in India.	11
5	**Case Studies in Expenditure Policy: Public Services** A) National Defense B) Highways C) Outdoor Recreation D) Education	06
	Total	39

Books Recommended:

Reference Books:

- Introduction to Public Policy by Charles Wheelan, W.W. Norton & Company.
- Understanding Public Policy by Thomas R. Dye, Prentice Hall.
- Public Policy-Making: An Introduction by Anderson J.E., Boston, Houghton.
- Public Administration by Avasthi & Maheshwari, Lakshminarayan Agarwal, Agra.
- New Horizons of Public Administration by Bhattacharya, Mohit, Jawahar Publishers, NewDelhi.
- Public Administration and Public Affairs by Henry, Nicholas, Prentice Hall of India, New Delhi.
- Public Finance 10th Edition by Harvey S Rosen and Ted Gayer, McGraw-Hill Education, 2013.
- Public Finance in Theory and Practice by Musgrave and Musgrave.

Program: Mechanical Engineering	Final Year B.Tech	Semester: VII
Course: Project Stage I (DJS22MEP704)		

Pre-requisites:

Knowledge of mechanical &/or inter-disciplinary subjects, concepts and analytical software.

Objectives:

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

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

1. Apply basic engineering fundamentals in the domain of practical applications.
2. Identify the engineering problems based on literature review.
3. Attempt a problem solution with right approach and ethics.
4. Develop the habit of working in a team, and communicate efficiently with engineering community and society.
5. Apply the principles of project management and financial aspects in multidisciplinary environments.
6. Recognize the need for lifelong learning activities to cope up with technological changes.

Project Stage I

- To proceed with the project work, it is very important to select a right topic. Project can be undertaken on any subject addressing Mechanical &/or inter-disciplinary concepts.
- Research and development projects on problems of practical, theoretical and societal interest should be encouraged.
- Project work must be carried out by the group of at least two students and maximum four and must be original.
- Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
- The project work can be undertaken in a research institute or organization/company/any business establishment.
- Student must consult internal guide along with external guide (if any) in selection of topic.
- Head of department and senior staff in the department will take decision regarding projects.
- Student has to document the progress report every 15 days in the project log book to the internal guide and internal guide has to keep track on the progress of the project and has to maintain attendance report. This progress report along with a synopsis report can be used for awarding term work marks.
- In case of industry projects, regular monitoring by internal guide is recommended.

Guidelines for Assessment of Project Stage I

Project - I should be assessed based on following points:

1. Quality of problem selected (Objective, Problem definition & Project motivation)
2. Clarity of Problem definition and Feasibility of problem solution

3. Relevance to specialization
4. Breadth and depth of literature survey
5. Project scope
6. Project methodology

Project - I should be assessed through project progress log-book, mid-semester progress presentations project report & a presentation by the student project group to a panel of examiners.