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

Department of Mechanical Engineering

B. Tech. Program (Mechanical Engineering)

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

Scheme and detailed syllabus (DJS23)

Second Year B. Tech

In

Mechanical Engineering

(Semester IV)

Revision 01 (Effective from A.Y. 2025-26)

Department of Mechanical Engineering

Scheme for Second Year of B. Tech. Program in Mechanical Engineering: Semester IV
(Autonomous-DJS23 NEP)

Sr. No.	Course Code	Courses Title	Teaching Scheme (Hrs.)				Semester End Examination (SEE) - A						Continuous Assessment (CA) - B						A+B	Total Credits	
			Th. (Hrs)	P (Hrs)	T (Hrs)	Credits	Duration (Hrs)	Th	O	P	O & P	SEE Total (A)	TT1	TT2	TT3	TT Total	T/W	CA Total (B)			
1	DJS23MPC251	Numerical and Statistical Techniques	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	3
	DJS23MPC251L	Numerical and Statistical Techniques Laboratory	--	2	--	1	-	--	--	--	--	--	--	--	--	--	25	25	25	1	
2	DJS23MPC252	Mechanics of Materials	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	4
	DJS23MPC252L	Mechanics of Materials Laboratory	--	2	--	1	2	--	25	--	--	25	--	--	--	--	25	25	50	1	
3	DJS23MPC253	Advanced Manufacturing Processes	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	3
4 #	DJS23XOE261	Project Management	3	--	--	3	2	60	--	--	--	60	15	15	10	40	--	40	100	3	3
	DJS23XOE262	Cyber Security, Policies and Laws																			
	DJS23XOE263	Advanced Operations Research																			
	DJS23XOE264	Corporate Finance Management																			
	DJS23XOE265	Corporate Social Responsibility																			
	DJS23XOE266	Bioinformatics																			
	DJS23XOE267	Human Resource Management																			
	DJS23XOE268	Digital Marketing Management																			
	DJS23XOE269	Logistics and Supply Chain Management																			
5	DJS23XHS283L	Design Thinking Laboratory	--	2	--	1	-	--	--	--	--	--	--	--	--	--	25	25	25	1	1
6	DJS23XHS284	Universal Human Values	2	--	--	2	2	60	--	--	--	60	15	15	10	40	--	40	100	2	3
	DJS23XHS284T	Universal Human Values Tutorial	--	--	1	1	-	--	--	--	--	--	--	--	--	--	25	25	25	1	
7	DJS23MSC251L	Computer Aided Machine Drawing Laboratory	--	4	--	2	2	--	--	50	--	50	--	--	--	--	50	50	100	2	2
8	DJS23MSC252L	Advanced Manufacturing Processes Laboratory	--	4	--	2	2	--	--	50	--	50	--	--	--	--	50	50	100	2	2
9	DJS23XSC251P	Innovative Product Development II	--	2	--	1	-	--	--	--	--	--	--	--	--	--	25	25	25	1	1
		Total	13	16	1	22	16	300	25	100	0	425	75	75	50	200	225	425	850	22	

Any 1 Open Elective from given list.

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

Prepared by   Checked by   Head of the Department   Principal

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Department of Mechanical Engineering

Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (min.)
Theory	a. Term test 1 (based on 40 % syllabus)	15	45
	b. Term test 2 (next 40 % syllabus)	15	45
	c. Assignment / course project / group discussion / presentation / quiz/ any other.	10	--
	Total Marks (a + b + c)	40	--
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 &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.	60	2
	* Computer-based assessment on the college premises.		
Oral	Questions based on the entire syllabus.	25	2
Practical	Performance of the practical assigned during the examination and the output / results obtained.	25	2
Oral & 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

Department of Mechanical Engineering

Program: Mechanical Engineering	S.Y. B. Tech	Semester: IV
Course: Numerical and Statistical Techniques (DJS23MPC251)		
Course: Numerical and Statistical Techniques Laboratory (DJS23MPC251L)		

Pre-requisite: --
1. Basics of Probability.
2. Mathematics I and Mathematics II.
3. Mathematics for Mechanical Engineering.

Objectives:
1. To apply differential equations to solve the applications in the domain of design, thermal, fluid mechanics, structural, etc.
2. To interpret statistical measures for quantitative data.
3. To develop regression models and predict the system's behavior for the experimental and field failure data.
4. To apply the laws of probability and probability distributions for modeling and analyzing the data.
5. To understand uncertain occurrences in data in a logical manner.

Outcomes: On completion of the course, the learner will be able to:
1. Analyze the statistical data using the concepts of correlation and regression.
2. Solve partial differential equations by applying numerical methods.
3. Apply the theoretical discrete and continuous probability distributions in the relevant application areas.
4. Examine data using different hypothesis tests and make conclusions about acceptance and rejections of sample data.
5. Apply the Chi-Square test to assess relationships between variables and interpret the significance of the results in real-world contexts. Analyze the variances of multiple variables simultaneously.

Numerical and Statistical Techniques (DJS23MPC251)		
Unit	Description	Duration
1	**Regression Analysis:** Statistical diagram: scattered diagram. Correlation: Karl Pearson's Coefficient of correlation and its mathematical properties, Spearman's Rank correlation and its interpretations. The measure of association between two variables. Linear Regression. **Partial Differential Equations [PDE]:** Bender-Schmidt Method and Crank- Nicolson method.	07
2	**Probability:** Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expected value, and Variance. **Probability distributions:** Discrete – Binomial, Poisson. Continuous - Normal.	09
3	**Test of Hypotheses:** **Sampling distribution:** Test of Hypothesis. Level of significance, critical region. One-tailed and two-tailed tests. Interval Estimation of population parameters. Large and small samples. **Test of significance for large samples:** Test for significance of the difference between	07

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Department of Mechanical Engineering

	samples mean and population means, Test for significance of the difference between the means of two samples. **Test of significance of small samples:** Student's t-distribution and its properties, Test for significance of the difference between samples mean and population means, Test for significance of the difference between the means of two Samples, paired t-test.	
4	**Chi Square Distribution:** Chi-square test, Test for the Goodness of fit, Association of attributes. **Analysis of Variance (F-Test):** One-Way classification, Two-way classification (short-cut method).	**05**
	Total	**28**

Numerical and Statistical Techniques Laboratory (DJS23MPC251L)	
Sr. No	**Suggested experiments** (Experiments should be performed using suitable software package/ programming language whenever required)
1	Develop a program to compute the correlation coefficient and analyse the relationship between two variables.
2	Generate a program to perform linear regression, determine the regression line equation, and analyse the fit.
3	Write a program to numerically solve PDEs using the explicit Bender-Schmidt method for heat conduction problems.
4	Develop a program to solve PDEs using the implicit Crank-Nicolson method for time-dependent problems.
5	Create a program to compute the expected value and variance for a given set of data or probability distribution.
6	Design a program to generate and analyse binomial or Poisson distributions for various parameters.
7	Write a program to generate and analyse normal distribution curves with specified mean and variance.
8	Write a program to perform a Z-test for large sample hypothesis testing and interpret the results
9	Develop a program to conduct t-tests for comparing sample means under different conditions and draw conclusions.
10	Create a program to apply the chi-square test for goodness of fit or independence and analyse the findings.
11	Implement a program to carry out ANOVA for comparing multiple samples means and determine statistical significance.

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 learned.

Books Recommended:

Textbooks:

- B. S. Grewal, 'Numerical Methods in Engineering and Science', Khanna Publication, 2018.
- B. S. Grewal, 'Higher Engineering Mathematics', Khanna Publication, 2012.

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Department of Mechanical Engineering

Reference Books:

- Erwin Kreyszig, 'Advanced Engineering Mathematics', Wiley India, 2010.
- Joe D. Hoffman, and Steven Frankel, 'Numerical Methods for Engineers and Scientists', CRC Press, 2018.
- Sheldon M. Ross, 'Introduction to Probability and Statistics for Engineers and Scientists', 5e, by Elsevier Academic Press, 2014.
- S. C. Gupta, V. K. Kapoor, 'Fundamentals of Mathematical Statistics', Sultan Chand & Sons –2020.
- P. Kandasamy, K. Thilagavathy, and K. Gunavathi, 'Numerical methods', S Chand and Company, 2006.

Web References:

- Numerical Methods for Engineers (https://nptel.ac.in/courses/127106019)
- Applied Numerical Methods (https://nptel.ac.in/courses/112104318)
- Probability and Statistics (https://nptel.ac.in/courses/111105041)

Department of Mechanical Engineering

Program: Mechanical Engineering	S.Y B. Tech	Semester: IV
Course: Mechanics of Materials (DJS23MPC252)		
Course: Mechanics of Materials Laboratory (DJS23MPC252L)		

Pre-requisite: --
1. Basic knowledge of Engineering Mechanics.
2. Basic knowledge of types of loads, free body diagram and beams.

Objectives:
1. To gain knowledge of different types of stresses, strains and deformations induced in the mechanical components due to external loads.
2. To study the distribution of various stresses in the mechanical elements that deform under loads.
3. To study the effect of component dimensions and properties of materials due to stresses and deformations.

Outcomes: On completion of the course, the learner will be able to:
1. Evaluate stresses, strains, deformation and properties of materials in mechanical components/ structures.
2. Draw SFD and BMD for different types of loads and support conditions for a beam.
3. Compute and plot direct, bending and shear stresses across sections of given beam.
4. Compute torsional shear stresses and strain energy in mechanical components.
5. Compute deflections and slopes in beams and analyze buckling phenomenon in columns and struts.

Mechanics of Materials (DJS23MPC252)		
Unit	**Description**	**Duration**
1	**Stress and Strain:** Definition, Simple stress-strain, uni-axial, bi-axial and tri-axial stresses, tensile stress, compressive stress and shear stresses, elastic limit, Hooke's law, deformation due to self-weight, bars of varying sections, composite sections, deformation of tapering members, Thermal Stresses. Theories of failures. **Elastic Constants and their relations:** Poisson's ratio, Modulus of elasticity, Modulus of rigidity, Bulk modulus, yield stress, ultimate stress. Factor of safety, state of simple shear, relation between elastic constants, Volumetric strain for tri-axial loading. **Principal stresses and Strains:** Principal plane and principal stresses, analytical and graphical method (Mohr's circle) for determining of stresses on oblique section.	10
2	**Shear Force and Bending Moment in Beams:** Axial force, shear force and bending moment diagrams for statically determinate beams (excluding beams with internal hinges), relationship between rates of loading, shear force and bending moment. **Moment of Inertia:** Area Moment of Inertia, Parallel axis theorem, Polar moment of inertia, Principal axes, Principal moment of inertia.	7

Department of Mechanical Engineering

3	**Bending stresses:** Theory of pure Bending, Assumptions, Flexural formula for straight beams, moment of resistance, bending stress distribution, Section modulus, beams of uniform strength. **Direct & Bending Stresses:** Combined stresses, Eccentricity, Stress distribution, Core /kernel of Section. **Shear Stresses:** Distribution of shear stresses for the section of beam.	8
4	**Torsion:** Torsion of circular shafts-solid and hollow, stresses in shafts when transmitting power, shafts in series and parallel. **Strain Energy:** Resilience, Proof Resilience, strain energy stored in the member due to gradually applies load, suddenly applied load, impact load. Strain energy stored due to Shear, Bending and Torsion.	8
5	**Deflection of Beams:** Deflection of Cantilever, simply supported and over hanging beams using Macaulay's or double integration method for different type of loadings. **Columns and Struts:** Buckling load, crushing load, Types of end conditions for column, Euler's column theory and its limitations, Rankine- Gordon Formula.	9
	Total	**42**

Mechanics of Materials Laboratory (DJS23MPC252L)	
Exp.	**Suggested experiments**
1	Tension test on mild steel bar (stress-strain behavior, determination of yield strength and modulus of elasticity) using a Universal Testing Machine (UTM).
2	Impact test on the metal specimen (Izod test/ Charpy test).
3	Hardness test on metals – (Brinell Hardness Number / Rockwell Hardness Number).
4	Flexural test on beam (central loading).
5	Flexural test on beam (two point loading).
6	Torsion test on mild steel bar / cast iron bar.

 # - Above tests are conducts as per the ASTM standard.
Minimum five experiments from the above-suggested list or any other experiment based on syllabus will be included, which would help the learner to apply the concept learnt.

Assignments:
Minimum five assignments based on syllabus will be conducted Or Mini project relevant to the subject, which would help the learner to apply the concept learnt.

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Department of Mechanical Engineering

Books Recommended:

Text books:
- S. Ramamrutham, Strength of Materials, Dhanpat Rai Pvt. Ltd.
- S.S.Ratan, Mechanics of Materials, Tata McGraw Hill Pvt. Ltd.
- R. Subramanian, Strength of Materials, Oxford University Press, Third Edition 2016.

Reference Books:
- Ryder, Strength of Materials , Macmillan.
- James M. Gere and Barry J. Goodno, Mechanics of Materials , Cengage Learning.
- Gere and Timoshenko, Mechanics of Materials, CBS.
- Basavrajaiah and Mahadevappa, Strength of Materials, Khanna Publishers,New Delhi.
- Timoshenko and Youngs, Elements of Strength of Materials, Affiliated East -West Press.
- Beer, Jhonston, DEwolf and Mazurek, Mechanics of Materials , TMH Pvt Ltd., New Delhi.
- S.B. Junnarkar, Mechanics of Structures, Charotar Publication.
- Shames, Introduction to Solid Mechanics by, PHI.
- Nag and Chandra, Strength of Materials by, Wiley India.
- W.Nash, Strength of Materials, Schaum's Outline Series, McGraw Hill Publication, Special Indian Edition.

Department of Mechanical Engineering

Program: Mechanical Engineering	S.Y. B. Tech	Semester: IV
Course: Advanced Manufacturing Processes (DJS23MPC253)		

Objectives:

1. To familiarize the students with unconventional modern machine tools & manufacturing practices.
2. To familiarize oneself with various micro manufacturing techniques like Meso, Micro and Nano manufacturing.
3. To acquaint the knowledge of additive manufacturing processes, and its capabilities in the modern digital manufacturing industry.

Outcomes: learner will be able to:

1. Illustrate the fundamentals of various non-conventional machining processes, highlighting their capabilities and areas of application.
2. Understand the operation of MEMS micro devices and microsystems, including their applications and manufacturing processes, such as bulk and surface micromachining techniques.
3. Gain insights into micro machining techniques as well as the challenges and methods involved in MEMS packaging.
4. Understand the principles of various nano-finishing techniques essential for enhancing surface quality and achieving ultra-smooth surfaces at the nanoscale level.
5. Review the differences between traditional and additive manufacturing techniques, while understanding the fundamental principles of various additive manufacturing (AM) technologies, including solid-based, liquid-based, and powder-based techniques.

Advanced Manufacturing Processes (DJS23MPC253)		
Unit	**Contents**	**Hrs.**
01	**Unconventional machining processes:** Classification of the Non-traditional machining process. Basic principles, machines, advantage, disadvantages, and applications of water jet machining (WJM), Abrasive jet machining (AJM), abrasive water jet machining (AWJM), ultrasonic machining (USM), electrical discharge machining (EDM), chemical machining (CHM), electrochemical machining (ECM), laser beam machining (LBM), plasma arc machining (PAM), electron beam machining (EBM). **Introduction to Hybrid machining**	09
02	**MEMS Introduction:** Intrinsic Characteristics of MEMS, Components of MEMS, Applications of MEMS and Microsystems, Overview of Commonly Used Mechanical Structures in MEMS (Beams, Cantilevers, Plates, Diaphragms), and Typical Applications. **MEMS Fabrication Technology** Challenges in Meso, Micro and Nano manufacturing, Overview about micro fabrication methods: Chemical vapour deposition (CVD); physical vapour deposition (PVD), optical and electron beam lithography; dry and wet etching.	09
03	**Micro Machining** Mechanics of micro machining, difference between micro and macro machining Micro	07

Department of Mechanical Engineering

	turning, Micro Milling, Micro grinding. **MEMS packaging challenges, MEMS packaging process.**	
04	**Nano Finishing Techniques** Abrasive flow machining (AFM), magnetic abrasive finishing (MAF), magneto rheological finishing (MRF), magneto rheological abrasive Flow Finishing (MRAFF), magnetic float polishing (MFP), elastic emission machining (EEM), chemical mechanical polishing (CMP).	07
05	**Additive Manufacturing (AM)** Introduction to Additive Manufacturing (AM): History of AM, traditional manufacturing v/s additive manufacturing, discussion on various materials used in AM, role of solidification rate in AM, and the influence of grain structure and microstructure in AM. **Extrusion based AM processes:** Fused deposition modelling (FDM), history of FDM, basic principles, material requirements, benefits and limitations, and post-processing. **Powder Bed Fusion AM Process:** Selective laser sintering (SLS): process workflow and material requirements, powder fusion mechanism, polymer ageing and recycling. **Vat Polymerization AM process:** Stereo lithography apparatus (SLA), history of SLA, material requirements, workflow, scan patterns, applications, benefits and limitations.	10
	Total	**42**

Books Recommended:

Reference Books:

- Jain V. K, "Advanced Machining Processes", 12th reprint, Allied Publishers Ltd, 2010.
- Hassan Abde, Gabad El Hoffy, "Advanced Machining Processes", McGraw Hill, 2005.
- Tai-Ran Hsu, "MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering", Wiley publications, 2020.
- Jain V. K, "Introduction to Micromachining", Narosa Publishing House, 2010.
- Mark J. Jackson, "Micro and Nano-manufacturing", McGraw Hill publications, 2015.
- N.P.Mahik, "Micro Manufacturing and Nanotechnology", Springer, 2006.
- M.J.Madou , "Fundamentals of microfabrication and nanotechnology Volume –II",3rd edition,CRC Press, 2011.
- Waqar Ahmed, Mark J. Jackson, "Emerging Nanotechnologies for Manufacturing",2nd Edition, Elsevier, 2015.
- Ian Gibson, David W. Rosen, Brent Stucker, "Additive manufacturing technologies: rapid prototyping to direct digital manufacturing", Springer, 2010.
- Andreas Gebhardt, "Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing", Hanser Publishers, 2011.
- O. P. Khanna, "A Textbook of Production Technology Vol.II.", Dhanpat Rai Publication, 2000.

Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y. B.Tech.	Semester: IV
Course: Project Management (DJS23XOE261)		

Pre-requisite:

1. Basic concepts of Management.

Objectives:

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

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

1. Explain project management life cycle and the various project phases as well as the role of project manager.
2. Apply selection criteria and select an appropriate project from different options.
3. Create a work break down structure for a project and develop a schedule based on it. Manage project risk strategically.
4. Use Earned value technique and determine & predict status of the project. Capture lessons learned during project phases and document them for future reference.
5. Differentiate between traditional waterfall approach and agile scrum methodology for software development projects.

Project Management (DJS23XOE261)		
Unit	Description	Duration
1	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical). Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Introduction to project leadership, ethics in projects, Multicultural and virtual projects, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI).	08
2	**Initiating Projects:** How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter, Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	09
3	**Project Planning:** Work Breakdown structure (WBS) and linear responsibility chart, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques, PERT, CPM. Crashing project time & Resource loading and levelling (Only Theory), Project Stakeholders and Communication plan.	08

Department of Mechanical Engineering

	Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability, and impact matrix. Risk response strategies for positive and negative risks.		
4	**Monitoring and Controlling Projects**: Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, communication and project meetings. Earned Value Management techniques for measuring value of work completed, using milestones for measurement, change requests and scope creep, Project audit, Project Contracting: Project procurement management, contracting and outsourcing. **Closing the Project:** Customer acceptance, Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report, doing a lessons learned analysis, acknowledging successes and failures.		08
5	**Agile project management:** Agile principle, Agile Manifesto, Agile process framework, Characteristics of Agile Approaches and Scrum, Benefits of Agile project management, Implementing Agile project management. **Agile Project Planning:** Comparison of Agile Project Management with Traditional Waterfall Approach, Project Planning with Scrum, Scrum Artifacts Supporting Project Planning , Scrum Events for Project Planning. Scheduling with scrum, Techniques for scrum scheduling- Poker estimation. **Agile Tools for Tracking Project Progress:** Task Boards, Burnup and Burndown Charts.		09
		Total	42

Books Recommended:

Text Books:
1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 11th Edition, Wiley India.
2. Project Management: The Managerial Process, 8th edition, Erik Larson, Clifford Gray, McGraw Hill Education.
3. Agile Project Management, Jim Highsmith, Pearson Education, Low Price Edition, India.

Reference Books:
1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 7th Ed, Project Management Institute PA, USA.
2. Project Management, Gido Clements, Cengage Learning.
3. Project Management, Gopalan, Wiley India.
4. Project Management, Dennis Lock, 9th Edition, Gower Publishing England.
5. Agile Essentials You Always Wanted to Know, Kalpesh Ashar, Vibrant Publishers U.S.A.

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Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Cyber Security, Policies and Laws (DJS23XOE262)		

Pre-requisite:

1. Fundamentals of Computers.

Objectives:

1. Familiarize with the provisions and implications of the Digital Personal and Data Protection Act, the obligations of data fiduciaries, the rights and duties of data principals, and mechanisms for resolving breaches.
2. Equip individuals and organizations with the knowledge and tools to create secure cyber ecosystems, strengthen regulatory frameworks, and develop incident response plans.

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

1. Understand and describe the major types of cybercrime and navigate legal frameworks and regulations concerning digital personal and data protection.
2. Implement strategies for cybersecurity outlined in the National Cyber Security Policy.
3. Apply appropriate law enforcement strategies to both, prevent and control cybercrime.
4. Comprehend regulations and strategies pertaining to AI (Artificial Intelligence) and large language models.

Cyber Security, Policies and Laws (DJS23XOE262)		
Unit	**Description**	**Duration**
1	**Cyber Crime:** Definition and Origin of the Word, Cyber Crime and Information Security, who are Cyber Criminals, Classification of Cybercrimes, E-mail Spoofing, Spamming, Cyber Defamation, Internet Time Theft, Salami Attack, Salami technique Data Diddling, Forgery, Newsgroup Spam, Online Frauds, Pornographic Offenders, Email Bombing, Password Sniffing, Credit Card Frauds.	09
2	**Cyber Offenses:** How Criminals plan them, Categories of Cyber Crimes, How Criminal Plans the Attack: Active Attacks, Passive Attacks, Social Engineering, Classification of Social Engineering, Cyber Stalking: types of Stalkers, Cyber Cafe and Cyber Crimes, Botnets, Attack Vectors, Cyber Crime and Cloud Computing.	09
3	**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, Security Standards: SOX, GLBA, HIPAA, NIST Cyber Security Framework (CSF).	08
4	**India's Digital Personal and Data Protection Act (2023)** Preliminary, Obligations of Data Fiduciary, Rights and Duties of Data Principal, Special Provisions, Data Protection Board of India, Powers,	08

Department of Mechanical Engineering

		Functions and Procedure to Be Followed by Board, Appeal and Alternate Dispute Resolution, Penalties and Adjudication.	
5		**India's AI Regulation and Strategy** Privacy, Security and Artificial Intelligence, Differential Privacy, Security in AI. National Artificial Intelligence Strategy, Principles for Responsible AI, Information Technology (Intermediary Guidelines and Digital Media Ethics Code-2021), Draft National Data Governance Framework Policy (NDGFP), Rules against Deepfakes, Due diligence advisory for AI, AI regulations framework (June 2024).	08
		Total	**42**

Books Recommended:

Text Books:
1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole, Sunit Belapur, Wiley-2011.
2. Understanding Cybersecurity Management in Decentralized Finance: Challenges, Strategies, and Trends by Gurdip Kaur, Springer-2023.

Reference Books:
1. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
2. Izzat Alsmadi , The NICE Cyber Security Framework: Cyber Security Intelligence and Analytics, Springer-2023.

References (Web Resources):
1. Digital Personal Data Protection Act 2023.pdf (meity.gov.in)
2. National Cyber Security Policy (draft v1 (meity.gov.in)
3. CISO_Roles_Responsibilities.pdf
4. Standards (bis.gov.in)
5. AI, Machine Learning & Big Data Laws & Regulations | India (globallegalinsights.com)

Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y B.Tech	Semester: IV
Course: Advanced Operations Research (DJS23XOE263)		

Pre-requisite:
1. Operation Research
2. Mathematics (Calculus)

Objectives:
1. To develop an ability to analyse the structure and mathematical model of various complex system occurring in manufacturing system, service system, and business applications.
2. To develop knowledge of the mathematical structure of linear and nonlinear optimization models.
3. To develop an understanding of the techniques used to solve linear and nonlinear optimization models using their mathematical structure.
4. To develop an understanding of the use of modelling languages for expressing and solving optimization models.

Outcomes: On completion of the course, learner will be able to:
1. Apply Duality theory to solve linear programming problem and analyse optimum solution.
2. Construct linear integer programming models and apply the O.R. algorithms and techniques to solve linear integer programming problems.
3. Determine best satisfying solution under a varying quantity of resources and priorities of the goals.
4. Set up decision models and solve nonlinear programming- unconstrained optimization problems.
5. Set up decision models and solve nonlinear programming- constrained optimization problems.

Advanced Operations Research (DJS23XOE263)		
Unit	**Description**	**Duration**
1.	**Dual Linear Programs** Primal, dual, and duality theory - The dual simplex method -The primal-dual algorithm- Duality applications. Post optimization problems: Sensitivity analysis.	07
2.	**Integer Programming** Pure and mixed integer programming problems, Solution of Integer programming problems – Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-one programming.	07
3.	**Goal Programming** Concept of Goal Programming, GP model formulations, Graphical method of GP, The simplex method of GP, Application areas of GP.	06
4.	**Nonlinear Programming- Unconstrained optimization** Minimization and maximization of convex functions- Local & Global optimum- Convergence-Speed of convergence. one-dimensional unconstrained optimization – Newton's method – Golden-section search method , multidimensional unconstrained optimization –Gradient method — steepest ascent (descent) method – Newton's method.	11
5.	**Nonlinear Programming- Constrained optimization**	11

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DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA: 3.18)

Department of Mechanical Engineering

	Constrained optimization with equality and inequality constraints. Lagrangian method - Sufficiency conditions - Kuhn-Tucker optimality conditions Rate of convergence - Engineering Applications Quadratic programming problems-convex programming problems.	
		42

Books Recommended:

Text Books:
1. Operations Research, Gupta, P. K. and Hira, D. S., S. Chand Publications, 2014.
2. Operations research: Principles and applications, Srinivasan, G., Prentice Hallof India, 2007.
3. Non-Linear Programming-A Basic Introduction, Nita H. Shah, Poonam Prakash Mishra, CRC Press, 2020.

Reference Books:
1. Introduction to Operations Research, Frederick S. Hillier & Gerald J. Lieberman, McGraw-Hill: Boston MA; 8th. (International) Edition, 2005.
2. Operations Research – Principle and Practice Ravindran, Philips and Soleberg, Second Edition, John Wiley, and sons, 2007.
3. Operations Research - An Introduction: Taha, H. A., Pearson Education, 2022.
4. Operations Research: models and methods, Paul A. Jensen, Jonathan F. Bard, Wiley Publications, 2003
5. Optimization Techniques in Operation Research, C. B Gupta, I.K. International Publishing House Pvt. Limited, 2008.

Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Corporate Finance Management (DJS23XOE264)		

Pre-requisite:
1. Nil

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

Outcomes: On completion of the course, learner will be able to:
1. Understand Indian finance system.
2. Apply concepts of time value money and risk returns to product, services and business.
3. Understand corporate finance and working capital management.
4. Take Investment and finance decisions.
5. Take dividend decisions.

Corporate Finance Management (DJS23XOE264)		
Unit	Description	Duration
1	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market. Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges.	09
2	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	09
3	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance-investment Decision, Financing Decision, and Dividend Decision.: **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements;	08

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

Department of Mechanical Engineering

	Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	
4	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value (NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)	08
5	**Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches — Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure **Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches — Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	08
	Total	42

Books Recommended:

Textbooks:
1. Financial Management, Theory & Practice 8th Edition (2011), by Prasanna Chandra: Tata McGraw Hill Education Private Limited, New Delhi.
2. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
3. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Reference Books:
1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, l0th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.

Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Corporate Social Responsibility (DJS23XOE265)		

Pre-requisite:
1. Nil

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

Outcomes: On completion of the course, the learner will be able to:
1. Upon completion of this course, students will be able to analyse and critique the ethical dimensions of Corporate Social Responsibility initiatives, demonstrating a comprehensive understanding of CSR principles and their ethical underpinnings.
2. Upon completion of this course, students will demonstrate an understanding of the legislative frameworks shaping Corporate Social Responsibility both in India and globally, alongside recognizing the key drivers fostering CSR practices within the Indian context.
3. Upon completion of this course, students will be able to identify and discuss the significance of social responsibility and community engagement initiatives, demonstrating an understanding of their impact on both businesses and society.

**Corporate Social Responsibility (DJS23XOE265)**		
Unit	**Description**	**Duration**
1	**Introduction to Corporate Social Responsibility (CSR)** - Understanding the concept of CSR - Historical evolution and development of CSR - Importance and benefits of CSR for businesses and society - Stakeholder theory and its relevance to CSR	08
2	**Ethical Foundations of CSR** - Ethical theories relevant to CSR (Utilitarianism, Deontology, Virtue Ethics) - Ethical decision-making frameworks in business - Corporate governance and ethics - Ethical issues in supply chain management	09
3	**CSR-Legislation in India and the World** Section 135 of Companies Act 2013.Scope for CSR Activities under Schedule VII, Appointment of Independent Directors on the Board, and Computation of Net Profit's Implementing Process in India	09
4	**The Drivers of CSR in India** Market based pressure and incentives, civil society pressure, the regulatory environment in India Counter trends, Review of current trends and opportunities in CSR, Review of successful corporate initiatives and challenges of CSR. Case Studies of Major CSR Initiatives Corporate Social Responsibility and Public-Private Partnership (PPP)	08
5	**Social Responsibility and Community Engagement**	08

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

Department of Mechanical Engineering

	- Social issues and challenges in contemporary society - Corporate philanthropy and community development initiatives - Stakeholder engagement strategies - Corporate volunteering and employee engagement programs - CSR as a strategic business tool vital for sustainable development		
		Total	**42**

Books Recommended:

Text Books:
1. Andrew Crane, Dirk Matten , "Corporate Social Responsibility: Definition, Core Issues, and Recent Developments" Oxford University Press.
2. O. C. Ferrell, John Fraedrich, Linda Ferrell , "Business Ethics: Ethical Decision Making & Cases", Cengage Learning
3. Corporate Social Responsibility in India, Sanjay K Agarwal, Sage Publications, 2008
4. Corporate Social Responsibility in India, Bidyut Chakrabarty, Routledge, New Delhi, 2015

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

Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Bioinformatics (DJS23XOE266)		

Pre-requisite:
1. Nil

Course Objectives:
1. To provide an overview of bioinformatics and its significance in modern biological research.
2. To enable students to apply bioinformatics methods in practical scenarios for biological data analysis and interpretation.

Course Outcomes: Upon successful completion of this course, students will be able to:
1. Understand the structure and function of cells, organelles, and biomolecules.
2. Understand the types of data stored in bioinformatics databases and their relevance to biological research.
3. Explore genomic databases and understand the structure and content of protein databases.
4. Understand system biology concepts and molecular evolution.
5. Apply knowledge of cellular and molecular biology concepts to analyze a biological problem.

Bioinformatics (DJS23XOE266)		
Unit	Description	Duration
1	**Module 1: Foundations of Molecular and Cellular Biology** **Introduction to molecular biology:** DNA, RNA, proteins, and their roles in cellular processes **Cell structure and function:** Organelles, membrane structure, and cellular transport **Cell cycle regulation:** phases of the cell cycle, checkpoints, and cell cycle control mechanisms	09
2	**Module 2: Genetics and Genomics** **Mendelian genetics:** Inheritance patterns, Punnett squares, and genetic crosses **Chromosome structure and organization:** karyotyping, gene mapping, and genetic linkage **Introduction to genomics:** genome structure, organization, and variation Techniques in molecular genetics: PCR, DNA sequencing, and gene cloning	09
3	**Module 3: Genomic and Protein Databases** Types of genomic databases such as GenBank, Ensemble, and UCSC Genome Browser, Understand the structure and content of protein databases such as UniProt and Protein Data Bank (PDB), Searching, Retrieving, and Analysing Genomic and Protein data from online databases.	08
4	**Module 4: Systems Biology** **Introduction to Systems Biology**: Modeling biological systems and network analysis, Bioinformatics tools for systems biology and modeling complex biological processes. **Principles of molecular evolution**: Mutation, Selection, and genetic drift.	08

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

Department of Mechanical Engineering

	Phylogenetic analysis: Tree construction, sequence alignment, and molecular clock.		
5	**Module 5: Applications and Case Studies** Applications of Bioinformatics in Medicine, Agriculture, and Biotechnology, Case Studies (Integrating Cellular and Molecular Biology with Bioinformatics) and Research Examples, Ethical and Legal Issues in Bioinformatics, Future Trends and Emerging Technologies in Bioinformatics.		08
		Total	42

Books Recommended:

Textbooks:
1. Bioinformatics For Dummies", Jean-Michel Claverie and Cedric Notredame, For Dummies. (2019)
2. Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner, Active Learning Publishers (2019)

Reference Books:
1. Introduction to Bioinformatics, Arthur Lesk, Biologist & Bioinformatics Expert, 2019
2. Introduction to Biomedical Data Science, Robert Hoyt, Informatics Education, 2019
3. Python for Biologists: A Complete Programming Course for Beginners, Martin Jones, Oxford University Press, 2013
4. An Introduction to Bioinformatics Algorithms, Neil C. Jones, and Pavel A. Pevzne, MIT Press,2004.
5. Exploring Bioinformatics: A Project-Based Approach, Caroline St. Clair, and Jonathan E. Visick, Jones & Bartlett Learning, 2014.

Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y. B.Tech.	Semester: IV
Course: Human Resource Management (DJS23XOE267)		

Pre-requisite:
1. Nil

Objectives:
1. To introduce the students with basic concepts, techniques and practices of the human resource management
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
3. To familiarize the students about the importance of the labour relations in the organization.

Outcomes: On completion of the course, the learner will be able to:
1. Understand and distinguish the changing environment of the HRM and the role of the HR managers.
2. Understand and analyse the recruitment process and the application of the IT.
3. Understand and examine the importance of the training and development.
4. Understand and determine the pay plans, performance appraisal and compensation.
5. Understand and explain the importance of the labour relation, the employee security and collective bargaining.

Human Resource Management (DJS23XOE267)		
Unit	Description	Duration
1	**Human Resource Function** Human Resource Philosophy – Changing environments of HRM – Strategic human resource management – Using HRM to attain competitive advantage – Trends in HRM – Organisation of HR departments – Line and staff functions – Role of HR Managers.	08
2	**Recruitment & Placement** Job analysis: Methods - IT and computerised skill inventory - Writing job specification - HR and the responsive organisation. Recruitment and selection process: Employment planning and forecasting - Building employee commitment: Promotion from within - Sources, Developing and Using application forms - IT and recruiting on the internet. Employee Testing & selection: Selection process, basic testing concepts, types of test, work samples & simulation, selection techniques, interview, common interviewing mistakes, Designing & conducting the effective interview, small business applications, computer aided interview.	10
3	**Training & Development** Orientation & Training: Orienting the employees, the training process, need analysis, Training techniques, special purpose training, Training via the internet. Developing Managers: Management Development - The responsive managers - On-the-job and off the-job Development techniques using HR to build a responsive organisation.	08

Department of Mechanical Engineering

	Performance appraisal: Methods - Problem and solutions - MBO approach - The appraisal interviews - Performance appraisal in practice. Managing careers: Career planning and development - Managing promotions and transfers.	
4	**Compensation & Managing Quality** Establishing Pay plans: Basics of compensation - factors determining pay rate - Current trends in compensation - Job evaluation - pricing managerial and professional jobs - Computerised job evaluation. Pay for performance and Financial incentives: Money and motivation - incentives for operations employees and executives - Organisation wide incentive plans - Practices in Indian organisations. Benefits and services : Statutory benefits - non-statutory (voluntary) benefits - Insurance benefits -retirement benefits and other welfare measures to build employee commitment.	08
5	**Labour relations and employee security** Industrial relation and collective bargaining: Trade unions - Collective bargaining - future of trade unionism. Discipline administration - grievances handling - managing dismissals and separation. Labour Welfare: Importance & Implications of labour legislations - Employee health - Auditing HR functions, Future of HRM function.	08
	Total	**42**

Books Recommended:

Text Books:
1. Pattanayak, Biswajeet, Human Resource Management, 6th Ed,PHI Learning Pvt. Ltd., 1 Jul 2020
2. Gary Dessler, Human Resource Management, 16th Ed, Pearson Publications, 2020

Reference Books:
1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
3. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
4. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
5. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications
6. Raymond J. Stone, Anne Cox, Mihajla Gavin, Human Resource Management, 10th Ed,John Wiley & Sons, 14 Dec 2020.
7. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing.

Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Digital Marketing Management (DJS23XOE268)		

Pre-requisite:
1. Nil

Objectives:
1. Explain the evolution and technology of digital marketing, including underlying frameworks.
2. Understand digital business strategy and emerging business structures.
3. Cover digital marketing planning, operations setup, and implementation of search campaigns, alongside emerging concepts like Big Data, IoT, SMB, B2B marketing, and SoLoMo.

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

Digital Marketing Management (DJS23XOE268)		
Unit	Description	Duration
1	**Introduction to Digital Marketing** Emergence of Digital Marketing as a tool, media consumption drivers for new marketing environment, applications and benefits of digital marketing. **Digital Marketing Framework** Delivering enhanced customer value, market opportunity analysis and digital services development, ASCOR framework **Digital Marketing Models Creation** Factors impacting digital marketplace, value chain digitization, business models. **The Consumer for Digital Marketing** Consumer behavior on the internet, evolution of consumer behavior models, managing consumer demand, integrated marketing communications (IMC)	07
2	**Digital marketing Strategy Development** Elements of assessment phase, macro-micro environmental analysis, marketing situation analysis. **Digital Marketing Internal Assessment and Objectives Planning** Analyzing present offerings mix, marketing mix, core competencies analysis and internal resource mapping. Digital presence analysis, digital marketing objectives development and review. **Digital Marketing Strategy Definition** Understanding digital business strategy and structures, consumer development strategy, offering mix for Digital, digital pricing models, managing promotional channels and developing the extended Ps- People, process, programs and performance.	12

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

Department of Mechanical Engineering

	Digital marketing Strategy Roadmap Developing digital marketing strategy roadmap, the 6s digital marketing implementation strategy, marketing across the product life cycle.	
3	**Digital Marketing Planning and Setup** Understanding digital media planning terminology and stages, steps to creating marketing communications strategy, introduction to search marketing, display marketing, social media marketing. **Digital Marketing Operations Setup** Basics of lead generation and conversion marketing, website content development and management, elements of user experience, web usability and evaluation.	**08**
4	**Digital marketing Execution** Basic elements of digital campaign management, search execution, display execution, social media execution, content marketing. **Digital marketing Execution Elements** Digital revenue generation models, managing service delivery and payments, managing digital implementation challenges like e commerce, internal & external and consumer specific challenges.	**08**
5	**Digital Business – Present and Future** Digital Marketing – Global Landscape, digital marketing overview – global spend, advertising spend, and technology/tools landscape. Data technologies (Big data and IOT) impacting marketing, segment based digital marketing and SoLoMo – the next level of hyperlocal marketing.	**07**
	Total	**42**

Books Recommended:

Text Books:
1. Fundamentals of Digital Marketing by Puneet Singh Bhatia, Pearson Education Limited,2017
2. Digital Marketing by Seema Gupta- McGraw Hill Education, 2022

Reference Books:
1. Digital Marketing Excellence: Planning, Optimizing and Integrating Online Marketing by Dave Chaffey and P. R. Smith, 5 th edition, Taylor & Francis, 2017
2. Digital Marketing: Strategy, Implementation and Practice- 6 th edition by Dave Chaffey Fiona Ellis-Chadwick, Pearson Education Limited,2019
3. Digital marketing by Vandana Ahuja, Oxford University Press, 2015
4. The Art of Digital Marketing by Ian Dodson, John Wiley & Sons, 2016

Department of Mechanical Engineering

Program: Open Elective for all Programs	S.Y B.Tech.	Semester: IV
Course: Logistics and Supply Chain Management (DJS23XOE269)		

Pre-requisite:
1. Latest trend of information technology in retail industry and logistic applications.

Objectives:
1. To develop advanced strategic thinking skills in supply chain management and logistics to effectively analyse and optimize supply networks.
2. To attain proficiency in leveraging cutting-edge tools and technologies to enhance supply chain efficiency and supply chain transformation.
3. Design and implement collaborative supply chain and sourcing strategies to promote information sharing and optimise coordination.

Outcomes: On completion of the course, learner will be able to:
1. Develop a sound understanding of the important role of supply chain management in today's business environment.
2. Develop criteria and standards to achieve improved business performance by integrating and optimizing the total logistics and supply-chain process.
3. Summarize the value of focusing on information business logistics systems which drives improved accuracy and decision-making at all levels of management.
4. Become familiar with current supply chain information technology management trends.
5. Use available technologies to enhance work performance and support supply chain functions, processes, transactions, and communications.

Logistics and Supply Chain Management (DJS23XOE269)		
Unit	**Description**	**Hours**
1	**Introduction** What Is Supply Chain Management? The Development Chain, Global Optimization, Managing Uncertainty and Risk, The Complexity in Supply Chain Management, Key Issues in Supply Chain Management.	05
2	**Network planning** Introduction, Network Design- Data Collection, Data Aggregation, Transportation Rates, Mileage Estimation, Warehouse Costs, Warehouse Capacities, Potential Warehouse Locations, Service Level Requirements, Future Demand, Model and Data Validation, Solution Techniques, Key Features of a Network Configuration Supply Chain Planning; Inventory Positioning and Logistics Coordination -Strategic Safety Stock.	07
3	**THE VALUE OF INFORMATION** Introduction, The Bullwhip Effect-Quantifying the Bullwhip Effect, The Impact of Centralized Information on the Bullwhip Effect, Methods for Coping with the Bullwhip Effect, Information Sharing and Incentives, Effective Forecasts, Information for the Coordination of Systems, Locating Desired Products, Lead-Time Reduction,	08

Department of Mechanical Engineering

	Information and Supply Chain Trade-offs-Conflicting Objectives in the Supply Chain, Designing the Supply Chain for Conflicting Goals ,Decreasing Marginal Value of Information.	
4	**Supply chain integration** Introduction, Push, Pull, and Push-Pull Systems-Push-Based Supply Chain, Pull-Based Supply Chain, Push-Pull Supply Chain ,Identifying the Appropriate Supply Chain Strategy, Implementing a Push-Pull Strategy The Impact of Lead Time Demand-Driven Strategies The Impact of the Internet on Supply Chain Strategies-what is E-Business, the Grocery Industry , the Book Industry , the Retail Industry and Impact on Transportation and Fulfillment.	08
5	**Information Technology and Business Process** Introduction, The Importance of Business Processes, Goals of Supply Chain IT Supply Chain Management System Components, Decision-Support Systems IT for Supply Chain Excellence, Sales and Operations Planning Integrating Supply Chain Information Technology. Implementation of ERP and Decision Support System.	07
6	**Technology standards** Introduction, IT Standards, Information Technology Infrastructure-Interface Devices, System Architecture and Electronic Commerce. Service-Oriented Architecture (SOA)-Technology Base: IBM and Microsoft and ERP Vendor Platform: SAP and Oracle. Radio Frequency Identification (RFID)- applications, point of sale data , business benefits and supply chain efficiency.	07
	Total	42

Books Recommended:

Text Books:
1. Sunil Chopra, Peter Meindl "Supply Chain Management-Strategy, Planning, and Operation", Pearson Publications 2016
2. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, "Designing and Managing the Supply Chain-Concepts, Strategies, and Case Studies", McGraw-Hill/Irwin 2008

Reference Books:
1. Ian Sadler, "Logistics and Supply Chain Integration", SAGE Publications, 2007
2. Donald Waters, "Supply Chain Management - An Introduction to Logistics", Bloomsbury Publishing, 2019
3. Dimitris Folinas, "E-Logistics and E-Supply Chain Management-Applications for Evolving Business, IGI Global publications, 2013
4. Martin Christopher, "Logistics & Supply Chain Management", Pearson Education publications, 2016

Department of Mechanical Engineering

Program: Common to all Programs.	Group B	S.Y B. Tech.	Semester: IV
Course: Design Thinking Laboratory (DJS23XHS283L)			

Pre-requisite:
1. Basic understanding with the development life cycle of products, processes, software, or services.
2. Basic knowledge of iterative frameworks (not mandatory).

Course Objectives:
1. To introduce students to the fundamentals, history, and importance of design thinking and its role in solving complex, real-world problems.
2. To develop students' empathy and user-research skills by teaching them how to gather insights, create personas, and map user journeys.
3. To equip students with the skills to define and reframe problem statements effectively, identifying opportunity areas and stakeholder touchpoints.
4. To foster creative ideation, prototyping, and testing skills through hands-on exercises that incorporate strategic innovation and rapid prototyping techniques.

Course Outcomes: On completion of the course, the learner will be able to:
1. Understand and apply the design thinking process to analyze and solve real-world problems.
2. Develop the ability to empathize with users, create user personas, and design empathy and journey maps tailored to specific challenges.
3. Demonstrate proficiency in defining clear and actionable problem statements that uncover areas of opportunity.
4. Generate diverse ideas using ideation techniques, such as brainstorming and SCAMPER, to approach problem-solving creatively and collaboratively.
5. Create and test prototypes, iterating based on feedback and validating solutions through digital platforms and peer review.

Design Thinking Laboratory (DJS23XHS283L)		
Unit	**Syllabus Content**	**Duration**
1	**Introduction to Design Thinking and Strategic Innovation** • Understanding the fundamentals of design thinking. • Exploring the history and evolution of design thinking. • The importance of empathy in the design thinking process. • Conduct market & industry research by observing and contextualizing various macro & micro trends. • Case Study - conduct their research on how Design Thinking helped solve some of the biggest and most critical problems of our time. **Design Thinking for Strategic Innovation**: • Types of innovations, strategic innovation. • Features of strategic innovation. • Design thinking and strategic innovation. • Practices of integrating design thinking in strategic innovation.	**08**

Department of Mechanical Engineering

2	**Empathize Phase**	**04**
	• Techniques for conducting user research and gathering insights.	
	• Creating user personas and empathy maps.	
	• Practicing active listening and observation skills.	
	• To apply various empathizing techniques to the problem statement selected.	
	• Use walk-a-mile immersion and heuristic reviews to first empathize with end users and then to build an empathy map and customer journey map.	
3	**Define Phase**	**04**
	• Defining problem statements and reframing challenges.	
	• Tools for synthesizing research findings.	
	• Developing a clear and actionable problem statement.	
	• Start building from Persona map and conduct interviews/ Gemba walk to plot user's journeys from start to end.	
	• Define the problem space using the HMW statement. Now highlight areas of opportunities in the journey map and enlist potential channels/touchpoints as well as stakeholders for proposed solution interventions.	
4	**Ideate Phase**	**06**
	• Generating creative ideas through brainstorming sessions.	
	• Techniques for divergent and convergent thinking.	
	• Prototyping and experimenting with ideas.	
	• Apply suitable ideation techniques to quickly generate diverse ideas that could be applied to target problem space – either partially or in full.	
	• Brain Writing – Build on each other's ideas and constructively & creatively develop better ideas using SCAMPER technique.	
	• Evaluation of ideas	
5	**Prototype and Validation**	**06**
	• Introduction to prototyping tools and techniques.	
	• Rapid prototyping methods.	
	• Testing prototypes with users and gathering feedback.	
	• Refining solutions based on user insights.	
	• Develop user storyboard to layout solution proposition in visual and easily explainable form. Run a quick peer validation.	
	• peer-validated the storyboard.	
	• Build an interactive digital prototype using any digital rapid prototyping platform and seek user validation.	
	Total	**28**

List of Experiments:
- Below is a list of assignments/ activities/ experiments that would be carried out by students as a mini project in groups consisting of 3-4 students.
- Problem statement for these assignments/ activities/ experiments will be provided by facilitator/ instructor/ faculty to the groups/ teams/ batches within each class.

Department of Mechanical Engineering

- This list of experiments will help students learn various design thinking methods and practice the corresponding tools available.

Sr. No.	Name of the Experiment
1	To conduct market and industry research and analyze case studies demonstrating the application of design thinking.
2	To exercise empathizing techniques to understand the needs and pain points of a target audience.
3	Developing empathy maps and customer journey maps based on collected insights.
4	To exercise different tools and techniques (such as affinity diagrams, journey mapping, and user story mapping) for synthesizing research findings.
5	Develop user personas to represent different user archetypes and their needs concerning the problem at hand.
6	To practice the SCAMPER technique, Brainstorming, and brain-writing as a collaborative ideation technique to create multiple creative ideas/ solutions for the problem at hand.
7	Create a mind map to generate a wide range of solutions to a problem at hand.
8	To explore different prototyping tools and platforms, such as Adobe XD, Figma, Sketch, and In Vision.
9	To Conduct rapid prototyping sessions to build low fidelity / High fidelity prototypes based on the ideas generated in the Ideation phase and iterate based on feedback received.
10	Develop a plan for implementing the final solution, considering factors like scalability and feasibility.
11	Conduct usability testing to gather feedback on prototypes. Use A/B testing to compare different versions of a solution and determine which performs better.

Note – A minimum of five experiments from the above-suggested list or any other assignment based on the syllabus will be included, which would help the learner to apply the concept. The mini-project is mandatory.

Books Recommended

Textbooks:
- I. Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", Wiley, 2013.
- M. Lewrick, P. Link, and L. Leifer, "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems", Wiley, 2018.
- T. Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", Allworth Press, 2010.
- K. T. Ulrich and S. D. Eppinger, "Product Design and Development", McGraw-Hill Hill Education, 6th Edition, 2016.
- C. J. Meadows and C. Parikh, "The Design Thinking Workbook: Essential Skills for Creativity and Business Growth", Emerald Publishing, 2022.

Reference books:
- T. Kelley and D. Kelley, "Creative Confidence: Unleashing the Creative Potential Within Us All", HarperCollins Publisher, 2013.

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

Department of Mechanical Engineering

- T. Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", HarperCollins, 2013.
- J. Knapp, J. Zeratsky, and B. Kowitz, "Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days", Simon & Schuster, 2016.
- Chakrabarti, "Engineering Design Synthesis: Understanding, Approaches and Tools", Springer, 2002.
- K. Otto, and K. Wood, "Product Design", Prentice Hall, 2000.

*Web Resources***:**
1. **Design and Innovation:**
   a. https://openstax.org/books/entrepreneurship/pages/4-suggested-resources
2. **Overview of Design Thinking:**
   a. https://www.interaction-design.org/literature/topics/design-thinking
   b. 10 Models for Design Thinking. In 2004, business consultants Hasso… | by Libby Hoffman | Medium
   c. https://www.tcgen.com/design-thinking/#What_is_Design_Thinking_and_How_Does_it_Relate_to_Product_Development
3. **Understand, observe and define the problem:**
   a. https://www.nngroup.com/articles/empathy-mapping/
   b. https://uxdesign.cc/the-purpose-of-a-journey-map-and-how-can-it-galvanize-action-9a628b7ae6e
4. **Ideation and prototyping**:
   a. https://www.interaction-design.org/literature/topics/prototyping
   b. https://www.uxmatters.com/mt/archives/2019/01/prototyping-user-experience.php
5. **Testing and implementation:**
   a. https://www.nngroup.com/articles/usability-testing-101/
   b. https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning
6. **Design thinking in various sectors:**
   a. https://www.tutorialspoint.com/design_thinking/design_thinking_quick_guide.htm

Swayam Courses:
1. Creative Engineering Design (https://nptel.ac.in/courses/107108010)
2. Understanding Creativity and Creative Writing (https://nptel.ac.in/courses/109101017)
3. Understanding Design Thinking & People Centred Design (https://nptel.ac.in/courses/109104109)
4. Design Thinking - A Primer (https://nptel.ac.in/courses/110106124)
5. Product Engineering and Design Thinking (https://nptel.ac.in/courses/112105316)

Laboratory: (Term work)
The distribution of marks for term work shall be as follows:

     Laboratory work (Performance of Experiments, Write-up): 15Marks

Mini Project (Report and Presentation): 10 Marks

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

Department of Mechanical Engineering

Program: All Program		S.Y B. Tech	Semester: III / IV
Course: Universal Human Values (DJS23XHS284)			
Course: Universal Human Values Tutorial (DJS23XHS284T)			

Objectives:
1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Outcomes: On completion of the course, the learner will be able to:
On completion of this course, the students will be able to
1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

Universal Human Values (DJS23XHS284)		
Unit	**Description**	**Duration**
1	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels	5
2	**Understanding Harmony in the Human Being - Harmony in Myself** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body'. Understanding the Body	5

Department of Mechanical Engineering

	as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Self-regulation and health.	
3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding harmony in the Family- the basic unit of human interaction, understanding values in human-human relationship; meaning of Justice and program for its fulfillment. Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family). Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family!	9
4	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence	4
5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics:** Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.	5
	Total	**28**

Universal Human Values Tutorial (DJS23XHS284T): (Term work)
Term work shall consist of a minimum 5 activities based on activities conducted.
The tutorials could be conducted as per the following topics: -

Activity No 1	Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony, and co-existence) rather than as arbitrariness in choice based on liking-disliking.
Activity No 2	Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Department of Mechanical Engineering

Activity No 3	Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.
Activity No 4	Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.
Activity No 5	Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

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

Books Recommended:

Text books:
- R R Gaur, R Sangal, G P Bagaria, 'Human Values and Professional Ethics' Excel Books, New Delhi, 2010.

Reference Books:
- A Nagaraj, "Jeevan Vidya: Ek Parichaya" Jeevan Vidya Prakashan, Amarkantak, 1999.
- A.N. Tripathi, "Human Values" New Age Intl. Publishers, New Delhi, 2004.
- The Story of Stuff (Book).
- Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth".
- E. F Schumacher, "Small is Beautiful".
- Cecile Andrews, "Slow is Beautiful".
- J C Kumarappa, "Economy of Permanence".
- Pandit Sunderlal, "Bharat Mein Angreji Raj".
- Dharampal, "Rediscovering India".
- Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule".
- Maulana Abdul Kalam Azad, "India Wins Freedom".
- Romain Rolland, "Vivekananda". (English)
- Romain Rolland, "Gandhi". (English)

Department of Mechanical Engineering

Program: Mechanical Engineering	S.Y. B. Tech.	Semester: IV
Course: Computer Aided Machine Drawing Laboratory (DJS23MSC251L)		

Objectives:
1. To study conventional representation of various machining and mechanical details.
2. To impart knowledge and skills of CAD modelling software.
3. To become conversant with 3D drafting of machine components from the given assembly/detail drawing.

Outcomes: Learner will be able to…
1. Visualize and interpret the machine components from the given assembly/detail drawing.
2. Using CAD software, prepare 3D models of the machine components from the given assembly/detail drawing.
3. Conversion of detailed drawings to assembly drawings and assembly drawings to detailed drawings.

Computer Aided Machine Drawing Laboratory (DJS23MSC251L)		
Unit	Description	Duration
1	**Introduction**: Introduction of CAD Softwares, Review of graphic interface, various tools and settings for preparation of graphics workspace. Introduction of basic sketching commands (Line, circle, arc, rectangle, slot, spline, fillet, polygon, text, dimensioning, etc.) modify commands (move, trim, copy, replace, extend, split, offset, etc.), feature commands (extrude, revolve, loft, sweep, rib, coil, emboss, etc.) and navigational commands (Pan, zoom in, zoom out, orientation, etc.). Types of drawing sheets and its sizes, Drawing units, grid and snap, title block. Conversion of 3D views into orthographic projections of simple machine parts like (nuts, bolts, keys, screws, springs, etc.), Editing, Hidden line view, shaded view, render view, presentation of various views along with different orientations.	10
2	**Details and assembly drawings**: Types of assembly drawings, part drawings, drawings for catalogues and instruction manuals, patent drawings, drawing standards, Introduction to unit assembly drawing, steps involved in preparing assembly drawing from details and vice-versa. **Geometric Dimensions and Tolerances (GD&T):** Introduction of Limits, fits, deviations, and tolerances with their applications, dimensioning with tolerances indicating various types of fits in details and assembly. **Threaded Fasteners**: Types of threads, thread designation, Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External), Square, Acme and American Standard thread, Conventional representation of threaded parts.	8
3	**Preparation of details/assembly drawings of Machinery parts, Joints, Keys and Couplings:** **Machinery parts:** Clapper block, Single tool post, Lathe and Milling tail stock, jigs and fixtures. **Joints and Keys:** Cotter joints, knuckle joints, taper key, feather key, woodruff key, etc.	12

Department of Mechanical Engineering

	Couplings: Muff coupling, flanged coupling, Protected type flange coupling, Pin type flexible coupling, Oldham's coupling and Universal Coupling.	
4	**Preparation of details / assembly drawings of Bearings** Solid bearing, Bushed bearing, Pedestal bearing/Plummer block and footstep bearing. **Preparation of details / assembly drawings of pulleys, Pipe joints: Pulleys:** Flat belt pulleys, V-belt pulleys, rope pulleys, Fast and loose pulleys. **Pipe joints:** Flanged joints, Socket and spigot joint, Gland and stuffing box expansion joint and Union joint.	12
5	**Preparation of details / assembly drawings of Valves:** Air cock, blow off cock, Steam stop valve, Gate valve, Globe valve and Non-Return Valve. **Preparation of details / assembly drawings of I.C. Engine parts:** Piston, Connecting rod, Crankshaft, Carburetor, Injector and Spark plug. **Introduction to Reverse Engineering: Historical** Background, scope and task of Reverse Engineering in Modern Industries.	14
	TOTAL	56

List of Laboratory Experiments (Any Six):
1. General machine elements - nuts, bolts, keys, cotter, screws, springs, etc. (any one)
2. Details/Assembly of Clapper block, Single tool post, Lathe and Milling tail stock, jigs and fixtures. (any one)
3. Details/Assembly of coupling - simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling. (any one)
4. Details/Assembly of ball and roller bearing, Pedestal bearing, footstep bearing. (any one)
5. Details/Assembly of different types of pulleys. (any one)
6. Details/Assembly of pipe joints - Flanged joints, Socket and spigot joint, Gland and stuffing box, expansion joint. (any one)
7. Details/Assembly of Air cock; Blow off cock, Steam stop valve, Gate valve, Globe valve, Non return Valve. (any one)
8. Details/Assembly of Piston, Connecting rod, Cross head, Crankshaft, Carburetor, Fuel pump, injector, and Spark plug. (any one)

Term work
Printouts / plots of the problems solved in practical class from the practical part of each module. Problems from practical parts of each module should be solved using any standard CAD packages like Autodesk Inventor, Fusion 360, PRO-E, CATIA, Solid Works, etc.

The distribution of marks for Term work shall be as follows:
- Printouts/Plots… ....   40 marks
- Attendance & participation …   10 marks

End Semester Practical & Oral examination:
To be conducted by pair of Internal and External Examiner
1. Practical examination duration is **three hours**, based on the Term work, and should contain two sessions as follows:

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	DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING	
	(Autonomous College Affiliated to the University of Mumbai)	
	NAAC Accredited with "A" Grade (CGPA: 3.18)	

Department of Mechanical Engineering

Session-I: Preparation of minimum five detailed 3-D part drawings from given assembly drawing**.**

Session-II: Preparation of 3-D models of parts, assembling parts and preparing views of assembly from given detailed drawing.

Oral examination should also be conducted to check the knowledge of conventional and CAD drawing.

2. Questions provided for practical examination should contain a minimum of five and not more than ten parts.

3. The distribution of marks for practical examination shall be as follows:
   - **Session-I ....** 20 marks
   - **Session-II..............** 20 marks
   - **Oral.....................** 10 marks
4. Evaluation of practical examination to be done based on the printout of student's work.

Books Recommended:

Reference Books:
- N.D. Bhatt, Machine Drawing, N.D. Bhatt, Charotar Publishing Home Pvt. Ltd, 51st Edition, 2022.
- K.I. Narayana, P. Kannaiah and K. Venkata Reddy, Machine Drawing, New Age International (P) Limited, Publishers. 5th Edition, 2016,
- K. C. John, Textbook of Machine Drawing 2010, PHI Learning Pvt. Ltd. New Delhi,2010.
- M. B. Shah, Engineering Drawing Pearson Education India. 2nd Edition, 2009
- Laxminarayan and M.L.Mathur, A textbook of Machine Drawing, 3rd Edition, Jain Brothers Delhi. 2017,
- R.B.Gupta, A textbook of Machine Drawing Satyaprakashan, Tech. Publication. 10th Edition, 2019,
- R. K. Dhawan, A textbook of Machine Drawing, S. Chand Publication ,2006.

Department of Mechanical Engineering

Program: Mechanical Engineering	S. Y. B.Tech	Semester: IV

Course: Advanced Manufacturing Process Laboratory (DJS23MSC252L)

Pre-requisite:
1. Knowledge of fundamental machining techniques and various manufacturing processes.

Objectives:
1. To apply safety precautions and adhere to norms while demonstrating effective interpersonal skills for successful teamwork and hands-on learning.
2. To evaluate the effects of process parameters on various responses in non-conventional machining processes.
3. To fabricate a simple component using 3D printing techniques, and to fabricate and assemble mechanical components by applying various manufacturing techniques. To demonstrate expertise in CNC control systems by determining parameters and executing CNC programs for a range of machining operations.

Outcomes: On completion of the course, the learner will be able to:
1. Demonstrate lifelong learning with a commitment to professional, safety, environmental, and social responsibilities for career excellence.
2. Fabricate and assemble mechanical components using diverse manufacturing techniques.
3. Assess the effects of process parameters on MRR, TWR in EDM of mild steel, and DOP, HOC in ECDM of glass.
4. Apply engineering expertise in additive manufacturing for the creation of functional 3D printed models.
5. Exhibit CNC control systems, compute technological parameters, and develop, simulate, and execute CNC programs for various machining operations.

Advanced Manufacturing Process Laboratory (DJS23MSC252L)		
Exp.	**Experiment**	**Duration**
1	To fabricate and assemble mechanical components through the application of conventional, non-conventional, and advanced manufacturing techniques.	16
2	To analyze the influence of process parameters on the EDM process and determine the material removal rate (MRR), tool wear rate (TWR), and surface roughness of mild steel (M.S) using a copper electrode.	06
3	To examine the effects of process parameters on ECDM and determine the depth of penetration (DOP) and hole overcut (HOC) in glass using a tungsten carbide electrode	06
4	To fabricate a simple component using one of the 3D Printing techniques below 1) Selective laser printing (SLS) 2) Stereolithography (SLA) 3) Fused deposition modelling (FDM).	12
5	To program, simulate, and fabricate a component on a CNC Vertical Machining Center, involving part programming, interpolation, contour motion, pocket milling (circular and rectangular), and mirror commands etc.	16
	Total	**56**

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DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA: 3.18)

Department of Mechanical Engineering

Program: Mechanical Engineering	S.Y. B.Tech	Semester: IV
Course: Innovative Product Development II (DJS23XSC251P)		

Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value-added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualize and create a successful product.

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

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualizing a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyze the impact of the proposed design and development of the product.
5. Develop product/project management skills, interpersonal skills, self-learning and effective communication eventually preparing them to be successful entrepreneurs.

Guidelines for the proposed product design and development:

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
- Students should carry out a survey and identify the need, which shall be converted into conceptualization of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students should recognize the essential requirements for product development and choose the most suitable design in consultation with the faculty supervisor.
- Students shall transform the most appropriate design solution into a functional model, incorporating components from their specific domain and related interdisciplinary fields.
- Throughout the two-semester duration of the activity, faculty supervisors will provide guidance to students, with a primary emphasis on self-directed learning.
- Each team is required to maintain an activity log-book, where they can document their weekly progress. The guide or supervisor should review the recorded notes and comments and provide approval on a weekly basis.
- Students should validate the design solution with appropriate justifications and compile a report in a standard format for submission to the department. Additionally, students are encouraged to make efforts to publish a technical paper, either in the institute journal 'Techno Focus: Journal for Budding

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

Department of Mechanical Engineering

Engineers' or in a suitable publication approved by the department's research committee or the Head of the department.

- The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, i.e. during the semesters III and IV.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
- Distribution of marks individually for the both reviews as well as for the first review during the subsequent semester shall be as given below:
  - Marks awarded by the supervisor based on log-book: 10
  - Marks awarded by review committee: 10
  - Quality of the write-up: 05

- A candidate needs to secure a minimum of 50% marks.

Review/progress monitoring committee may consider the following points during the assessment.

- In the semester III, the entire design proposal shall be ready, including components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.
  - First shall be for finalization of the product selected.
  - Second shall be on finalization of the proposed design of the product.
- In the semester IV, the expected work shall be procurement of components/systems, building of the working prototype, testing and validation of the results based on work completed in semester III.
  - First review is based on readiness of building the working prototype.
  - Second review shall be based on a presentation as well as the demonstration of the working model, during the last month of semester IV. This review will also look at the readiness of the proposed technical paper presentation of the team.

The overall work done by the team shall be assessed based on the following criteria;
1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.

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

Department of Mechanical Engineering

6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

- The semester reviews (III and IV) may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.
- The evaluation of the product's design and development will involve a presentation and demonstration of the working model by the student team. This assessment will be conducted before a panel of Internal and External Examiners, preferably with more than five years of experience in industry or research organizations. The Head of the Institution approves the selection of these examiners. The presence of an external examiner is desirable only for the second presentation during semester IV. Additionally, students are required to present an outline of the technical paper they have prepared during the final review in semester IV.