



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE
JECRC Campus ,Shri Ram ki Nangal, Via-Vatika ,Tonk Road, Jaipur
Department of Mechanical Engineering

Name of Subject: Design of Machine Elements-I(DME-I)

Subject Code: 5ME7-11

Year: 3rd Year, 5th Semester



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Department of Mechanical Engineering

Vision and Mission of Institute:

Vision: To become a renowned center of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

Mission:

M1: Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2: Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3: Offer opportunities for interaction between academia and industry.

M4: Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Vision and Mission of Department:

Vision: The Mechanical Engineering Department strives to be recognized globally for outcome based technical knowledge and to produce quality human resource, who can manage the advance technologies and contribute to society.

Mission:

M1: To impart quality technical knowledge to the learners to make them globally competitive mechanical engineers.

M2: To provide the learners ethical guidelines along with excellent academic environment for a long productive career.

M3: To promote industry-institute relationship.



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Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1: To equip graduates with a strong foundation in engineering sciences, with an emphasis on mechanical engineering principles, enabling them to analyze, design, and solve real-world engineering challenges.

PEO2: To prepare graduates with sound scientific and engineering fundamentals to innovate and deliver effective solutions addressing practical challenges in mechanical engineering

PEO3: To inculcate in graduates a professional and ethical attitude, effective communication and teamwork skills, a multidisciplinary approach, entrepreneurial mindset, and the ability to connect engineering solutions with societal and environmental concerns.

PEO4: To provide students with an academic environment that fosters excellence, leadership, adherence to ethical standards, and encourages self-motivated lifelong learning essential for a successful professional career in mechanical

PEO5: To prepare students to excel in industry and higher education by providing quality education grounded in strong technical knowledge and high moral values

Program Specific Outcomes (PSOs)

PSO1: Graduates will be able to design, analyze, and fabricate electric and hybrid vehicles using modern engineering tools and sustainable practices.

PSO2: Graduates will be able to apply design principles and computational techniques, including programming and data structures, to analyze and solve mechanical engineering problems.



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Program Outcomes (POs)

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)



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SYLLABUS

Credit: 3
3L+0T+0P

Max. Marks: 150(IA:30, ETE:120)

End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Materials: Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects.	3
	Manufacturing Considerations in Design: Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Design for assembly.	4
3	Design for Strength: Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration: causes and mitigation, fatigue failures.	4
	Design of Members subjected to direct stress: pin, cotter and keyed joints.	5
4	Design of Members in Bending: Beams, levers and laminated springs. Design for stiffness of beam: Use of maximum deflection formula for various end conditions for beam design	7
5	Design of Members in Torsion Shaft and Keys: Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys.	5
	Couplings: Design of muff coupling, flanged couplings: rigid and flexible	3
6	Design of Threaded fasteners: Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading	4
	Power screws like lead screw, screw jack	2
	Design of members which are curved like crane hook, body of C-clamp, machine frame etc.	3
TOTAL		41

REFERENCE BOOKS (DME-I)

TEXT BOOK		
1	Bhandari, V. B., Introduction to Machine Design, McGraw Hill Education (India)	2013
REFERENCE BOOKS		
SN	Name of Authors /Books /Publisher	Year of Pub.
1	Bahl and Goel, Mechanical Machine Design, Standard Publishers Distributors	2002
2	Shigley, Joseph E., Mechanical Engineering Design, McGraw Hill Education (India)	2002
3	Sharma and Aggarwal, Machine Design, S.K.Kataria and Sons, Delhi.	1997
4	Sharma and Purohit, Design of Machine Elements, Prentice Hall India.	2002
5	Jindal U C, Machine Design, Pearson Education India	2010



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Course Plan

Name of the Course: **Design of Machine Elements – I**

Code of the course: **5ME7-11**

Name of Faculty: **Dr. M.P.Singh**

Course Outcome

CO1: Explain the objectives, scope, and fundamentals of machine design, and the role of material properties and IS coding in selecting suitable materials for components.

CO2: Apply manufacturing considerations and BIS codes for design and assembly of machine elements.

CO3: Analyze the strength and stiffness of machine elements under static, fatigue, and impact loading.

CO4: Design machine members subjected to direct, bending, and torsional stresses.

CO5: Designs for threaded fasteners, power screws, and couplings ensuring strength, efficiency, and reliability.

CO6: Evaluate and design special components like curved members to achieve safe and economical machine design.

Unit	Topic	Lec .	CO	Specific Objectives	Expected Outcomes	Primary Reference (Bhandari – 3rd Ed.)
Intro	Introduction	1	CO1	Explain scope & applications of machine design	Understand design methodology	Ch.1 p.1–8
1	Mechanical Properties	2	CO1	Explain tensile, compressive, hardness, toughness, fatigue	Compare material properties	Ch.2 p.21–39
	IS/BIS Coding	3	CO1	Explain BIS codes for steels, cast irons and alloys	Interpret IS codes	Ch.2 p.39–52
	Material Selection	4	CO1	Relate cost & properties	Select suitable materials	Ch.2 p.52–62
	Case Studies	5	CO1	Industrial examples of material selection	Relate properties with applications	Examples from different applications.
2	Standardization	6	CO2	Explain principles of standardization	Apply preferred standards	Ch.3 p.71–82
	Interchangeability	7	CO2	Explain preferred sizes	Use interchangeability	Ch.3 p.83–93
	Fits & Tolerances	8	CO2	Explain BIS fit system	Apply tolerances in design	Ch.3 p.94–118
	Manufacturing in Design	9	CO2	Explain casting, forging, machining considerations	Select manufacturing processes	Ch.3 p.119–135



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	Design for Assembly	10	CO2	Explain DFA principles	Integrate assembly considerations	Ch.3 p.136–142
3	Modes of Failure	11	CO3	Explain brittle, ductile, creep, fatigue failure	Identify failure modes	Ch.4 p.145–166
	Strength, Stiffness, FOS	12	CO3	Define allowable stress & factor of safety	Calculate allowable loads	Ch.4 p.167–176
	Stress Concentration	13	CO3	Explain SCF causes	Recognize stress concentration	Ch.5 p.191–200
	SCF Mitigation	14	CO3	Show design modifications	Reduce stress concentration	Ch.5 p.200–209
	Fatigue Failure	15	CO3	Explain S-N curve & endurance limit	Predict fatigue life	Ch.6 p.213–232
4	Pin Joints	16	CO4	Explain pin joint design	Design safe pin joints	Ch.7 p.243–254
	Cotter Joints	17	CO4	Explain cotter joint types	Design cotter joints	Ch.7 p.255–267
	Keys	18	CO4	Explain key types	Design keys	Ch.7 p.268–280
	Combined Axial & Shear	19	CO4	Explain combined stresses	Analyze stress states	Ch.7 p.281–287
	Problem Solving	20	CO4	Apply concepts in problems	Solve design problems	Examples from competitive examinations
5	Bending Theory	21	CO4	Explain bending stress & section modulus	Calculate bending stress	Ch.8 p.299–312
	Levers	22	CO4	Explain lever design	Design levers	Ch.8 p.313–321
	Laminated Springs	23	CO4	Explain spring theory	Design springs	Ch.23 p.909–928
	Beam Deflection	24	CO4	Explain deflection formulas	Estimate beam deflection	Ch.8 p.322–335
	Stiffness Design	25	CO4	Explain stiffness control	Design beams	Ch.8 p.336–343
	Beam End Conditions	26	CO4	Show support effects	Select support conditions	Ch.8 p.344–350
	Problem Solving	27	CO4	Solve bending problems	Apply bending theory	Examples from competitive examinations
6	Torsion Theory	28	CO4	Explain torsion	Calculate shear stress	Ch.9 p.363–377
	Solid & Hollow Shafts	29	CO4	Design shafts	Select shaft size	Ch.9 p.378–389
	Combined	30	CO4	Explain torsion +	Design shafts	Ch.9 p.390–



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	Loading			bending		402
	Keys in Torsion	31	CO4	Explain sunk keys	Design keys	Ch.9 p.403–410
	Couplings	32	CO5	Explain couplings	Design couplings	Ch.9 p.411–426
	Problem Solving	33	CO5	Solve shaft problems	Apply torsion design	Examples from competitive examinations
7	Threaded Fasteners	34	CO5	Explain bolt types	Select bolts	Ch.10 p.439–456
	Preloading	35	CO5	Explain preload effects	Calculate preload	Ch.10 p.457–466
	Eccentric Loading	36	CO5	Explain eccentric bolt loading	Design bolt groups	Ch.10 p.467–474
	Problem Solving	37	CO5	Apply bolt design	Solve bolt problems	Examples from competitive examinations
8	Power Screws	38	CO5	Explain screw jack design	Design power screws	Ch.11 p.491–509
	Curved Members	39	CO6	Design curved members	Design hooks & clamps	Ch.13 p.555–569
	Thick walled pressure vessels(CB)	40	CO6	Introduction of Thick walled pressure vessels	Design of Thick walled pressure vessels	NPTEL
	Integrated Design	41	CO6	Apply combined knowledge	Solve open-ended design problems	Discussion and presentation

Reference Books

- Shigley, J.E., Budynas, R.G., *Mechanical Engineering Design*, McGraw-Hill Education.
- Norton, R.L., *Machine Design: An Integrated Approach*, Pearson Education.
- Dieter, G.E. & Schmidt, L.C., *Engineering Design: A Materials and Processing Approach*, McGraw-Hill.
- Khurmi, R.S., Gupta, J.K., Gupta, S., Chand Publication.
- Bansal, V.B., *Machine Design*, Khanna Publishers.