



JAIPUR ENGINEERING COLLEGE
AND RESEARCH CENTRE

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JECRC Campus, Shri Ram Ki Nangal, Via-Vatika, Tonk Road, Jaipur

Department of Mechanical Engineering

Name of Subject: Theory of Machines

Subject Code: 4ME4-07

Year: 2nd Year, 4th 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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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 Investigation of Complex Problems:** Conduct investigation 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



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

2nd Year - IV Semester: B.Tech. : Mechanical Engineering

4ME4-07: THEORY OF MACHINES

Credit: 4
3L+1T+0P

Max. Marks: 200 (IA:40, ETE:160)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Introduction to mechanism: Basic concept of machines, links, kinematic pair, kinematic chain and mechanism. Inversions of kinematic chains: four bar chain mechanisms, quick return mechanisms, inversions of double slider crank mechanisms.	4
	Velocity and acceleration in mechanism: Velocity and acceleration polygons, relative velocity and instantaneous centre method	3
3	Friction devices: Types and laws of friction. Pivots and collars. Power screws such as lead screw of the lathe.	3
	Clutches: Single and multi-plate clutches. Brakes: Band, block and band and block brakes.	4
4	Gears: Laws of gearing, gears terminology; tooth form; interference, undercutting and minimum number of teeth on pinion. Rack and pinion, Spur, helical, basic introduction of bevel, worm and worm gears.	6
	Gear Trains: Simple, compound and epicyclic gear trains.	3
5	Cams: Type of cams; displacement, velocity and acceleration curves for different cam followers; consideration of pressure angle and wear.	4
	Gyroscope: Principles of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicles taking a turn, stabilization of ship.	4
6	Balancing: Balancing of rotating masses in same and different planes, balancing of reciprocating masses, swaying couple, hammer blow and tractive effort.	7
	TOTAL	39

REFERENCE BOOKS(TOM)

1. Theory of Machines by R.S. Khurmi and J.K. Gupta:
2. Theory of Machines by S.S. Rattan:
3. Theory of Machines and Mechanisms by Joseph E. Shigley, John J. Uicker, and Gordon R. Pennock:



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Course Plan

Name of the Course: Theory of Machines

Code of the course: 4ME4-07

Name of Faculty: Abhishek Kumar

Course Outcomes

CO-1: Understand kinematics of mechanisms and classify different types of mechanisms and their applications.

CO-2: Analyze velocity and acceleration in linkages and cams using graphical and analytical methods.

CO-3: Evaluate the dynamics of mechanisms including friction, gears, and flywheels.

CO-4: Apply the principles of balancing, governors, and vibration analysis to mechanical systems.

CO-5: Assess the performance of machines and mechanisms under various loading and operating conditions.

CO-6: Design mechanical systems and mechanisms for improved efficiency and performance

Course Plan

Unit	Topic	Lecture	CO	Specific Objectives	Expected Outcomes	Primary Reference (R.S Khurmi)
1	Introduction & basic concepts	1	CO1	Explain basics	Understand systems	Ch 5 (94–96)
2	Links, pairs & chains	2	CO1	Define elements	Classify mechanisms	Ch 5 (96–100)
	Four bar mechanism	3	CO1	Explain mechanism	Apply concepts	Ch 5 (105–108)
	Quick return mechanism	4	CO1	Analyze motion	Solve problems	Ch 5 (115–117)
	Double slider mechanism	5	CO1	Explain inversions	Apply concepts	Ch 5 (110–115)
	Velocity analysis	6	CO2	Use velocity polygon	Solve problems	Ch 6 (138–150)
	Acceleration analysis	7	CO2	Use acceleration polygon	Analyze motion	Ch 7 (200–210)
3	Friction laws	8	CO3	Explain friction	Apply laws	Ch 11 (350–360)
	Pivot & collar friction	9	CO3	Analyze systems	Solve problems	Ch 11 (360–370)
	Power screws	10	CO3	Apply concept	Solve numericals	Ch 11 (370–385)
	Clutches	11	CO3	Explain	Evaluate	Ch 12 (400–)



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				types	performance	410)
	Brakes	12	CO3	Analyze brakes	Solve problems	Ch 12 (410–420)
4	Gear terminology	13	CO3	Define gears	Understand terms	Ch 13 (440–450)
	Gear tooth profile	14	CO3	Explain geometry	Analyze design	Ch 13 (450–455)
	Interference & undercutting	15	CO3	Explain limits	Apply rules	Ch 13 (455–460)
	Spur & helical gears	16	CO3	Analyze gears	Apply equations	Ch 13 (455–460)
	Bevel & worm gears	17	CO3	Explain types	Compare systems	Ch 13 (455–460)
	Gear trains	18	CO3	Analyze trains	Solve problems	Ch 13 (470–480)
5	Cam types	19	CO2	Explain cams	Identify types	Ch 8 (250–260)
	Displacement diagrams	20	CO2	Plot diagrams	Analyze motion	Ch 8 (260–275)
	Velocity diagrams	21	CO2	Analyze motion	Solve problems	Ch 8 (260–275)
	Acceleration diagrams	22	CO2	Interpret graphs	Apply concepts	Ch 8 (260–275)
	Gyroscopic principles	23	CO4	Explain effect	Apply in systems	Ch 15 (500–510)
	Gyroscopic applications	24	CO4	Analyze vehicles	Solve problems	Ch 15 (510–520)
6	Balancing rotating masses	25	CO4	Explain balancing	Solve problems	Ch 16 (520–530)
	Balancing multiple planes	26	CO4	Analyze systems	Apply methods	Ch 16 (530–540)
	Reciprocating masses	27	CO4	Explain motion	Analyze effects	Ch 16 (540–545)
	Swaying couple	28	CO4	Explain concept	Solve problems	Ch 16 (545–550)
	Hammer blow	29	CO4	Analyze effect	Apply in design	Ch 16 (550–555)
	Tractive effort	30	CO4	Evaluate systems	Solve problems	Ch 16 (555–560)
	Numerical/problem solving	31	CO5	Practice	Improve skills	
	Numerical/problem solving	32	CO5	Practice	Improve skills	
	Numerical/problem solving	33	CO5	Practice	Improve skills	
	Numerical/problem solving	34	CO5	Practice	Improve skills	
	Numerical/problem solving	35	CO5	Practice	Improve skills	
	Numerical/problem solving	36	CO5	Practice	Improve skills	
	Numerical/problem	37	CO5	Practice	Improve	



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	solving				skills	
	Numerical/problem solving	38	CO5	Practice	Improve skills	
	Numerical/problem solving	39	CO5	Practice	Improve skills	