

Course File

Theory of Machines (2020-21)

Syllabus

Course Code	Course Name	Credits
PEC403	Theory of Machines	03

Contact Hours			Credit Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term work / Practical / Oral			Total
Internal Assessment			End semester	Duration of End semester Exam	TW	PR	OR	
Test I	Test II	Average						
20	20	20	80	03 hrs.	-	-	-	100

Detailed Syllabus: (Module wise)		
Module No.	Description	Duration
01	Basic Concepts: Links, kinematics pairs, kinematics pairs giving one, two and three degrees of freedom, kinematics chains, degree of freedom and mobility criterion. Constrained kinematics chains as mechanism. Inversions of four bar, single and double slider crank chains and their applications, Introduction to gyroscope (no numerical problems).	05

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02	Motion Characteristics of Mechanisms: Velocity and acceleration analysis of mechanisms with single degree of freedom system with Coriolis component using graphical method. Instantaneous centre, Kennedy's theorem; analysis of velocities of mechanism using instantaneous centre method (introduction).	07
03	CAMS: Introduction to types of cams, types of followers. Follower motions. viz. simple harmonic motions, constant velocity, uniform and constant acceleration and retardation and cycloidal motion, layout of cam profile for specified displacement characteristics. Cams with oscillating follower systems.	06

04	GEARS: Introduction: Types of gears and applications, Gear terminology, Condition for constant velocity ratio–conjugate profiles, profiles used in gears. Interference of involute teeth, methods of preventing interferences through undercutting, length of path of contact and contact ratio, no of teeth to avoid interference. Gear trains: Simple, compound, planetary and epicyclic gear trains (with numerical).	07
05	Balancing: Introduction. Rotary masses: several masses in same plane, several masses in different planes. Balancing of locomotives– Variation of Tractive Effort, Swaying Couple and Hammer blow, The concept of primary and secondary balancing (No numerical problems) Vibrations: Introduction–free vibrations; longitudinal, transverse and torsional vibrations, critical or whirling speed of shaft. Torsional vibrations of two rotor system - torsionally equivalent shaft. Basics of vibration measuring concepts.	07
06	Clutches Brakes and Dynamometers: Study and analysis of single plate clutch, multiple plate clutches and cone clutches. Types of brakes. viz. block and shoe brakes, band brake, band and block brakes Types of dynamometers, classification, Prony brake, Rope brake belt transmission dynamometers	07

List of recommended books

Reference Books:

1. *Theory of Machines*, 3rd edition by Thomas Bevan, Pearson publication.
2. *Theory of Machines*, 11th Edition by P.L. Ballaney, Khanna Publications (2005).
3. *Theory of Machines*, 2nd Edition by S.S.Ratan, Tata McGraw Hill(2005)
4. *Theory of Machines and Mechanisms*, 3rd Edition by John, J Shighley, Oxford University.
5. *Theory of Machines*, Pandya & Shah.
6. *Mechanisms of Machines*, J. Hannah & R C Stephen.
7. *Theory of Machines*, V. Ravi, PHI Learning publication (2011).

Assessment

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

- 1 First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).
- 2 Total duration allotted for writing each of the paper is 1 hr.
- 3 Average of the marks scored in both the two tests will be considered for final grading.

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
3. **Remaining questions will be mixed in nature** (for example, if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Time Table

Fr. Conceicao Rodrigues College of Engineering, Bandra

Class : S.E. (Production)					Room Number:				
Class Teacher: Prof. Deepika Singh					With Effect From: 25th January 2021-6th February 2021				
	9.00 a.m.- 10.00 a.m.	10.00 a.m.- 11.00 a.m.	11.00 a.m. – 11.30 a.m.	11.30 a.m. – 12.30 p.m.	12.30 p.m. – 13.30 p.m.				
Monday	AMP VS	EE SJP		TOM DS	MMFT DB				
Tuesday	EM IV SSP	AMP VS		EE SJP	TOM DS				
Wednesday	MMFT DB	EM IV SSP		AMP VS	TOM DS				
Thursday	TOM DS	MMFT DB		EM IV SSP	AMP VS				
Friday	EE SJP	TOM DS		MMFT DB	EM IV SSP				
Saturday									
Subject Abbreviation									
EM IV	Engineering Mathematics IV		TOM	Theory of Machines		MMFT	Mould and Metal Forming Technology		
EE	Applied Electrical and Electronics		AMP	Advanced Manufacturing Processes					
Faculty Abbreviation									
DS	Prof. Deepika Singh		ABR	Dr. Arun Rane		VS	Dr. Vajim Shaikh		
VSJ	Dr. V. S. Jorapur		SSP	Prof. Sundary Prabavathy					

(Dr. Srijja Unnikrishnan)
Principal

H.O.D.
Production Engineering

Course Objectives & Outcomes

Objectives:

1. To prepare the students to understand the Mechanics of machines, principles and its application areas.
2. To familiarize with various types of Mechanisms and Motion analysis.
3. To develop the students with the problem solving capabilities in the topics of velocity and acceleration.
4. To familiarize with the kinematics and kinetics of simple machine elements and devices.
5. To provide an understanding and appreciation of the variety of mechanisms employed in modern complex machines, such as automobiles, machine tools etc.

Outcomes: learner will able to:

1. Understand the common mechanisms used in machines, correlate the concepts of kinematics with kinetics of rigid body dynamics and Design of four bar mechanisms, gyroscopic devices etc.
2. Analyze the velocity and acceleration of various links in motion.
3. Illustrate different types of cams, followers with their different motions for their application and Develop profiles of cams for engineering applications.
4. Illustrate various types of gears/ their terminology areas of application along with parameters pertaining to spur gears and gear trains.
5. Develop basic concepts pertaining to balancing/vibrations in evaluation of simple machine components.
6. Illustrate different types of clutches, brakes and dynamometers for evaluation of braking force.

Lesson Plan

	Topics Planned	Module	Hours
<u>Week1</u> (25/01/21 – 31/01/21)	Basic Concepts: Links, kinematics pairs, kinematics pairs giving one, two and three degrees of freedom, kinematics chains, degree of freedom and mobility criterion.	1	3
<u>Week 2</u> (01/02/21 – 07/02/21)	Constrained kinematics chains as mechanism. Inversions of four bar, single and double slider crank chains and their applications, Introduction to gyroscope (no numerical problems).	1	4

<u>Week 3</u> (08/02/21 – 14/02/21)	Velocity and acceleration analysis of mechanisms with single degree of freedom system Coriolis component using graphical method.	2	4
<u>Week 4</u> (15/02/21 – 21/02/21)	Cams: Introduction to types of cams, types of followers. Follower motions. viz. simple harmonic motions, constant velocity, uniform and constant acceleration and retardation and cycloidal motion	2	4
<u>Week 5</u> (22/02/21 – 28/02/21)	layout of cam profile for specified displacement characteristics. Cams with oscillating follower systems.	2	4
<u>Week 6</u> (1/03/21 – 7/03/21)	layout of cam profile for specified displacement characteristics. Cams with oscillating follower systems.	5	4
<u>Week 7</u> (8/03/21 – 14/03/21)	Unit Test 1 SE, TE.		
<u>Week 8</u> (15/03/21 – 21/03/21)	GEARS: Introduction: Types of gears and applications, Gear terminology, Condition for constant velocity ratio–conjugate profiles, profiles used in gears.	5	4
<u>Week 9</u> (22/03/21 – 28/03/21)	Interference of involute teeth, methods of preventing interferences through undercutting, length of path of contact and contact ratio, no of teeth to avoid interference. Gear trains: Simple, compound, planetary and epicyclic gear trains (with numerical).	5	4
<u>Week 10</u> (5/04/21 – 11/04/21)	Gear trains: Simple, compound, planetary and epicyclic gear trains (with numerical). Study and analysis of single plate clutch, multiple plate clutches and cone clutches.	6	4
<u>Week 11</u> (12/04/21 – 18/04/21)	Study and analysis of single plate clutch, multiple plate clutches and cone clutches. Types of brakes. viz. block and shoe brakes, band brake, band and block brakes	3	4

