TEACHING PLAN: MECHANICAL VIBRATION

SCHOOL OF ENGINEERING AND TECHNOLOGY		**ACADEMIC SESSION: 2022-23**		**FOR STUDENTS' BATCH: 2021-2025**	
1	**Course code**	**PCC-ME 210**			
2	**Course Title**	**KINEMATICS OF MACHINES**			
3	**Credits**	**4**			
4	**Learning Hours**	**Contact Hours: 3** **Practical Teaching: 0** **Project, Tutorial, and Assessment: 1** **Total hours: 4**			
5	**Course Objective**	i. To develop skills for designing and analyzing linkages, cams, gears and other mechanisms. ii. To develop skills for use of mathematics software and for writing computer programs to solve kinematics problems. iii. To provide a foundation for the study of machine design. iv. Development of individual and team skills involving pre- and post-processing and interpretation computer-aided design and analysis data.			
6	**Course Outcomes**	Student will demonstrate knowledge in CO 1: Designing a suitable mechanism depending on application CO 2: Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers, CO 3: Drawing velocity and acceleration diagrams for different mechanisms, CO 4: Selecting gear and gear train depending on application. CO 5: Understand the kinetics of the rigid bodies and solve simple problems using work-energy method			
7	**Outline syllabus:** Classification of mechanisms, Classification of cams and followers, Displacement, velocity and acceleration analysis, gear profiles, gear parameters, Surface contacts				
7.01	**Paper Code**	**Unit**	**Introduction**	**Reference number**	**Teaching methods**
	PCC-ME-210	(I)	Classification of mechanisms- Basic kinematic concepts and definitions Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators Universal Joint- Rocker mechanisms	Theory of Machines and Mechanisms by Joseph Edward Shighley Page no :1-27	Whiteboard, PPT slides, Tutorials
		(II)	Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis	Theory of Machines and Mechanisms by Joseph	Whiteboard, PPT slides, Tutorials

			using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation	Edward Shighley Page no :27-123	
		(III)	Classification of cams and followers Terminology and definitions Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers	Theory of Machines and Mechanisms by Joseph Edward Shighley Page no :193-242	Whiteboard, PPT slides, Tutorials
		(IV)	Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics	Theory of Machines and Mechanisms by Joseph Edward Shighley Page no :243-305	Whiteboard, PPT slides, Tutorials
		(V)	Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes	Theory of Machines and Mechanisms by Joseph Edward Shighley Page no :305-384	Whiteboard, PPT slides, Tutorials

8	**Course Evaluation**	
8.10	**CA: 20%**	
8.1	**Attendance**	10%
8.12	**Homework**	10%
8.13	**Quizzes**	-
8.14	**Projects**	-
8.15	**Presentation**	-
8.16	**Any other**	-
8.2	**MTE(IA)**	20%
8.3	**End-term examination: 60%**	
9	**Text Books & References**	
9.1	**Text books**	1. Thomas Beven, Theory of Machines, Longman‘s Green & Co., London. 2. W. G. Green, Theory of Machines, Blackie & Sons, London 3. V. P. Singh, Theory of Machines, Dhanpat Rai. 4. Gosh and Malik, Theory of Mechanism and Machines, East-west Pvt. Ltd. 1988.
9.2	**References**	1. Hsieh, Wen-Hsiang, and Chia-Heng Tsai. "A study on a novel quick return

		mechanism." Transactions of the Canadian Society for Mechanical Engineering 33.3 (2009): 487-500. 2. Foster, David E., and Gordon R. Pennock. "A graphical method to find the secondary instantaneous centers of zero velocity for the double butterfly linkage." J. Mech. Des. 125.2 (2003): 268-274. 3. Nie, Liangyi, et al. "Instant Center Identification of Single-Loop Multi-DOF Planar Linkage Using Virtual Link." Applied Sciences 11.10 (2021): 4463.
9.3	**Video References**	https://nptel.ac.in/courses/112104121 https://nptel.ac.in/courses/112105268

Mapping of Outcomes v. Topics

Course Outcome	**Program Outcome**												**PSO**			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	3	3	2	1	3	2	2	3	3	3	3	2
CO2	3	3	3	3	3	3	2	1	2	2	2	3	3	3	3	2
CO3	3	3	3	3	3	2	2	1	2	2	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	1	2	2	2	3	3	3	3	2
CO5	3	3	3	3	3	3	3	1	2	3	2	3	3	3	3	2

QUESTION BANK

1. What is Grashof's law for a `four-bar mechanism and give out its significance
2. State the application of an offset slider crank mechanism.
3. Explain the term kinematic link. Give the classification of kinematic link.
4. Explain the term: a) Lower pair, (b) Higher pair.
5. Define kinematic chain & inversion of kinematic chain.
6. Differentiate between a machine and a mechanism.
7. Write and explain Gruebler's equation.
8. Define degree of freedom and give the DOF for a cam with roller follower.
9. Define the terms kinematic pair and kinematic chain.
10. List out the applications of straight-line motion mechanism.
11. State Gruebler's criterion for spatial mechanisms.
12. State Gruebler's criterion for planar mechanisms.
13. State the Kutzbach Criterion.
14. What is toggle position?

15. Define “Mechanical Advantage”.

16. Give any two inversions of a single slider chain.

17. Give out inversions of a double slider crank chain.

18. Differentiate between a machine and a structure.

19. Sketch an exact straight line mechanism, with link properties.

20. State and explain the three inversions of a four bar chain?

21. In a crank and slotted lever quick return motion mechanism, the distance between fixed centres is 240mm and the length of driving crank is 120mm. Find the inclination of the slotted bar with the vertical in the extreme position and the time ratio of cutting stroke to return stroke. If the length of the slotted is 450mm, find the length of the stroke if the line of stroke passes through the extreme positions of free end of the lever.

22. What is inversion of mechanism? Describe various inversions of double slider crank mechanism with sketches.

23. Explain the working of toggle mechanism and its application with a neat sketch.

24. Explain the working of pantograph and one indexing mechanism with a neat sketch.

25. Explain the working of any two inversions of a single slider crank chain with neat sketches.

26. State and explain the various inversions of four bar chain mechanism.

27. Explain with neat sketch the working of crank and slotted lever quick return motion mechanism. Deduce the expression for length of stroke in terms of link lengths.

28. Perform kinematic analysis of following exact straight line motion mechanisms (a) Peaucellier’s mechanism (b) Hart’s Mechanism

29. Define Kinematic pair and discuss various types of kinematic pairs with example.