Lok Jagruti Kendra University
University with a Difference

Diploma in Automation & Robotics

Course Code: 025120305

Theory of Machines

Programme / Branch Name			Diploma in Automation & Robotics			
Course Name	Theory of Machines				**Course Code**	025120305
Course Type	HSSC	BSC	ESC	PCC	OEC	PEC

Legends: HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

1. Teaching and Evaluation Scheme

Teaching Hours / Week				Evaluation Scheme			
L	**T**	**P**	**Total Credit**	**CCE**	**SEE (Th)**	**SEE (Pr)**	**TOTAL**
4	0	2	5	50	50	50	150

Legends:
L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

2. Prerequisites

- ✓ Engineering Mathematics-I
- ✓ Engineering Mathematics-II
- ✓ Engineering Physics
- ✓ Applied Mechanics

3. Rationale

Knowledge of various mechanisms and machines is a pre-requisite for enabling a mechanical engineer to work in an industry. This course provides the knowledge of kinematics and dynamics of different machine elements and popular mechanisms such as four link mechanisms, cam-follower, Belt-pulley, chain sprocket gears, brake and clutch to enable a diploma holder to carry out maintenance of these and it also serves as a prerequisite for course' Design of Machine Elements' to be studied in later semester.

4. Objectives

- ✓ The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
- ✓ Identify various links in popular mechanisms.
- ✓ Select suitable mechanism for various applications.
- ✓ Interpret the motion of cams and followers.
- ✓ Recommend relevant belts, chains and drives for different applications.
- ✓ Choose relevant brakes and clutches for various applications.

5. Contents

Unit No.	Unit Name	Topics	Learning Outcome	% Weightage	Hours
1.	**Introduction**	1.1. Theory of Machines: introduction, need, scope and importance in design and analysis 1.2. Kinematics, kinetics and dynamics-concept and examples Kinematic links, joints, pairs, chain and its types Constrained motion and its types. 1.3. Basic terminology related to machines and mechanisms. 1.4. Development of different mechanisms and its inversions like four bar chain mechanism, slider crank mechanism, double slider crank mechanism, Scotch Yoke mechanism, Whitworth quick return mechanism, Quick return mechanism of shaper etc.	• To understand the basics concepts of link, pairs, mechanisms, inversion, structure and machines. • To understand the various terminology associated with theory of machine.	20	8
2.	**Velocity and Acceleration Diagram**	2.1. Concepts of relative velocity and relative acceralations of a point on a link, angular acceleration, inter-relation between linear and angular velocity and acceralations. 2.2. Analytical methods and Klien's construction to determine velocity and acceralations of different links in single slider crank mechanisms. 2.3. Drawing of velocity and acceleration diagrams for simple mechanisms. 2.4. Determination of velocity and	• To calculate the velocity and acceleration diagram for a given mechanism. • To describe with a dimensioned sketch of the given mechanism.	15	12

		acceleration of a point on a link by relative velocity method.			
3.	**Cam and Cam Follower**	3.1. Introduction to Cams and Followers. Cam and follower terminology. 3.2. Classifications of Cams and Followers. Applications of Cams and Followers. 3.3. Types of follower motions and their displacement diagrams – Uniform velocity, Simple harmonic motion, uniform acceleration and retardation. 3.4. Drawing of a profile of a radial cam based on given motion of reciprocating knife-edge and roller follower with and without offset.	• To identify the motion of the Follower in the given situation with justification. • To describe the dimensioned sketch of the given Cam and Follower arrangement. • To draw the Cam profile for various distinct motions.	15	8
4.	**Friction**	4.1. Concept and laws of friction. 4.2. Appreciate the role of friction in thrust bearing, pivot bearing and collars considering - Uniform pressure and Uniform wear condition. 4.3. Clutch: i. Functions. ii. Types with sketches and working. 4.4. Brakes: i. Functions. ii. Types with sketches and working. 4.5. Dynamometers - types and operational working principles.	• Calculate power loss due to friction in bearings. • To describe the working of different types of clutches, brakes and dynamometers.	22	6
5.	**Power Transmission**	5.1. Belt Drives - Introduction to flat belt, V-belt and its applications, materials used for flat and V - belts. Introduction of timing belt and pulley.	• To calculate velocity ratio, belt tensions, slip and angle of contact in the given belt drive.	28	8

		Angle of lap, length of the belt, slip and creep. 5.2. Determination of velocity ratio of tight side and slack side tension, centrifugal tension and initial tension, condition for maximum power transmission. merits, demerits and selection of belts for given applications. 5.3. Chains: Drives - Introduction to chain drives, types of chains and sprockets, methods of lubrication, merits and demerits of selection of chains and applications. 5.4. Gears : Drive – Introduction to Gears drives. Classification of gears. Law of gearing. Gear terminology, Types of gear trains, Train value and velocity ratio for simple, compound, reverted and epicyclic gear trains using spur and helical gears. merits and demerits and selection of gear drives for given' applications.	• To estimate power transmitted and condition for maximum power transmitted in the given belt drive for given data. • To identify and select the suitable belt for the given application with justification.		
				Total Hours	**42**

6. List of Practicals / Exercises

The practicals/exercises have been properly designed and implemented in an attempt to develop different types of skills, so that students can acquire the competencies/programme outcomes. Following is the list of practicals/exercises.

Sr. No.	Practical / Exercises	Key Competency	Hours
1.	Determine velocity and acceleration of various links of the given mechanism (any two) by relative velocity method for analysis of the motion of links (Minimum 2 problems on A2 size drawing sheet).	Calculation of the velocity and acceleration diagram for a given mechanism.	4
2.	Determine velocity and acceleration in an I.C. engine's slider the Crank mechanism by Klein's construction (Minimum 2 problems on A2 size drawing sheet).	Drawing of the velocity and acceleration diagram of an I.C. Engine	6
3.	Draw profile of a radial cam for given follower type to obtain the desired follower motion(Minimum 2 problems on A2 size drawing sheet).	Motion of various followers in engage with Radial Cam.	6
4.	Estimate slip length of the belt, angle of contact in an open and cross belt drive.	Factors affecting the power transmission mechanism.	4
5.	Identify different parts of a single plate disc clutch through disassembly, observe wear and tear due to friction, and prepare a report based on inspection criteria.	Parts of various Clutches.	2
6.	Demonstration of Power Transmission Systems: a. Identify various power transmission systems by observing different machines and equipment used in mechanical engineering laboratory/workshop. For example- IC Engine test rig, Compressors, Machine tools, Elevators, etc. Sketch at least four mechanisms with labeling on each. b. Demonstrate the working of each.	Power transmission mechanisms using various components.	6
		Total Hours	**28**

7. Suggested Specification Table for Evaluation Scheme

Unit No.	Unit Name	Distribution of Topics According to Bloom's Taxonomy					
		R %	U %	Ap %	C %	E %	An %
1.	Introduction	24	28	25	12	6	5
2.	Velocity and Acceralation Diagram	12	8	40	24	8	8
3.	Cam and Cam Follower	6	18	38	22	10	6
4.	Friction	14	12	26	24	14	10
5.	Power Transmission	22	18	28	22	4	6

Legends: R: Remembering U: Understanding
App: Applying C: Creating
E: Evaluating An: Analyzing

8. Textbooks

1) "Theory of Machines" by R.S. Khurmi & J. K. Gupta (S. Chand Publication)
2) "A Textbook of Theory of Machines" by Dr. R. K. Bansal & J,S. Brar (Laxmi Publication)

9. Reference Books

1) "Theory of Machines and Mechanism" – by P.I. Ballancy (Khanna Publication)
2) "Theory of Machines" – by S S Rattan (McGraw Hill Publication)

10. Open Sources (Website, Video, Movie)

1) http:// nptel.ac.in/course.html
2) http://wvvw.tcchnologystudcnt.com/gearsl/gears7.htm
3) https://learnmechanical.com/kinematic-link/
4) https://youtu.be/ZO8QEG4x0wY
5) https://youtu.be/KBFFwgCCP0U
6) https://youtu.be/3eVQA6AyE7A
7) https://youtu.be/vxFYfumAAlY
8) https://youtu.be/wCu9W9xNwtI
9) https://youtu.be/j6woGQdUPFs
10) https://youtu.be/HsXWewecMLE
11) https://youtu.be/nSNkB0BXnHM
12) https://youtu.be/devo3kdSPQY
13) https://youtu.be/HY_PjmHRxuE
14) https://youtu.be/lqo0_StXf4M