

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT****Course Curriculum****MECHANISMS FOR MACHINES & AIRCRAFTS  
(Code: 3330102)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
AERONAUTICAL ENGINEERING	THIRD

**1. RATIONALE.**

In industries, the aeronautical engineers/technicians are supposed to manage functioning of equipment with proper planning, operation and maintenance of equipment. Such a functional requirement needs knowledge and skills of various motion and force transforming mechanisms and devices, such as mechanism, belt pulley, flaps up & down, aileron up & down, and other control surface mechanism of aircraft etc. This course is included in the curriculum to provide such necessary knowledge and skills in the area of aeronautical equipment and devices to help in understanding of kinematics & dynamics of different equipment being used in industry. Thus it is a key course for mechanical engineers/technicians.

**2. LIST OF COMPETENCIES.**

- Use principles of kinematics and dynamics in operation and maintenance of various mechanisms and equipments.

**3. TEACHING AND EXAMINATION SCHEME.**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
04	00	02	06	70	30	20	30	

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit,ESE -End Semester Examination; PA - Progressive Assessment.

**4. DETAILED COURSE CONTENTS.**

<b>Unit</b>	<b>Major Learning Outcomes</b>	<b>Sub-topics</b>
<b>UNIT – I INTRODUCTION</b>	<ul style="list-style-type: none"> <li>• Define link, pairs, mechanisms, inversion, structure and machines.</li> <li>• Explain various terminology associated with theory of machine.</li> <li>• Draw inversions of different mechanisms</li> </ul>	1.1 Introduction, need, scope and importance of design and analysis. 1.2 Kinematics, kinetics and dynamics - concept and examples. 1.3 Link, kinematic pair, degrees of freedom. 1.4 Classification of kinematic pairs. 1.5 Inversions of four bar chain, slide crank mechanism & double slider crank mechanism.
<b>UNIT –2 VELOCITY AND ACCELERATION ANALYSIS</b>	<ul style="list-style-type: none"> <li>• Draw velocity and acceleration diagram for a given mechanism.</li> <li>• Calculate velocity and acceleration from a given mechanism.</li> </ul>	2.1 Absolute & relative motion, vectors, motion of a link 2.2 Velocity analysis of four-link mechanism & slider crank mechanism 2.3 Acceleration analysis: Acceleration, Acceleration analysis of four-link mechanism & slider crank mechanism 2.4 Klein's construction for single slider Cranks mechanism.
<b>UNIT-3 CAM AND CAM PROFILE</b>	<ul style="list-style-type: none"> <li>• Explain different types of cams and cam followers and their motions.</li> <li>• Construct different types of cam profile from given data.</li> </ul>	3.1 Introduction 3.2 Functions and types of cams 3.3 Types of motions and displacement for different types of cam and cam followers. 3.3 Construct of different types of cam profiles.
<b>UNIT-4 POWER TRANSMISSION</b>	<ul style="list-style-type: none"> <li>• Explain the need and modes of power transmission.</li> <li>• Solve problems on flat belt drive</li> <li>• Solve simple problems on gear trains.</li> </ul>	4.1 Introduction, need and modes of power transmission. 4.2 Types of power transmission. 4.3 Belt drive- types, terminology and standards/designation methods as per BIS/ISO. 4.4 Belt speed-co-efficient of friction, velocity ratios and slip. 4.5 Power transmitted by flat belt - tensions, centrifugal tensions, maximum tension, condition for transmitting maximum power and initial tension.(with derivations), numerical examples. 4.6 Merits and demerits of power transmission drives.

Unit	Major Learning Outcomes	Sub-topics
<b>UNIT -5 FLYWHEEL AND GOVERNOR</b>	<ul style="list-style-type: none"> <li>• Construct Turning moment diagram.</li> <li>• Differentiate between flywheel and governor.</li> <li>• Calculate mass of flywheel.</li> </ul>	5.1 Turning moment diagram: <ol style="list-style-type: none"> <li>Concept.</li> <li>Its use for different machines.</li> <li>Fluctuations of energy.</li> </ol> 5.2 Co-efficient of fluctuation of speed and energy. 5.3 Method to construct turning moment diagram, numerical examples. 5.4 Flywheel: functions and types. 5.6 Moment of inertia and mass calculation of Flywheel - numerical examples. 5.7 Governors: terminology, types & functions.
<b>UNIT- 6 FRICTION</b>	<ul style="list-style-type: none"> <li>• Explain laws of friction.</li> <li>• Describe the working of different types of clutches, brakes and dynamometers.</li> </ul>	6.1 Concept and laws of friction. 6.2 Clutch: Functions. Types with sketches and working. 6.3 Brakes: i. Functions. ii. Types with sketches and working. 6.4 Dynamometers- types and operational Working principles.
<b>UNIT -7 BALANCING AND VIBRATIONS</b>	<ul style="list-style-type: none"> <li>• Effect of weights and load distribution.</li> </ul>	7.1 Concepts and types of balancing. 7.2 Effects of unbalanced masses. 7.3 Balancing of revolving masses in same Plane. 7.4 Vibration: i. Effects. ii. Causes. iii. Remedies.
<b>UNIT -8 AIRCRAFT MECHANISM</b>	<ul style="list-style-type: none"> <li>• Study various mechanism of aircraft.</li> </ul>	8.1 Landing gear mechanism. 8.2 Flaps mechanism. 8.3 Rudder mechanism. 8.4 Aileron mechanism. 8.5 Elevator mechanism.

### 5. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY).

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	INTRODUCTION	5	4	3	4	08
2	VELOCITY AND ACCELERATION ANALYSIS	6	4	3	3	10
3	CAM AND CAM PROFILE	5	4	2	4	10
4	POWER TRANSMISSION	8	3	2	1	10
5	FLYWHEEL AND GOVERNOR	6	2	2	2	07
6	FRICTION	6	4	2	1	08
7	BALANCING AND VIBRATIONS	4	3	2	2	07
8	AIRCRAFT MECHANISM	8	4	3	3	10
	<b>Total</b>	<b>48</b>	<b>31</b>	<b>19</b>	<b>20</b>	<b>70</b>

Legends: R = Remember U= Understand; A= Apply and above levels (Bloom's revised taxonomy).

**6. SUGGESTED LIST OF EXERCISES/PRACTICAL/EXPERIMENTS**

EX. NO.	UNIT NO.	Practical Exercises/Experiment	Hours
1.	1	To study about various mechanisms four bar and slider crank mechanism.	02
2.	2	Prepare a sheet for velocity and acceleration analysis.	04
3.	3	Prepare a sheet for construction of cam profile.	04
4.	4	To study about various power transmission systems.	02
5.	5	To study about working principle of governor and flywheel.	02
6.	6	To study about brakes, clutches and dynamometers.	02
7.	7	To study about balancing and vibration.	02
8.	8	Prepare a sheet for various mechanism of aircraft.	04

**7. STUDENT ACTIVITIES:**

Sr. No.	Details of activity.
1	Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work.
2	List the mechanisms which you are using in your day to day life. Sketch any three from these.
3	List the mechanism used in a typical aircraft.

**8. SUGGESTED LEARNING RESOURCES.****A. List of Books:**

Sr. NO	TITLE OFBOOK	AUTHOR	PUBLICATION
1	Theory of Machines	Jagdishlal	Metropolitan Book New Delhi,
2	Theory of Machines	S.S.Ratan	Tata McGraw Hill , New Delhi.
3	Theory of Machines	R.S.Khurmi	S.chand, New Delhi.
4	Theory of Machines	P.L.Bellaney	Khanna publication, NewDelhi.
5	Understanding the flight	J.D. Anderson	McGraw Hill, Inc

**B. List of Major Equipment/ Instrument.**

- i. Working Models / wooden/thermocool theoretical models of:
  - a. Kinematic links and pairs.
  - b. Single slider crank.
  - c. Four bar chain.
- ii. Types of cams, followers and cam/follower arrangements.
- iii. Friction bearing- all types.
- iv. Dynamometers - all types.
- v. Friction clutches - all types.

- vi. Friction brakes - all types.
- vii. Rope/belt – All types of flat and vee.
- viii. Gear trains - all types. (Simple, compound, reverted, epicyclical).
- ix. Balancing machines -Revolving masses, Reciprocating masses.
- x. Steam engine, internal combustion engine.
- xi. Governors - all types.
- xii. Vibration -spring and mass model.
- xiii. Any machine having flywheel.

### C. List of Software/Learning Websites:

- i. <http://nptel.iitm.ac.in/video.php?subjectId=112104121>
- ii. <http://www.technologystudent.com/gears1/gears7.htm>
- iii. <http://kmoddl.library.cornell.edu/model.php?m=20>
- iv. <http://www3.ul.ie/~kirwanp/whatisacamandfollowersyste.htm>
- v. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-Delhi/Kinematics%20of%20Machine/index.htm>
- vi. [http://elearning.vtu.ac.in/12/enotes/Des\\_Mac-El2/Unit6-RK.pdf](http://elearning.vtu.ac.in/12/enotes/Des_Mac-El2/Unit6-RK.pdf)
- vii. [en.wikipedia.org/.../Canadian\\_Committee\\_for\\_the\\_Theory\\_of\\_Machines...](http://en.wikipedia.org/.../Canadian_Committee_for_the_Theory_of_Machines...)
- viii. [global.oup.com/.../theory-of-machines-and-mechanisms-978019537123...](http://global.oup.com/.../theory-of-machines-and-mechanisms-978019537123...)
- ix. [www.tecquipment.com/Theory\\_of\\_Machines.aspx](http://www.tecquipment.com/Theory_of_Machines.aspx)
- x. [www.researchgate.net/.../0094-114X\\_Mechanism\\_and\\_Machine\\_Theory](http://www.researchgate.net/.../0094-114X_Mechanism_and_Machine_Theory)
- xi. [www.journals.elsevier.com/mechanism-and-machine-theory/](http://www.journals.elsevier.com/mechanism-and-machine-theory/)
- xii. [journalseek.net/cgi-bin/journalseek/journalsearch.cgi?field=issn...](http://journalseek.net/cgi-bin/journalseek/journalsearch.cgi?field=issn...)
- xiii. [site.iugaza.edu.ps/wp-content/.../IUGAZA%20TOM2012\\_CH1-2.pdf](http://site.iugaza.edu.ps/wp-content/.../IUGAZA%20TOM2012_CH1-2.pdf)
- xiv. [www.iftomm.org/](http://www.iftomm.org/)
- xv. [www.wiziq.com/online-tests/44047-mechanical-theory-of-machine](http://www.wiziq.com/online-tests/44047-mechanical-theory-of-machine)
- xvi. [www.cs.ubc.ca/~murphyk/Teaching/CS340-Fall07/infoTheory.pdf](http://www.cs.ubc.ca/~murphyk/Teaching/CS340-Fall07/infoTheory.pdf)

## 9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics.

- **Prof. ANKIT PATEL**, H.O.D., Aeronautical Dept. Parul institute of engg. & tech-  
Diploma studies