AMITY UNIVERSITY
UTTAR PRADESH

**Course Title: KINEMATICS AND DYNAMICS OF MACHINES**

**Credit Units: 04**

**Course Level: UG**

**Course Code: MAE205**

| L | T | P/S | SW/FW | TOTAL CREDIT UNITS |
|---|---|---|---|---|
| 2 | 1 | 2 | - | 04 |

**Course Objectives:** The objective of this course is to identify the alternatives to satisfy the needs of the customer and to quantify and evaluate the alternatives. It includes an introduction to the study of motion of constrained mechanism in machine systems. The objective is to develop the students understanding of basic machine design. Concepts, such as linkages, cams, sliders, crank and rocker, offset crank slider etc. The combination of several of these elements in machine drive trains and the resulting static and dynamic forces will also be studied. This course also includes study of forces, motion and inertia in machines, analysis of linkages, cams, rotor dynamics, reciprocal and rotational balancing.

**Pre-requisites: Engineering mechanics, friction, motion**

**Course Contents/Syllabus:**

| | **Weightage (%)** |
|---|---|
| **Module I** | **20%** |
| **General Concepts, Velocity and Acceleration Analysis**<br><br>1. Introduction to simple mechanisms.<br>2. Different types of kinematics pairs.<br>3. Grubler's rule for degrees of freedom, Grashof's criterion for mobility determination.<br>**4.** Inversions of 3R-P, 2R-2P chains.<br>**5.** Kinematics analysis of planar mechanism. Instantaneous center method for analysis three center in line theorem.<br>**6.** Concept of rotating reference frame and its application for Corioli's acceleration. | |
| **Module II** | **20%** |

| | |
|---|---|
| **CAM**<br><br>1. Classification.<br>2. Cams with uniform acceleration and retardation.<br>3. SHM, Cylcloidal motion.<br>**4.** Oscillating followers. | |
| **Module III** | **20%** |
| **Gears**<br><br>1. Geometry of tooth profiles, Law of gearing, involutes profile, interference.<br>2. Helical, spiral and worm gears, simple, compound gear trains.<br>**3.** Epicyclic gear trains – Analysis by tabular and relative velocity method, fixing torque. | |
| **Module IV** | **20%** |
| **Dynamic Analysis**<br><br>**1.** Slider-crank mechanism, turning moment computation<br>**2.** Balancing: Static and dynamic balancing, balancing of revolving and reciprocating masses, single and multi-cylinder engines | |
| **Module V** | **10%** |
| **Gyroscopes**<br><br>**1.** Gyroscopic law, effect of gyroscopic couple on automobiles, ships, aircrafts | |
| **Module VI** | **10%** |
| Clutches | |

**Student Learning Outcomes:**

**On completion of the course the student will be able to:**

1. Demonstrate knowledge of fundamental concepts mechanics.
2. Identify various components of machines and apply basic operations and apply safety procedures.
3. Design and analyze problems relating to Machines and its components.

**Pedagogy for Course Delivery:**

The course pedagogy will include lectures, numerical practice, case studies, seminars and presentations. It also includes discussion on real life problems and demonstrations of Gyroscopes.

## Lab/ Practicals details, if applicable:

**List of Experiments:**

1. To study inversion of 3 R-IP Kinematics chain
2. To study inversions of 2R-2P Kinematics Chain
3. To study gear box, clutch and differential gear
4. To find coefficient of friction for clutch plate
5. To determine gear ratio for an epicyclical gear train and verify it by analytical method
6. To study different types of Cam follower systems
7. To verify Gyroscopic Law
8. To determine and verify the whirling speed of a shaft-disc system
9. To determine the damping factor for a given horizontal vibration set up
10. To obtain dynamic balance for an unbalanced system with revolving masses

## Assessment/ Examination Scheme:

| Theory L/T (%) | Lab/Practical/Studio (%) | Total |
|---|---|---|
| 75% | 25% | 100% |

## Theory Assessment (L&T):

| | Continuous Assessment/Internal Assessment | | | | End Term Examination |
|---|---|---|---|---|---|
| Components (Drop down | A | CT | S/V/Q | HA | EE |
| Weightage (%) | 5 | 10 | 8 | 7 | 70 |

## Lab/ Practical/ Studio Assessment:

| | Continuous Assessment/Internal Assessment | End Term Examination |
|---|---|---|

| Components (Drop down | A | PR | LR | V | PR | V |
|---|---|---|---|---|---|---|
| **Weightage (%)** | 5 | 10 | 10 | 5 | 35 | 35 |

## Text & References:

## Text Books:

- PL Ballaney, Theory of Machines,
- J. Lal, Theory of Machines
- SS Rattan, Theory of Machines .
- R.S. Khurmi, Theory of Machine, S. Chand.

## Reference Books:

- Hams Crone and Roggers, Theory of Machines
- Shigley, Theory of Machines
- Ghosh and Mallick, Mechanisms and Machines, EWP publication