Paper Code: ARA 211

Subject: Kinematics and Dynamics of Machines

	L	T/P	Credits
	4	-	4

Marking Scheme

1. Teachers Continuous Evaluation: 25 Marks
2. End Term Theory Examination: 75 Marks

INSTRUCTIONS TO PAPER SETTERS:

Maximum Marks : 75

1. There should be 9 questions in the end term examination question paper
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 15 marks.
3. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 15 marks.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes:

CO1:	Ability of students to implement the basic knowledge about components and layout of linkages in the assembly of a system/machine in terms of kinematics and dynamics.
CO2:	Ability of students to implement knowledge of the principles for analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
CO3:	Ability of students to utilize the motion resulting from a specified set of linkages; design few linkage and cam mechanisms for specified output motions.
CO4:	Ability of students to utilize basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale 1: Low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	1	1	1	2
CO2	3	3	3	3	2	-	-	-	1	1	1	2
CO3	3	3	3	3	2	-	-	-	1	1	1	2
CO4	3	3	3	3	2	-	-	-	1	1	1	2

Unit I

Mechanisms: Definition – Machine and Structure – Kinematic link, pair, and chain – classification of Kinematic pairs – Constraint and motion – Degrees of freedom – Slider crank – single and double – Crank rocker mechanisms – Inversions, applications **[10]**
Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms

Unit II

Gears and Cams: Gear – Types and profile – nomenclature of spur and helical gears – laws **[10]** of gearing – interference – the requirement of the minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – Cam – Types of cams and followers – Cam design for different follower motions.

Prof. Ajay S. Singholi
Professor In-charge, USAR
Guru Gobind Singh Indraprastha University
(East Delhi Campus)
Surajmal Vihar, Delhi-110092

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Unit III
[10]
Balancing: Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi-cylinder engines -Governors and Gyroscopic effects

Vibrations: free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft.

Unit IV
[10]
Force Analysis: Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic, Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.

Text Books:
1. Bansal R.K., (2009) Theory of Machines, Laxmi Publications Pvt Ltd., New Delhi, 20th edition.
2. Rattan S.S., (2011) Theory of machines, Tata McGraw Hill publishing Co., New Delhi, 2nd edition.

References:
1. Gosh A and Mallick A.K.,(2009) Theory of Machines and Mechanisms, Affiliated East West press.
2. Malhotra D.R. and Gupta H.C , (2008) The Theory of machines, Satya Prakasam, Tech. India Publications
3. Dukkipati, R. V. (2007). *Mechanism and machine theory.* bohem press.
4. Shigley J.E. and Uicker J.J., (2006) Theory of Machines and Mechanisms", McGraw Hill.
5. Ambekar, A. G. (2007). *Mechanism and machine theory.* PHI Learning Pvt. Ltd.

Prof. Ajay S. Singholi
Professor In-charge, USAR
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