SAPTHAGIRI College of Engineering Creating Tomorrow

DEPARTMENT OF MECHANICAL ENGINEERING
SAPTHAGIRI COLLEGE OF ENGINEERING
LESSON PLAN FOR THE ACADEMIC YEAR: 2018-19 (ODD SEMESTER)
(For students)

Course	DYNAMICS OF MACHINERY				Course code		15ME52
Faculty	Dr. P. Mahadevaswamy				Semester		5
Core/Elective	Contact Hours /week			Total Hours	Assessment		Credits
Core	L	T	P	50	CIE	SEE	4
	3	2	-		20	80	
Prerequisite	1.Engineering Mechanics 2.Engineering Mathematics						

Course Objectives

1	To analyze the static and dynamic equilibrium conditions of mechanisms subjected forces and couple, with and without friction.
2	To understand the balancing principles of rotating and reciprocating masses.
3	To analyze the characteristics of governors and gyroscopes.
4	To gain the basic knowledge of vibratory system and addition of SHM
5	To understand free vibrations characteristics of single degree of freedom systems.
6	To understand forced vibrations characteristics of single degree of freedom systems.

Syllabus	
MODULE 1	**RBT Level**
Static force Analysis: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque, Free body diagrams, Static force analysis of four bar mechanism and Slider-crank mechanism with and without friction. **Dynamic force Analysis:** D'Alembert's principle, Inertia force, Inertia torque. Dynamic force analysis of four-bar mechanism and Slider crank mechanism without friction, numerical problems. **(10 Hours)**	L1,L2,L3, L4
MODULE 2	
Balancing of Rotating Masses: Static and dynamic balancing, balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. **Balancing of Reciprocating Masses:** Inertia effect of crank and connecting rod, Single cylinder engine, balancing in multi cylinder-inline engine (primary and secondary forces), numerical problems. **(10 Hours)**	L1,L2,L3, L4

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MODULE 3	
Governors: Types of governors, force analysis of Porter and Hartnell governors. Controlling force, Stability, Sensitiveness, Isochronism, Effort and Power. **Gyroscope**: Vectorial representation of angular motion, Gyroscopic couple. Effect of gyroscopic couple on plane disc, aeroplane, ship, stability of two wheelers and four wheelers, numerical problems. **(10 Hours)**	L1,L2,L3, L4
MODULE 4	
Introduction & Undamped free Vibrations (Single Degree of Freedom) Types of vibrations, Definitions, Simple Harmonic Motion (SHM), Work done by harmonic force, Principle of super position applied to SHM. Methods of analysis – (Newton's, Energy & Rayleigh's methods). Derivations for spring mass systems, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and problems. **(10 Hours)**	L1,L2,L3, L4
MODULE 5	
Damped free Vibrations (Single Degree of Freedom) Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and numerical problems. **Forced Vibrations (Single Degree of Freedom):** Analysis of forced vibration with constant harmonic excitation, Magnification factor (M.F.), Vibration isolation - Transmissibility ratio, Excitation of support (absolute and relative), Numerical problems. **(10 Hours)**	L1,L2,L3, L4

Text Books:

1. Sadhu Singh, Theory of Machines, 2nd Edition, Pearson Education, India, 2007.
2. Rattan S.S, Theory of Machines, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
3. A. G. Ambekar, Mechanism and Machine Theory, 1st edition, PHI, New Delhi, 2007
4. G. K.Grover, Mechanical Vibrations, 7th edition,Nem Chand and Bros.India,2003

Reference Books:

1. S. S. Rao, Mechanical Vibrations, 4th edition, Pearson Education Inc, India,2003.
2. V. P. Singh, Mechanical Vibrations, 3rd edition,Dhanpat Rai and Company,New Delhi 2006

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Course outcomes	
At the end of this course the students will be	
CO1	Able to analyze simple mechanisms subjected to static and dynamic force.
CO2	Able to analyze the balancing of rotating and reciprocating masses.
CO3	Able to analyze various characteristics of the governor and gyroscope.
CO4	Able explain the basics of vibration and apply principle of super position to addition of motion
CO5	Able to analyze free vibration of single degree of freedom systems.
CO6	Able to analyze forced vibration of single degree of freedom system.

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Lesson plan

Period	Date	Topic Planned
1		Introduction to the subject
2		**Static force Analysis:** Static equilibrium. Equilibrium of two and three force members.
3		Members with two forces and torque, Free body diagrams,
4		Static force analysis of Slider-crank mechanism without friction.
5		Static force analysis of four bar mechanism without friction.
6		Static force analysis of mechanism with friction.
7		Numerical problems.
8		**Dynamic force Analysis:** D'Alembert's principle, Inertia force, Inertia torque.
9		Dynamic force analysis of Slider crank mechanism without friction,
10		Dynamic force analysis of four-bar mechanism without friction,
11		Numerical problems.
At the end of this topic students able to Analyze simple mechanisms subjected to static and dynamic force.		
12		**Governors:** Types of governors, Force analysis of Porter governors,
13		Numerical problems.
14		Force analysis of Hartnell governors.
15		Numerical problems.
16		Controlling force, Stability, Sensitiveness, Isochronism, Effort and Power.
17		**Gyroscope**: Vectorial representation of angular motion, Gyroscopic couple.
18		Effect of gyroscopic couple on plane disc and on aeroplane.
19		Effect of gyroscopic couple on ship - numerical problems.
20		Stability of two wheelers- numerical problems.
21		Stability of four wheelers, numerical problems.
At the end of this topic students able to Analyze various characteristics of the governor and gyroscope.		
22		**Balancing of Rotating Masses**: Static and dynamic balancing,
23		Balancing of single rotating mass by balancing masses in same plane and in different planes.
24		Balancing of several rotating masses by balancing masses in same plane
25		Balancing of several rotating masses by balancing masses in different planes. Numerical problems

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26		Numerical problems
27		**Balancing of Reciprocating Masses:** Inertia effect of crank and connecting rod,
28		Single cylinder engine,
29		Balancing in multi cylinder-inline engine (primary and secondary forces),
30		Numerical problems.
31		Numerical problems.
At the end of this topic students able to **Able to analyze the balancing of rotating and reciprocating masses.**		
32		**Introduction to vibration** Types of vibrations, Definitions,
33		Simple Harmonic Motion (SHM), Work done by harmonic force,
34		Principle of super position, addition of motion(SHM). Numerical problems.
35		**Undamped free Vibrations (Single Degree of Freedom)** Methods of analysis – (Newton's, Energy & Rayleigh's methods).
36		Derivations for spring mass systems, Natural frequencies of simple systems,
37		Natural frequencies of simple systems,
38		Natural frequencies of simple systems,
39		Springs in series and parallel,
40		Torsional and transverse vibrations,
41		Effect of mass of spring and problems
At the end of this topic students able to **Explain the basics of vibration and apply principle of super position to addition of motion**		
42		**Damped free Vibrations (Single Degree of Freedom)** Types of damping, Analysis with viscous damping
43		Derivations for over, critical and under damped systems,
44		Logarithmic decrement and numerical problems.
45		Numerical problems.
46		Numerical problems.
47		**Forced Vibrations (Single Degree of Freedom):** Analysis of forced vibration with constant harmonic excitation,
48		Magnification factor (M.F.), Vibration isolation - Transmissibility ratio,
49		Numerical problems.
50		Excitation of support (absolute and relative), Numerical problems.
51		Numerical problems.
52		Numerical problems.

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PROGRAMME OUTCOMES

Program outcomes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge and behavior. Graduation students of **Bachelor of Mechanical Engineering** program at Sapthagiri College of Engineering will attain the following program outcomes **in the field of mechanical engineering.**

	PROGRAM OUTCOME
PO1.	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2.	**Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5.	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6.	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7.	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8.	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9.	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10.	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11.	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12.	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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PROGRAMME SPECIFIC OUTCOMES

The graduates of Mechanical engineering program of Sapthagiri College of Engineering should be able to attain the following at the time of graduation.

	PROGRAM SPECIFIC OUTCOMES
PSO1	Expertise in specialized areas of Mechanical Engineering such as Design, Thermal, Materials and Manufacturing Engineering with a focus on research and innovation.
PSO2	Ability of problem solving by adopting analytical, numerical and experimental skills with awareness of societal impact for mechanical engineering.

CO-PO Mapping

Mapping of Course outcomes, Program Objectives and Program specific outcomes
Note: 1 = Slight 2 = Moderate 3 = Strong

Course outcomes	Program Outcomes												PSOs		Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO-1	3	2	1	-	-	-	-	-	-	-	-	-	2	2	
CO-2	3	2	1	-	-	-	-	-	-	-	-	-	2	2	
CO-3	3	2	1	-	-	-	-	-	-	-	-	-	2	2	
CO-4	3	2	1	-	-	-	-	-	-	-	-	-	2	2	
CO-5	3	2	1	-	-	-	-	-	-	-	-	-	2	2	
CO-6	3	2	1	-	-	-	-	-	-	-	-	-	2	2	
Average	3	2	1	-	-	-	-	-	-	-	-	-	2	2	

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Faculty Signature

HOD
Professor & Head
Department of Mechanical Engineering
Sapthagiri College of Engineering