DYNAMICS OF MACHINERY (ME501PC)

COURSE PLANNER

COURSE OVERVIEW:

The objective is to introduce some of the components mainly used in IC Engines and make analysis of various forces involved. Subjects deals with topics like inertia forces in slider crank mechanism; IC Engine components & the analysis like governors is introduced. It also deals with balancing of rotating & reciprocating parts. Studies are made about balancing of multi cylinder engines, Radial engines etc. study of primary & secondary forces are considered while balancing. Finally they are introduced to the topic of vibrations. The study deals with linear, longitudinal, & torsional vibrations. The idea is to introduce the concept of natural frequency and the importance of resonance and critical speeds.

COURSE PURPOSE:

Dynamic loads and undesired oscillations increase with higher speed of machines. At the same time, industrial safety standards require better vibration reduction. This book covers model generation, parameter identification, balancing of mechanisms, torsion and bending vibrations, vibration isolation, and the dynamic behavior of drives and machine frames as complex systems. Typical dynamic effects, such as the gyroscopic effect, damping and absorption, shocks, resonances of higher order, nonlinear and self-excited vibrations are explained using practical examples. These include manipulators, flywheels, gears, mechanisms, motors, rotors, hammers, block foundations, presses, high speed spindles, cranes, and belts. Various design features, which influence the dynamic behavior, are described.

PREREQUISITE(S):

The knowledge of following subjects is essential to understand the subject:

1. Engineering Mechanics
2. Strength of Materials
3. Kinematics of Machinery

COURSE OBJECTIVES:

1. The objective is to introduce some of the components mainly used in IC Engines and make analysis of various forces involved.
2. Deals with topics like inertia forces in slider crank mechanism; IC Engine components & the analysis like governors is introduced.
3. Deals with balancing of rotating & reciprocating parts.
4. Introduced to the topic of vibrations. The study deals with linear, longitudinal, & torsional vibrations.
5. The idea is to introduce the concept of natural frequency and the importance of resonance and critical speeds.

I. COURSE OUTCOME:

Sl. No.	Description	Bloom's Taxonomy level
CO1.	Understand the gyroscopic effect	**L2: Understanding**
CO2.	Analyze static and dynamic force in mechanisms and design of flywheel.	**L4: Analyze**
CO3.	Able to determine frictional torque and power in bearings, clutches, brakes, dynamometers and governors.	**L2: Understanding**
CO4.	Understand the concept of balancing of rotating and reciprocating masses.	**L2: Understanding**
CO5.	Understand Free vibrations of single degree freedom systems.	**L2: Understanding**

II. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignment / Exam
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Assignment / Exam
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignment / Exam
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.	1	Assignment /Exams
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	1	Assignment /Exams
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.	2	Assignment /Exams
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.	1	Assignment /Exams
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.	2	Assignment /Exams

III. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Level	Proficiency assessed by
PSO1	The student will be able to apply the knowledge of Mathematics, Sciences and engineering fundamentals to formulate, analyze and provide solutions for the problems related to Mechanical engineering and communicate them effectively to the concerned.	3	Lectures, Assignments
PSO2	Design mechanical systems in various fields such as machine elements, thermal, manufacturing, industrial and inter-disciplinary fields by using various engineering/technological tools to meet the mercurial needs of the industry and society at large.	2	Lectures, Assignments
PSO3	The ability to grasp the latest development, methodologies of mechanical engineering and posses competent knowledge of design process, practical proficiencies, skills and knowledge of programme and developing ideas towards research.	1	Lectures, Assignments

IV. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	3	2	2	-	-	-	-	-	2	1	-	2
CO2.	3	3	2	-	1	-	-	-	2	1	-	2
CO3.	3	3	2	1	1	-	-	-	2	1	-	2
CO4.	3	3	2	1	1	-	-	-	2	1	-	2
CO5. .	3	3	2	1	1	-	-	-	2	1	-	2
Average	**3.00**	**2.80**	**2.00**	**1.00**	**1.00**	**-**	**-**	**-**	**2.00**	**1.00**	**-**	**2.00**

PROGRAM SPECIFIC OUTCOMES:

Course Outcomes (COs)	Program Specific Outcomes (PSOs)		
	PSO1	PSO2	PSO3
CO1.	3	2	1
CO2.	3	2	1
CO3.	3	2	1
CO4.	3	2	1
CO5.	3	2	1
Average	**3.00**	**2.00**	**1.00**

V. SYLLABUS (JNTUH)

UNIT – I

Precession: Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

Static and Dynamic Force Analysis: Static force analysis of planar mechanisms – Analytical Method – Dynamic Force Analysis – D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

UNIT II

Turning Moment Diagram and Flywheels: Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method - Turning moment diagram –fluctuation of energy – flywheels and their design - Inertia of connecting rod inertia force in reciprocating engines – crank effort and torque diagrams.

UNIT III

Friction: pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches - Types - Single plate, multi-plate and cone clutches.

Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

UNIT IV

Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting – stability – effort and power of the governors.

Balancing: Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of "V" and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

UNIT – V

Vibrations: Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

SUGGESTED BOOKS:

TEXT BOOK:

1) Theory of machines by Thomas Bevan, CBS
2) Theory of machines – R.K.Bansal
3) Theory of machines – R.S.Khurmi & J.K.Gupta
4) Theory of machines – Rattan S.S., TMH, 2009 Edition
5) Theory of machines – PL. Ballaney/Khanna publishers
6) Theory of machines – Sadhu Singh parson's edition

REFERENCES:

7) J. S. Rao, R. V. Dukkipati (2010), Mechanism and Machine Theory, New Age Publishers, New Delhi, India.
8) Shiegley (2011), Theory of Machines, Tata McGraw hill education (P) Ltd, New Delhi, India.
9) Khurmi, R.S. (2011), Theory of machines, S.Chand publishers, New Delhi, India.

GATE SYLLABUS: Analysis of plane mechanisms, dynamic analysis of slider-crank mechanism, planer cams and followers, governors and flywheels, balancing of reciprocating and rotating masses.

Vibrations: Free and forced vibrations of single degree freedom systems, effect of damping, vibration isolation, resonance, critical speed shafts.

IES SYLLABUS:

Kinematic and dynamic analysis of planer mechanisms, Flywheels, Governors, Balancing of rigid rotors and field balancing, Balancing of single and multi-cylinder engines, linear vibration analysis of mechanical systems, Critical speeds and whirling of shafts Automatic controls.

VI. COURSE PLAN:

Lecture No.	Unit No.	Topics to be covered	contents to be covered	Link for PPT	Link for PDF	Course learning outcomes	Bloom's Taxonomy	Teaching Methodology	Reference
1	I	INTRODUCTION- Right Hand Screw Rule	Right Hand Screw Rule	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing	CO1	Knowledge	ICT	**T1 & R2**
2		Angular motion Gyroscope	Angular motion Gyroscope	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
3		Effect of precession-motion, angular velocity, angular momentum	Effect of precession-motion, angular velocity, angular momentum	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
4		Effect of precession-motion on the stability of aero planes	Effect of precession-motion on the stability of aero planes	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**

5		Effect of precession-motion on the stability of aero planes	Effect of precession-motion on the stability of aero planes	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.g		Knowle	ICT	**T1**
6		Effect of precession-motion on the stability of ships	Effect of precession-motion on the stability of ships	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
7		Effect of precession-motion on the stability of ships	Effect of precession-motion on the stability of ships	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
8		Effect of precession-motion on the stability of 4/2 wheeler	Effect of precession-motion on the stability of 4/2 wheeler	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
9		Effect of precession-motion on the stability of 4/2 wheelers	Effect of precession-motion on the stability of 4/2 wheelers	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**

10		Static force analysis of planar mechanisms	Static force analysis of planar mechanisms	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
11		Static force analysis of planar mechanisms	Static force analysis of planar mechanisms	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
12		Dynamic force analysis of planar mechanisms	Dynamic force analysis of planar mechanisms	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
13		Dynamic force analysis of planar mechanisms	Dynamic force analysis of planar mechanisms	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing	**CO1, CO2**	Understand	ICT	**T1 & R2**
15		**MOCK TEST1**		-	-				

16		Inertia Torque connecting rod angular velocity and acceleration	Inertia Torque connecting rod angular velocity and acceleration	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.g		Unders	ICT	**T1**
17		crank effort and torque diagrams	crank effort and torque diagrams	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
18		crank effort and torque diagrams	crank effort and torque diagrams	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
19		Fluctuation of energy	Fluctuation of energy	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
20		Fluctuation of energy	Fluctuation of energy	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**

21		Fluctuation of energy	Fluctuation of energy	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
22		Fluctuation of energy	Fluctuation of energy	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
23		Fly wheel design	Fly wheel design	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
24		Fly wheel design	Fly wheel design	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
26		FRICTION: Inclined plane	FRICTION: Inclined plane	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**

27		Friction of screw and nuts	Friction of screw and nuts	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing			Unders	ICT	**T1**
28		pivot and collars-uniform pressure, uniform wear-	pivot and collars-uniform pressure, uniform wear-	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
29		Friction circle and Friction axis	Friction circle and Friction axis	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
30	III	Lubricated surfaces	Lubricated surfaces	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing	**CO2**	Knowledge	ICT	**T1 & R2**
31		Bridge class	Bridge class	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**

32		Boundary friction- film lubricants	Boundary friction-film lubricants	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
33		CLUTCHES: Single plate, multi plate	CLUTCHES: Single plate, multi plate	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
34		DYNAMOMETERS: simple block break,band and block break	DYNAMOMETERS: simple block break,band and block break	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
35		Shoe break-effect	Shoe break-effect	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
36		Dynamometers and types	Dynamometers and types	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**

37		General discriotion and methods of operation	General discriotion and methods of operation	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under	ICT	**T1**
39		Govereners: Watt	Govereners : Watt	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**
40		Porter and Proell governors	Porter and Proell governors	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**
41	IV	Spring loaded governors Hartnell and hartung with auxiliary springs	Spring loaded governors Hartnell and hartung with auxiliary springs	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing	**CO3**	Under stand	ICT	**T1 & R2**
42		Sensitiveness, isochronism and hunting	Sensitiveness, isochronism and hunting	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**

43		Balancing: Introduction	Balancing: Introduction	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
44		Balancing of rotating masses Single and multiple	Balancing of rotating masses Single and multiple	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
45		Single and different planes.	Single and different planes.	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
46		Bridge class	Bridge class	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
47		Balancing of Reciprocating masses:Primary	Balancing of Reciprocating masses:Primary	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**

48		Balancing of Reciprocating masses:Secondary	Balancing of Reciprocating masses:Secondary	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under	ICT	**T1**
49		Higher Balancing of Reciprocating masses	Higher Balancing of Reciprocating masses	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
50		Analytical and graphical methods	Analytical and graphical methods	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Knowledge	ICT	**T1 & R2**
51	V	Unbalanced forces and Couple	Unbalanced forces and Couple	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
52		Locomotive balancing - Hammer blow	Locomotive balancing -Hammer blow	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**

53		Swaying couple	Swaying couple	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**
54		variation of tractive efforts	variation of tractive efforts	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**
56		**MOCK TEST 2**		-	-				
57		Free vibration of mass attached to vertical spring	Free vibration of mass attached to vertical spring	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**
58		Oscillation of pendulums-Transverse loads	Oscillation of pendulums-Transverse loads	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**

59		Dunkerlya's methods	Dunkerlya's methods	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.g		Under	ICT	**T1**
60		Raleigha's method	Raleigha's method	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**
61		Problems	Problems	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**
62		Problems	Problems	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**
63		problems	problems	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQyESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Under stand	ICT	**T1 & R2**

64		Critical speed	Critical speed	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
65		Torsional vibrations	Torsional vibrations	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
66		One rotor system	One rotor system	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
67		Two rotor system	Two rotor system	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**
68		Three rotor system	Three rotor system	https://drive.google.com/drive/folders/161IdTTyZmoe34w1FjEEqhQvESbEz7hEU?usp=sharing	https://drive.google.com/drive/folders/1JYlQtsVv-SI-MR6AiVICoqhFgcRBjQTL?usp=sharing		Understand	ICT	**T1 & R2**

VII. QUESTION BANK: (JNTUH)

DESCRIPTIVE QUESTIONS:

UNIT-I

Short Answer Questions-

S.No	Question	Blooms	Course outcomes
1	Explain the effect of the Gyroscopic Couple on an aero plane.	L1	C01
2	Explain about "terms used in a Naval Ship.	L1	C01
3	Explain about "Processional Angular Motion".	L1	C01
4	Effect of Gyroscopic Couple on a Naval Ship during pitching.	L2	C01
5	Write about the terms used in Four Wheel Drive.	L1	C01

Long Answer Questions-

S.No	Question	Blooms	Course outcomes
1	a) Explain the effect of the Gyroscopic Couple on an Aero plane? b) An Aero plane makes a complete half circle of 50 meters radius, towards, when flying at 200 km/hr. The rotary engine and the Propeller of the plane have a mass of 400 kg and a radius of gyration of 0.3m.The engine rotates at 2400 rpm clockwise when viewed from the rear. Find the Gyroscope Couple on the Aircraft and state its effect on it.	L1,L3	C01
2	Briefly explain about "terms used in a Naval Ship".	L1	C01
3	Derive the equation of stability of a four wheel Drive moving in a Curved Path.	L2	C01
4	Derive the equation stability of a Two Wheel Vehicle taking a turn?	L2	C01
5	a) Terms used in Four Wheel Drive? b) A four wheeled Trolley car of mass 2500 kg runs on rails, which are 1.5m apart and travels around a curved of 30 m radius at 24 km/hr. The rails are at the same level. Each wheel of the Trolley is 0.75m in diameter and each of the two axles' driven by a motor running in a direction opposite to that of the wheels at a speed of five times the speed of rotation of the wheels. The moment of Inertia of each axle with gear and wheels is 18 kg-m^2. Each motor with shaft and gear pinion has a moment of inertia of 12 kg-m^2.The center of gravity of the car is 0.9m above the rail level. Determine the vertical force exerted by each wheel on the rails taking into consideration the Centrifugal and Gyroscopic effects. State the Centrifugal and Gyroscopic effects in the Trolley.	L1,L3	C01
6	a) Explain about "Processional Angular Motion"?	L1,L3	C01

	b) A uniform disc having a mass of 8 kg and a radius of Gyration of 150 mm is mounted on one end of a horizontal arm of length 200mm. The other end of the arm can rotate feely of 250 rpm as seen from the disc end of the arm. Determine the motion of the disc if the arm remains horizontal.		
7	a) Terms used in Naval Ship? b) The mass of the turbine rotor of a ship 20 tones and has a radius of gyration of 0.6m.It's speed is 2000 rpm. The ship pitches 6deg above 6deg below the horizontal position. A complete oscillation takes 30 seconds and the motion is simple harmonic. Determine the following i) Maximum Gyroscopic Couple ii) Maximum angular acceleration of the ship during pitching.	**L1,L3**	**C01**
8	Explain any three terms: i) Naval Ship ii) Four Wheel Vehicle iii) Two Wheel Vehicle iv).Aero plane	**L1**	**C01**
9	a) Write down Naval Ship 'Notes'? b) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45m and a speed of 3000 rpm clockwise when looking from stern. Determine the Gyroscopic Couple and its effect upon the ship. i).When the ship is steering to the left on a curve of 100m radius at a speed of 36 km/hr.? ii) When the ship is pitching in a Simple Harmonic Motion, The bow failing with its Maximum Velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 deg.	**L1,L3**	**C01**
10	a) Effect of Gyroscopic Couple on a Naval Ship during pitching? b) Explain about "Processional Angular Motion"?	**L2,L1**	**C01**

UNIT-2

Short Answer Questions-

S.No	Question	Blooms	Course outcomes
1	A) What is the function of a flywheel? How does it differ from that of a governor? B) Explain about co-efficient of fluctuation of speed?	**L2,L1**	**C03**
2	Prove that the maximum fluctuation of energy (energy stored in flywheel)?	**L2**	**C03**
3	Define the following terms: A) Stability of governor B) Sensitiveness C) Isochronism's	**L1**	**C03**

	D) Hunting		
4	What is the function of a governor? How does it differ from that of a flywheel?	**L2**	**C03**
5	State different types of governors? Explain about watt governor?	**L1**	**C03**

Long Answer Questions-

S.No	Question	Blooms	Course outcomes
1	A) Explain the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to flywheels. B) The mass of flywheel of an engine is 6.5 tones and the radius of gyration is 1.8 meters. It is found from the turning moment diagram that the fluctuation of energy is 56 KN/m. If the mean speed of the engine is 120 rpm, find the maximum and minimum speeds.	**L1,L3**	**C03**
2	A) What is the flywheel? B) An engine flywheel has a mass of 6.5 tones and the radius of gyration is 2m. If the maximum and minimum speed is 120 rpm and 118 rpm respectively, find maximum fluctuation of energy?	**L1,L3**	**C03**
3	A) Explain about flywheel? B) The turning moment diagram for a petrol engine is drawn to the following scales: turning moment 1mm=5n-m; crank angle 1mm=1°. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order, are 295, 685, 40, 340, 960, 270 mm^2. The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 150mm. determine the co-efficient of fluctuation of speed when the engine runs at 1800 rpm.	**L1,L3**	**C03**
4	A shaft fitted with a flywheel rotates at 250 rpm and drives a machine. The torque of machine varies in a cyclic manner over a period of 3 revolutions. The torque raises from 750 N-m and 300 N-m uniformly during half revolution and remains constant for the following revolution. It then falls uniformly to 750 n-m during the next half revolution and remains constant for one revolution, the cycle being repeated thereafter. Determine the power required to drive the machine and percentage fluctuation in speed if the driving torque applied to the shat is constant and the mass of the flywheel is 500 kg with radius of gyration of 600 mm.	**L3**	**C03**
5	A) Explain about co-efficient of fluctuation of speed? B) A punching press is driven by constant torque electric motor. The press is provided with a flywheel that rotates at maximum speed of 225 rpm. The radius of gyration of the flywheel is 0.5m. The press punches 720 holes per hour. Each punching operation	**L1,L3**	**C03**

	takes 2 seconds and requires 15 KN-m of energy. Find the power of the motor and the minimum mass of the flywheel if speed of the same is not to fall below 200 rpm.		
6	A) What is the difference between flywheel and governor? B) A machine punching 38mm holes in 32mm thick plate required 7 N-m of energy per square mm of sheared area, and punches one hole in every 10 seconds. Calculate the power of the motor required. The mean speed of the flywheel is 25 meters per second. The punch has a stroke of 100 mm. find the mass of the flywheel required, if the total fluctuation of speed is not to exceed 3 percent of the mean speed. Assume that the motor supplies energy to the machine at uniform rate.	**L1,L3**	**C03**
7	A porter governor has equal arms each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor.	**L3**	**C03**
8	A) Calculate the vertical height of a watt governor when it rotates at 60 rpm. Also find the change in vertical height when its speed increases to 61 rpm. B) A hartnell governor having a central sleeve spring and two right-angled, bell crank levers moves between 290 rpm and 310 rpm for a sleeve lift of 15mm. The sleeve arms and the ball arms are 80mm and 120 mm respectively. The levers are pivoted at 120mm from the governor axis and mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine: i) Loads on the spring at the lowest and the highest equilibrium speeds, and ii) Stiffness of the spring.	**L3**	**C03**
9	A) Derive the equation of proell governor? B) A proell governor has equal arms of length 300mm. The upper and lower ends of the arms are provided on the axis of the governor. The extension arms of links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150mm and 200mm. The mass of each ball is 10 kg and the mass of the central load is 100 kg. Determine the range of speed of the governor.	**L1,L3**	**C03**
10	Derive the equation of hart ell governor?	**L2**	**C03**
11	Derive the following terms: A) Proell governor B) Porter governor using instantaneous center method.	**L2**	**C03**
12	What is the relation between sensitiveness and hunting?	**L1**	**C03**

13	What is the function of a governor? Explain about centrifugal governor with neat sketch?	**L1**	**C03**

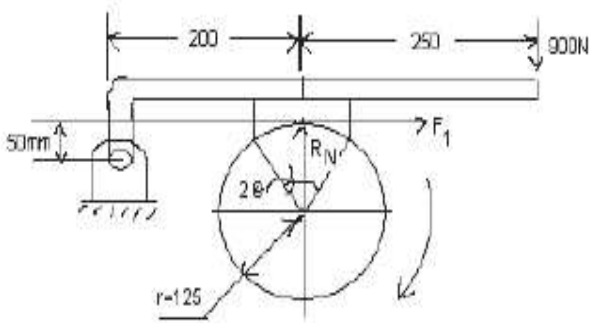
UNIT-3

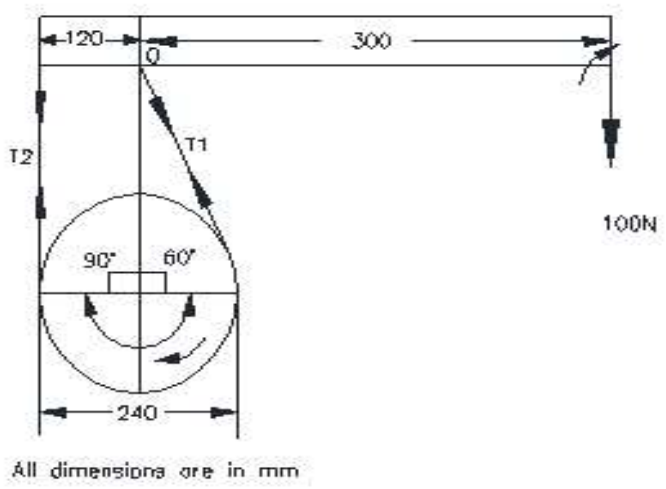
Short Answer Questions-

S.No	Question	Blooms	Course outcomes
1	a) Functions of Clutches? b) Explain about Cone Clutch?	**L2,L1**	**C02**
2	a) what is Dynamometer? b) Explain about "Block (or) Shoe Brake"?	**L1,L1**	**C02**
3	What is the Brake? Briefly explain about Band Brake?	**L1**	**C02**
4	What is the difference between brakes and clutch?	**L1**	**C02**
5	Types of Dynamometer? Explain about "Prony Brake Dynamometer"?	**L1**	**C02**
6	a) what is the Difference between Brake and Dynamometer? b) Explain about Rope Brake Dynamometer?	**L2,L1**	**C02**
7	What is the "Transmission Dynamometers"? Explain about "Belt Transmission Dynamometers"?	**L1**	**C02**
8	What is functions' of Clutches? What are the various types of Friction Clutches?	**L2**	**C02**

Long Answer Questions-

S.No	Question	Blooms	Course outcomes
1	a) What is the difference between brakes and clutch? b) A differential Band Brake has a drum of diameter 800mm. The two ends of the band are fixed to the pins on the opposite sides of the fulcrum of the level at distance of 40mm and 200mm from the fulcrum. The angle of contact is 270^o and the coefficient of friction 0.2 determines the brake Torque when a force of 600N is applied to the lever at a distance of 800mm from the Fulcrum. The angle of contact is 270^o and the co-efficient of friction 0.2. Determine the brake torque when a force of 600N is applied to the lever at a distance of 800mm from the fulcrum.	**L1,L3**	**C02**
2	A cone clutch of cone angle 30^o is used to transmit a power of 10kW at 800 rpm. The intensity of pressure between the contact surfaces is not to exceed 85 KN/m^2. The width of the conical friction surface is half of the mean radius. If co-efficient of friction=0.15, then find the dimensions of the contact surfaces, Assuming uniform wear. Also find the axial load or force required to hold the clutch while transmitting the power. What is the width of the friction surface?	**L3**	**C02**
3	a) What is the relation between Brake and Dynamometer?	**L2,L3**	**C02**

	b) The diameter of the brake drum of a single block brake is 1m.It sustains 240 N/m of Torque at 400 rpm. The co=efficient of the friction is 0.32. Determine the required force to be applied when the angle of contact is (i) 35° and (ii) 100° given a= 800mm, b=150mm and c=25mm. Assume the rotation of the drum to be both clockwise and counter-clockwise.		
4	A single block brake is shown in figure the diameter of drum is 250mm and the angle of contact is 120°. If the operating force of 900N is applied at the end of a lever and the coefficient of friction between the drum and the lining is 0.45 determine the torque that may be transmitted by the block brake. 	**L3**	**CO2**
5	A cone clutch with cone angle 20° is to transmit 7.5 kW at 750 rpm. The normal intensity of pressure between the contact faces is not to exceed 0.12N/mm^2. The coefficient of friction is 0.2. If face width is 1/5th of mean diameter, find: (i) the main dimensions of the clutch, and (ii) Axial force required while running.	**L3**	**CO2**
6	A centrifugal clutch has 4 shoes which slide radially in a spider keyed to the driving shaft and make contact with internal cylindrical surface of a rim keyed to the driven shaft. When the clutch is at rest, each shoe is pulled against a stop by a spring so as to leave a radial clearance of 5 mm between the shoe and the rim. The pull exerted by the spring is then 500 N. The mass centre of shoe is 160 mm from the axis of the clutch. If the internal diameter of the rim is 400 mm, the mass of each shoe is 8 kg, the stiffness of each spring is 50 N/mm and the coefficient of friction between the shoe and the rim is 0.3. Find the power transmitted by the clutch at 500 rpm.	**L3**	**CO2**
7	The simple band brake, as show in fig.1 is applied to a shaft carrying a flywheel of mass 400 kg. The radius of gyration of the flywheel is 450mm and runs at 300rpm. If the co-efficient of friction is 0.2 and the brake drum diameter is 240, find the torque applied due to a hand load of 100N.	**L3**	**CO2**

			
8	A cone clutch with a semi-cone angle of 15° transmits 10kW at 600 rpm. The normal pressure intensity between the surfaces in contact is not to exceed 100kN/m^2. The width of the friction surfaces is half of the mean diameter. Assume μ=0.25. Determine (i) The outer and inner diameters of the plate (ii) Width of the cone face (iii) The axial force to engage the clutch.	**L3**	**C02**
9	A Simple band brake is applied to a drum of 560mm diameter, which rotates at240 rpm. Angle of contact of band is 270°. One end of the band is fastened to a fixed pin and the other end of the brake lever 140mm from the fixed pin. The brake lever is 800mm long and is placed perpendicular to the diameter that bisects the angle of contact. The coefficient of friction is 0.3; determine the necessary pull at the end of the lever to stop the drum if 40 kW of power is being absorbed. Also find the width of the band if its thickness is 3mm and the maximum tensile stress is limited to 40N/mm^2.	**L3**	**C02**

UNIT-4

Short Answer Questions-

S.No	Question	Blooms	Course outcomes
1	Why is balancing of rotating parts necessary for high speed engines?	**L2**	**C05**
2	Explain the terms 'static balancing' and 'dynamic balancing'. State the necessary conditions to achieve them.	**L1**	**C05**
3	Discuss how a single revolving mass is balanced by two masses revolving in different planes.	**L2**	**C05**
4	Explain the method of balancing of different masses revolving in	**L1**	**C05**

	the same plane.		
5	How the different masses rotating in different planes are balanced?	**L2**	**C05**
6	Explain and derive the equation for the following terms: (i) Tractive force (ii) Swaying couple (iii) Hammer blow	**L1,L2**	**C05**

Long Answer Questions-

S.No	Question	Blooms	Course outcomes
1	Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving mass.	**L1**	**C05**
2	Derive the following expressions, for an uncoupled two cylinder locomotive engine: Variation is tractive force; Swaying couple; and Hammer blow.	**L2**	**C05**
3	Discuss the unbalanced forces and couples acting in a four cylinder in-line engines and the method of balancing them.	**L2**	**C05**
4	Explain the 'direct and reverse crank' method for determining unbalanced forces in radial engines.	**L1**	**C05**
5	A) Write a short note on primary and secondary balancing. B) Discuss the balancing of V-engines.	**L2**	**C05**
6	A two cylinder uncoupled locomotive has inside cylinders 60 cm apart. The radius of each crank is 30 cm. The cranks are at right angles. The weight of the revolving mass per cylinder is 2452.5 N and the weight of the reciprocating mass per cylinder is 2943 N. The whole of the revolving and 2/3rd of the reciprocating masses are to be balanced and the balanced weights are placed, in the planes of rotation of the driving wheels, at radius of 80 cm. The driving wheels are 2 m in diameter and 1.5 m apart. If the speed of the engine is 80 km/hr., find the hammer blow, maximum variation of tractive effort and maximum swaying couple.	**L3**	**C05**
7	A shaft carries four rotating masses A, B, and C which are completely balanced. The masses B, C and D are 50 kg, 80 kg and 70 kg respectively. The masses C and D make angles of 900 and 1950 respectively with mass B in the same sense. The masses A, B, C and D are concentrated at radius 75 mm, 100 mm, 50 mm and 90 mm respectively. The plane of rotation of masses B and C are 250 mm apart. Determine: (i) the mass A and its angular position, (ii) the position of planes of A and D.	**L3**	**C05**
8	Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 12kg, 10kg, 18kg and 15kg respectively and their radii of rotations are 40mm, 50mm, 60mm and 30mm. The angular position of the masses B, C, and D are 60^0, 135^0 and 270^0 from the mass A. Find the magnitude and	**L3**	**C05**

	position of the balancing of mass at a radius of 100mm.		
9	Explain briefly about primary balancing and secondary balancing as applied to balancing of reciprocating masses.	**L1**	**C05**

UNIT-5

Short Answer Questions-

S.No	Question	Blooms	Course outcomes
1	Define, in short, free vibrations, forced vibrations and damped vibrations.	**L1**	**C04**
2	Discuss briefly with neat sketches the longitudinal, transverse and torsion, free vibrations.	**L1**	**C04**
3	A) What are the causes and effects of vibrations? B) Terms used in vibratory motion?	**L1**	**C04**
4	Terms used in vibratory motion?	**L1**	**C04**
5	Explain the terms 'under damping 'critical damping' and 'over damping'.	**L1**	**C04**

Long Answer Questions-

S.No	Question	Blooms	Course outcomes
1	A) Terms used in vibratory motion? B) A shaft of length 0.75m, supported freely at the ends, is carrying a body of mass 90 kg at 0.25m from one end. Find the natural frequency of transverse vibration. Assume E=200 GN/m^2 and shaft diameter=50mm.	**L1,L3**	**C04**
2	A single cylinder vertical petrol engine of total mass 300 kg is mounted upon a steel chassis frame and causes a vertical static deflection of 2mm. The reciprocating parts of the engine have mass of 20 kg and move through a vertical stroke of 150mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5 KN per meter per second. Considering that the steady state of vibration is reached; determine: i) The amplitude of forced vibrations, when the driving shaft of the engine rotates at 480 rpm and ii) The speed of the driving shaft at which resonance will occur.	**L3**	**C04**
3	A mass of 10 kg is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is 10 N/mm. The viscous damping causes the amplitude to decrease to one-tenth of the initial value in four complete oscillations. If a	**L3**	**C04**

	periodic force of 150cos50t N is applied at the mass in the vertical direction, find the amplitude of the forced vibrations. What is its value of resonance?		
4	A machine part of mass 2 kg vibrate in viscous medium. Determine the damping co-efficient when a harmonic exciting force of 25 N results in resonant amplitude of 12.5mm with a period of 0.2 second. If the system is excited by a harmonic force of frequency 4 HZ, What will be the percentage increase in the amplitude of vibration when damper is removed as compared with that with damping:	**L3**	**C04**
5	Derive an expression for the natural frequency of free transverse vibration by equilibrium method.	**L2**	**C04**
6	Derive an expression for the natural frequency of free longitudinal vibrations by equilibrium method.	**L2**	**C04**
7	Determine the frequency of the free vibrations, when a body of mass 20 kg is suspended from a spring which deflects 15 mm under the weight of the body. Also find the viscous damping force required to make the motion a period at a speed of 1 m/s. If when damped to this extent, a distinguish force having a maximum value of 187.5 N and vibrating at 8 Hz is made to act on the body, fine the amplitude of the ultimate motion.	**L3**	**C04**
8	A shaft is simply supported at the ends and is of 20 mm in diameter and 600 mm in length. The shaft carries a load of 19.62 N at its centre. The weight of the shaft per metre length is 248.2 N. Find the critical speed of the shaft. Take Young's modulus as 200 GN/m^2.	**L3**	**C04**
9	A shaft of diameter is supported in two bearings 2.5 m apart. It carries three discs of mass 250kg, 500kg, and 200kg are 0.6m, 1.5m and 2m from the left end bearing. Assuming the mass of the shaft 190 kg/m^2 .Determine the critical speed of the shaft. Young's modulus of the material of shaft =211 GN/m^2.	**L3**	**C04**
10	An electric motor rotating at 1500 rpm drives a centrifugal pump at 500 rpm through a single stage reduction gearing. The M.I. of the electric and the pump impeller arc 400 $kg\text{-}m^2$ and 1400 $kg\text{-}m^2$ respectively. The motor shaft is 45mm in diameter and 180mm long. The pump shaft is 90 mm diameter and 450mm long. Determine the natural frequency of torsional oscillations of the system neglecting the inertia of the gears. The modulus of rigidity of the shaft material is 84 GN/m^2.	**L3**	**C04**

OBJECTIVE QUESTIONS:

JNTUH:

UNIT-1

1. Effect of Gyroscopic couple on a ship during rolling _____.
2. The rotor of a ship rotates in clockwise direction when viewed from stern and the ship takes a left turn. The effect of gyroscopic couple acting on it will be _____.
3. The rotor of a ship rotates in clockwise direction when viewed from stern and the ship takes a right turn. The effect of gyroscopic couple acting on it will be _____.
4. The rotor of a plane rotates in clockwise direction when viewed from stern and the plane takes a left turn. The effect of gyroscopic couple acting on it will be _____.
5. The rotor of a plane rotates in clockwise direction when viewed from stern and the plane takes a left turn. The effect of gyroscopic couple acting on it will be _____.
6. Equation of Gyroscopic couple _____.
7. The steering of a ship means _____.
8. The pitching of a ship produces forces on the bearings which act _____ to the motion of the ship.
   (a) Vertically and parallel (b) vertically and perpendicular
   (c) Horizontally and parallel (d) horizontally and perpendicular
   Answer: D
9. When the pitching of a ship is upward ,the effect of gyroscopic couple acting on it will be
   (a) to move the ship towards star board (b) to move the ship towards port side
   (c) To raise the bow and lower the stern (d) To raise the stern and lower the bow
   Answer: A
10. The rotor of a ship in a clockwise direction when viewed from stern and the ship takes a left turn. The effect of gyroscopic couple acting will be
    (a) To raise the bow and stern (c) to lower the bow and stern
    (b) To raise the bow and lower the stern (d) to raise the stern and lower the bow.
    Answer: B

UNIT-2

1. The ratio of max .fluctuation of speed to the _____ is called Co-efficient of Fluctuation of energy.
2. When the sleeve of a Porter governor moves upwards, the governor speed _____.
3. When the sleeve of a Porter governor moves Downwards, the governor speed _____.
4. When the speed of the engine fluctuates continuously above and below the mean speed, the governor is said to be _____.
5. If I =Mass moment of inertia of the flywheel, E = Maximum fluctuation of energy, C_S = Coefficient of fluctuation of speed, and ω = Mean angular speed = $(\omega_1+\omega_2)/2$, then maximum fluctuation of energy in a flywheel is equal to _____.
6. In a turning moment diagram, the variations of energy above and below the mean resisting torque line are called _____.

7. For two governors *A* and *B*, the lift of sleeve of governor *A* is more than that of governor *B*, for a given fractional change in speed. It indicates that _____.
8. When the sleeve of a Porter governor moves upwards, the governor speed:
   A. increases B. decreases
   C. remains unaffected D. first increases and then decreases
   Answer: Option A
9. When the speed of the engine fluctuates continuously above and below the mean speed, the governor is said to be:
   A. stable B. unstable C. isochronous D. Hunt
   Answer: Option D
10. The height of a Watt's governor (in meters) is equal to (where N = Speed of the arm and ball about the spindle axis)
    A.$8.95/N^2$ B.$89.5/N^2$ C.$895/N^2$ D.$8950/N^2$
    Answer: Option C

UNIT-3

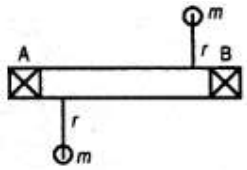
1. The brakes commonly used in railway trains are _____ brakes.
2. The brakes commonly used in Motor cars are _____ brakes.
3. When the crank is at the inner dead center, in a reciprocating steam engine, then the velocity of the piston will be_____
4. The dynamic friction is the friction experienced by a body, when the body _____.
5. When the crank is at the inner dead centre, in a reciprocating steam engine, then the velocity of the piston will be _____.
6. The frictional torque transmitted in a flat pivot bearing, considering uniform wear, is (where μ = Coefficient of friction, W = Load over the bearing, and R = Radius of bearing surface) _____.
7. In a band and block brake, the ratio of tensions on tight side and slack side of the band is (where μ = Coefficient of friction between the blocks and the drum, θ = Semi-angle of each block subtending at the centre of drum, and n = Number of blocks) _____.
8. In a disc clutch, if there are n_1 number of discs on the driving shaft and n_2 number of discs on the driven shaft, then the number of pairs of contact surfaces will be _____.
9. The acceleration of piston in a reciprocating steam engine is given by (where ω = Angular velocity of crank, r = Radius of crank pin circle, θ = Angle turned by crank from inner dead centre, and n = Ratio of length of connecting rod to the radius of crank) _____.
10. A thin circular disc is rolling with a uniform linear speed, along a straight path on a plane surface. Which of the following statement is correct in this regard?
    A. All points of the disc have the same velocity
    B. The center of the disc has zero acceleration
    C. The center of the disc has centrifugal acceleration

D. The point on the disc making contact with the plane surface has zero acceleration
Answer: Option B

11. In railway axle boxes, the bearing used is:
    A. deep groove ball bearing
    B. double row self-aligning ball bearing
    C. double row spherical roller bearing
    D. cylindrical roller bearing
    Answer: Option C

UNIT -4

1. The secondary unbalanced force due to inertia of reciprocating parts in a reciprocating engine is given by (where m = Mass of reciprocating parts, ω = Angular speed of crank, r = Radius of crank, θ = Angle of inclination of crank with the line of stroke, and n = Ratio of the lenth of connecting rod to radius of crank) _____.
2. The static balancing is satisfactory for low speed rotors but with increasing speeds, dynamic balancing becomes necessary. This is because, the _____.
3. A disturbing mass m1 attached to the rotating shaft may be balanced by a single mass m_2 attached in the same plane of rotation as that of m_1, such that (where $r_1$and r_2 are the radii of rotation of m_1 and m_2 respectively) _____.
4. A rotor supported at A and B carries two masses as shown in the below figure. The rotor is _____.



5. The force required to accelerate the reciprocating masses is given by _____.
6. The balancing of resultant centrifugal force = _____.
7. The angle made by the resultant centrifugal force with the horizontal is given by _____.
8. A disturbing mass m1 attached to the rotating shaft may be balanced by a single mass m2 attached in the same plane of rotation as that of m1, such that (where r1and r2 are the radii of rotation of m1 and m2 respectively):
   (A). m1r2 = m2r1 (B). m1r1 = m2r2 (C). m1m2 = r1r2 (D). none of these
   Answer: Option B
9. If the rotating mass of a rim type flywheel is distributed on another rim type flywheel whose mean radius is half the mean radius of the former, then energy stored in the latter at the same speed will be:
   A. Four times the first one
   B. same as the first one
   C. one fourth of the first one
   D. One and a half times the first one
   Answer: Option C

10. The balancing of a rigid rotor can be achieved by appropriately placing balancing masses in:
    A. A single plane B. Two planes C. Three planes D. Four planes
    Answer: Option B

UNIT -5

1. The natural frequency of free transverse vibrations due to a point load acting over a simply supported shaft is equal to (where δ = Static deflection of a simply supported shaft due to the point load) _____.
2. A body is said to be under forced vibrations, when _____.
3. The natural frequency of free longitudinal vibrations is equal to (where m = Mass of the body, s = Stiffness of the body, and δ = Static deflection of the body) _____.
4. The natural frequency of free torsional vibrations of a shaft is equal to (where q = Torsional stiffness of the shaft, and I = Mass moment of inertia of the disc attached at the end of a shaft) _____.
5. Frequency of vibrations is usually expressed in _____.
6. Two springs of stiffness k1 and K2 are connected in series. The resultant stiffness will be equal to _____.
7. The natural frequency of free longitudinal vibrations can be obtained by in terms of stiffness and mass _____.
8. The natural frequency of free longitudinal vibrations can be obtained by in terms of static deflection _____.
9. The frequency of damped vibrations with viscous damping is _____ the frequency of UN damped vibrations.
    A. more than
    B. less than
    C. same as
    Answer: Option B
10. In under damped vibrating system, the amplitude of vibration
    A. decreases linearly with time
    B. increases linearly with time
    C. decreases exponentially with time
    D. increases exponentially with time
    Answer: Option C

GATE:

1. The primary unbalanced force is Maximum when the angle of inclination of the crank with the line of stroke is
A. 0° and 90°
B. 0° and 180°
C. 90° and 180°
D.180° and 360°
Answer: Option B

2. In vibration isolation system, the transmissibility will be equal to unity, for all values of damping factor, if ω/ω_n is

A. equal to one

B. equal to 2

C. less than 2

D. greater than 2

Answer: Option B

3. The two links OA and OB are connected by a pin joint at O. If the link OA turns with angular velocity ω1 rad/s in the clockwise direction and the link OB turns with angular velocity ω2 rad/s in the clockwise direction, then the rubbing velocity at the pin jointO is (where r = Radius of the pin at O)

A.ω1.ω2.r

B. (ω1 - ω2) r

C. (ω1 + ω2) r

D. (ω1 - ω2)2r

Answer: Option B

4. If $\omega/\omega_n = 2$, where co is the frequency of excitation and ω_n is the natural frequency of vibrations, then the transmissibility of vibration will the _____.

A.0.5 B.1 C.1.5 D.2 Answer: Option B

5. A disturbing mass m1 attached to the rotating shaft may be balanced by a single mass m2 attached in the same plane of rotation as that of m1, such that (where r1and r2 are the radii of rotation of m1 and m2 respectively)

A. m1r2 = m2r1

B. m1r1 = m2r2

C. m1m2 = r1r2

D. none of this

Answer: Option B

6. In railway axle boxes, the bearing used is:

A. deep groove ball bearing

B. double row self-aligning ball bearing

C. double row spherical roller bearing

D. cylindrical roller bearing

Answer: Option C

7. In under damped vibrating system, the amplitude of vibration

A. decreases linearly with time

B. increases linearly with time

C. decreases exponentially with time

D. increases exponentially with time

Answer: Option C

8. The dynamic friction is the friction experienced by a body, when the body

A. is in motion

B. is at rest

C. just begins to slide over the surface of the other body

D. none of the above
Answer: Option A
9. The steering of a ship means
A. movement of a complete ship up and down in vertical plane about transverse axis
B. turning of a complete ship in a curve towards right or left, while it moves forward
C. rolling of a complete ship side-ways
D. none of the above
Answer: Option B
10. The tractive force in a locomotive with two cylinders is given by (where c = Fraction of reciprocating parts per cylinder, m = Mass of reciprocating parts, ω = Angular speed of crank, r = Radius of crank, and θ = Angle of inclination of crank to the line of stroke)
A. $m.\omega^2.r \cos \theta$
B. $m.\omega^2.r \sin \theta$
C. $(1 - c)\ m.\omega^2.r (\cos \theta - \sin \theta)$
D. $m.\omega^2.r (\cos \theta - \sin \theta)$
Answer: Option C
11. When the crank is at the inner dead centre, in a reciprocating steam engine, then the velocity of the piston will be
A. minimum
B. zero
C. maximum
D. none of this
Answer: Option B
12. The frequency of damped vibrations with viscous damping is _____ the frequency of UN damped vibrations.
A. more than
B. less than
C. same as
Answer: Option B
13. The rotor of a ship rotates in clockwise direction when viewed from stern and the ship takes a right turn. The effect of gyroscopic couple acting on it will be to raise the stern and lower the bow.
A. Agree B. Disagree
Answer: Option A
14. The static friction
A. bears a constant ratio to the normal reaction between the two surfaces
B. is independent of the area of contact, between the two surfaces
C. always acts in a direction, opposite to that in which the body tends to move
D. all of the above
Answer: Option D
15. A shaft has an attached disc at the centre of its length. The disc has its centre of gravity located at a distance of 2 mm from the axis of the shaft. When the shaft is allowed to vibrate

in its natural bow-shaped mode, it has a frequency of vibration of 10 rad/s, when the shaft is rotated at 300 rpm. It will whirl with a radius of

A.2 mm B.2.22 mm C.2.50 mm D.3.0 mm

Answer: Option B

16. In order to balance the reciprocating masses,

A. primary forces and couples must be balanced

B. secondary forces and couples must be balanced

C. both (a) and (b)

D. none of this

Answer: Option C

17. In order to give the primary balance of the reciprocating parts of multi-cylinder in-line engines,

A. the algebraic sum of the primary forces must be equal to zero

B. the algebraic sum of the couples about any point in the plane of the primary forces must be equal to zero

C. both (a) and (b)

D. none of this

Answer: Option C

18. A mass of 1 kg is attached to the end of a spring with a stiffness of 0.7 N/mm. The critical damping coefficient of this system is

A.1.4 N-s/m B. 18.52 N-s/m C. 52.92 N-s/m D. 529.2 N-s/m

Answers: Option C

19. When the sleeve of a Porter governor moves upwards, the governor speed

A. increases B. decreases C. remains unaffected D. first increases and then decreases

Answer: Option A

20. A thin circular disc is rolling with a uniform linear speed, along a straight path on a plane surface. Which of the following statement is correct in this regard?

A. All points of the disc have the same velocity

B. The center of the disc has zero acceleration

C. The center of the disc has centrifugal acceleration

D. The point on the disc making contact with the plane surface has zero acceleration

Answer: Option B

21. When the speed of the engine fluctuates continuously above and below the mean speed, the governor is said to be

A. stable B. unstable C. isochronous D. Hunt

Answer: Option D

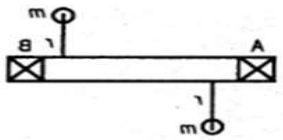
22. Which of the following statement is correct?

A. The periodic time of a particle moving with simple harmonic motion is the time taken by a particle for one complete oscillation.

B. The periodic time of a particle moving with simple harmonic motion is directly proportional to its angular velocity.

C. The velocity of a particle moving with simple harmonic motion is zero at the mean position.

D. The acceleration of the particle moving with simple harmonic motion is Maximum at the mean position.
Answer: Option A
23. The height of a Watt's governor is
A. directly proportional to speed
B. directly proportional to (speed) ^{2}
C. inversely proportional to speed
D. inversely proportional to (speed) ^{2}
Answer: Option D
24. A rotor supported at A and B carries two masses as shown in the below figure. The rotor is:



A. dynamically balanced
B. statically balanced
C. statically and dynamically balanced
D. not balanced
Answer: Option C
25. Maximum fluctuation of energy in a flywheel is equal to (where I = Mass moment of inertia of the flywheel, E = Maximum fluctuation of energy, CS = Coefficient of fluctuation of speed, and ω = Mean angular speed)
A. Iω(ω1 - ω2)
B. $I\omega^2CS$
C. 2E*CS
D. all of this
Answer: Option D

IES:
1. The instantaneous centers which vary with the configuration of mechanism, are called
A. permanent instantaneous centers
B. fixed instantaneous centers
C. neither fixed nor permanent instantaneous centers
D. none of the above
Answer: Option C
2. The displacement of the reciprocating roller follower, when it has contact with the straight flanks of the tangent cam, is given by (where r1 = Minimum radius of the cam, r2 = Radius of the roller follower, and θ = Angle turned by the cam from the beginning of the follower displacement)
A. (r1 - r2) (1 - cosθ)
B. (r1 + r2) (1 + cos θ)
C. (r1 - r2)
D. (r1 + r2)

Answer: Option D

3. A body is said to be under forced vibrations, when

A. there is a reduction in amplitude after every cycle of vibration

B. no external force acts on a body, after giving it an initial displacement

C. a body vibrates under the influence of external force

D. none of the above

Answer: Option A

4. In a turning moment diagram, the variations of energy above and below the mean resisting torque line is called

A. fluctuation of energy

B. maximum fluctuation of energy

C. coefficient of fluctuation of energy

D. none of this

Answer: Option A

5. In a spring controlled governor, when the controlling force _____ as the radius of rotation increases, it is said to be a stable governor.

A. remains constant

B. decreases

C. Increases

Answer: Option C

6. The primary unbalanced force due to inertia of reciprocating parts in a reciprocating engine is given by (where m = Mass of reciprocating parts, ω = Angular speed of crank, r = Radius of crank, θ = Angle of inclination of crank with the line of stroke, andn = Ratio of the length of connecting rod to radius of crank)

A. $m.\omega^2.r \sin \theta$

B. $m.\omega^2.r \cos \theta$

C. $m.\omega^2.r$

D. $m.\omega^2.r$

Answer: Option B

7. For two governors A and B, the lift of sleeve of governor A is more than that of governor B, for a given fractional change in speed. It indicates that

A. governor A is more sensitive than governor B

B. governor B is more sensitive than governor A

C. both governors A and B are equally sensitive

D. none of the above

Answer: Option A

8. The balancing of a rigid rotor can be achieved by appropriately placing balancing masses in

A. A single plane

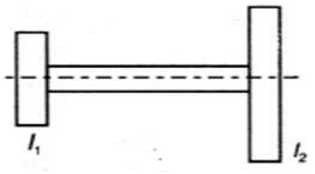
B. Two planes

C. Three planes

D. Four planes

Answer: Option B

9. In the two rotor system as shown in the below figure (I1 < I2), a node of vibration is situated:



A. between I1, and I2 but nearer I1
B. between I1, and I2 but nearer to I2
C. exactly in the middle of the shaft
D. nearer to I1 but outside
Answer: Option B

10. The rotor of a ship rotates in clockwise direction when viewed from stern and the ship takes a left turn. The effect of gyroscopic couple acting on it will be
A. to raises the bow and stern
B. to lowers the bow and stern
C. to raises the bow and lowers the stern
D. to raises the stern and lowers the bow
Answer: Option C

11. A spring controlled governor is found unstable. It can be made stable by
A. increasing the spring stiffness
B. decreasing the spring stiffness
C. increasing the ball mass
D. decreasing the ball mass
Answer: Option B

12. A governor is said to be stable, if the
A. radius of rotation of balls increases as the equilibrium speed decreases
B. radius of rotation of balls decreases as the equilibrium speed decreases
C. radius of rotation of balls increases as the equilibrium speed increases
D. radius of rotation of balls decreases as the equilibrium speed increases
Answer: Option C

13. The static balancing is satisfactory for low speed rotors but with increasing speeds, dynamic balancing becomes necessary. This is because, the
A. unbalanced couples are caused only at higher speeds
B. unbalanced forces are not dangerous at higher speeds
C. effects of unbalances is proportional to the square of the speed
D. effects of unbalances is directly proportional to the speed
Answer: Option C

14. The maximum fluctuation of speed is the
A. difference of minimum fluctuation of speed and the mean speed
B. difference of the maximum and minimum speeds
C. sum of maximum and minimum speeds
D. variations of speed above and below the mean resisting torque line
Answer: Option B

15. The secondary unbalanced force due to inertia of reciprocating parts in a reciprocating engine is given by (where m = Mass of reciprocating parts, ω = Angular speed of crank, r = Radius of crank, θ = Angle of inclination of crank with the line of stroke, and n = Ratio of the length of connecting rod to radius of crank)

A. $m.\omega^2.r \sin\theta$

B. $m.\omega^2.r \cos\theta$

C. $m.\omega^2.r$

D. $m.\omega^2.r$

Answer: Option D

16. The acceleration of the reciprocating roller follower when it has contact with the straight flanks of the tangent cam, is given by

A. $\omega^2 (r1 - r2) (1 - \cos2\theta)$

B. $\omega^2 (r1 + r2) (1 + \cos2\theta)$

C. $\omega^2 (r1 + r2)$

D. $\omega^2 (r1 - r2) (1 - \sin2\theta)$

Answer: Option C

17. In a disc clutch, if there are n1 number of discs on the driving shaft and n2 number of discs on the driven shaft, then the number of pairs of contact surfaces will be

A. n1 + n2

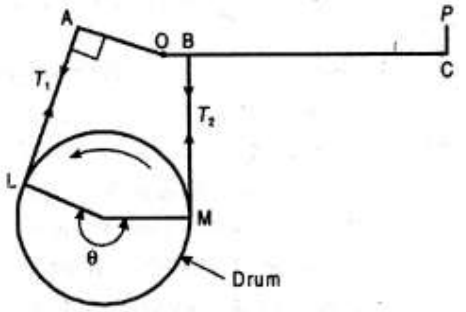
B. n1 + n2 + 1

C. n1 + n2 - 1

D. n1 + n2 – 2

Answer: Option C

18. For the brake to be self locking, the force P at C shown in the below figure, should



A. be zero

B. act in upward direction

C. act in downward direction

D. none of this

Answer: Option A

19. If the rotating mass of a rim type flywheel is distributed on another rim type flywheel whose mean radius is half the mean radius of the former, then energy stored in the latter at the same speed will be

A. Four times the first one

B. same as the first one

C. one fourth of the first one

D. one and a half times the first one
Answer: Option C
20. Which of the following property of the instantaneous centre is correct?
A. A rigid link rotates instantaneously relative to another link at the instantaneous centre for the configuration of the mechanism considered.
B. The two rigid links have no linear velocity relative to each other at the instantaneous centre.
C. The velocity of the instantaneous centre relative to any third rigid link is same whether the instantaneous centre is regarded as a point on the first rigid link or on the second rigid link.
D. all of the above
Answer: Option D
21. The height of a Watt's governor (in meters) is equal to (where N = Speed of the arm and ball about the spindle axis)
A. $8.95/N^2$ B. $89.5/ N^2$
C. $895/ N^2$ D. $8950/ N^2$
Answer: Option C
22. Sensitiveness of the governor is defined as the ratio of the
A. Mean speed to the maximum equilibrium speed
B. Mean speed to the minimum equilibrium speed
C. difference of the maximum and minimum equilibrium speeds to the mean speed
D.sum of the maximum and minimum equilibrium speeds to the mean speed
Answer: Option C
23. Effort of a governor is the
A. mean force exerted at the sleeve for a given percentage change of speed
B. work done at the sleeve for maximum equilibrium speed
C. mean force exerted at the sleeve for maximum equilibrium speed
D. none of the above
Answer: Option A
24. The Klein's method of construction for reciprocating engine mechanism
A. is a simplified version of instantaneous centre method
B. utilizes a quadrilateral similar to the diagram of mechanism for reciprocating engine
C. enables determination of carioles component
D. is based on the acceleration diagram
Answer: Option B
25. The brake commonly used in railway trains is
A. shoe brake
B. band brake
C. band and block brake
D. internal expanding brake
Answer: Option A
26. In locomotives, the ratio of the connecting rod length to me crank radius is kept very large in order to
A. minimize the effect of primary forces

B. minimize the effect of secondary forces
C. has perfect balancing
D. to start the locomotive quickly
Answer: Option B

VIII. NPTEL WEB VIDEOS:

https://nptel.ac.in/courses/112104114/
https://nptel.ac.in/courses/112104114/1

IX. WEBSITES:

1. www.nptel.ac.in/downloads/112101096/
2. www.khannapublishers.in/categories.php
3. teaching.ust.hk/~mech103/chapter9.pdf
4. https://www.vidyarthiplus.com/vp/thread-10646.html
5. www.springer.com

X. EXPERT DETAILS:

1. Prof. Sriram Venkatesh, OU, Hyderabad
2. Mr. M.Chandra Sekhar Reddy, OU, Hyderabad
3. Dr. Jayaram S R, MCE, Hassan
4. Prof. V.V.Bongale, MCE, Hassan
5. Dr. B.KSridhara, NIE, Mysore
6. Prof. Y.M.Shashidhar, MCE, Hassan

XI. JOURNALS:

1. American standards of mechanical engineering(ASME)
2. Mechanism and machine theory
3. Journal of Machinery Manufacture and Reliability
4. Theory of Mechanisms and Machines
5. International Journal of Engineering Science and Technology
6. International Journal of Engineering Science and Research
7. International Journal of Engineering Science and Innovative Technology (IJEIT)

XII. LIST OF TOPICS FOR STUDENT SEMINARS:

1. Dynamo meters
2. Gyroscope
3. Fly wheel & turning movement
4. Governors
5. Balancing
6. Vibrations

XIII. CASE STUDIES / SMALL PROJECTS:

1. Balancing and vibrational analysis of rotating shafts.
2. Governing of a vehicle under different weight conditions.
3. Turning Movement & Fly wheel diagrams for punching press.