Hall Ticket No | | | | | | | | | | | Question Paper Code: AME011

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER-II

B.Tech V Semester End Examinations, December - 2019

Regulations: IARE - R16

DYNAMICS OF MACHINERY

(MECHANICAL ENGINEERING)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1	a)	Define angle of heel in the case of a two wheeler negotiating a curve.	[7M]
	b)	The mass of the motor cycle along with the rider is 180 kg. The height of the centre of gravity of total mass is 600mm above the ground when it moves straight. Each wheel has a diameter of 700mm and mass moment of inertia of 2 kgm^2. The engine rotates at a speed of 5 times the road wheel and engine rotating parts have mass moment of inertia of 0.2 kgm^2. Find the angle of heel if it is travelling at 50 km/h and is taking a turn of 30 meters radius.	[7M]
2	a)	Explain the effect of gyroscopic couple on an automobile taking left turn.	[7M]
	b)	A uniform disc having a mass of 8 kg and radius of gyration 150 mm is mounted on one end of a horizontal arm of length 200 mm. The other end rotates freely in a bearing. The disc is given a clockwise spin of 240 rpm. Determine the motion of the disc if its arm remains horizontal.	[7M]

UNIT – II

3	a)	Deduce expression for the friction torque for a flat collar bearing considering uniform wear.	[7M]
	b)	A conical pivot supports a load of 10kN, cone angle is 1100 and intensity of pressure normal to the cone is 0.3N/mm2. The outer diameter is twice the inner diameter. Find the outer and inner radii of bearing surface if the shaft rotates at 300 rpm and μ= 0.1. Find the power absorbed in friction assuming uniform wear.	[7M]
4	a)	Deduce expression for the friction torque for a flat collar bearing considering uniform pressure.	[7M]
	b)	A band brake acts on 3/4th of a circumference of a brake drum of 450 mm diameter which is keyed to a shaft. The band brake provides a braking torque of 225 Nm. One end of the lever is attached to a fulcrum pin of the lever and the other end is attached to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and coefficient of friction is 0.25, find the operating force when the drum rotates in Clock-wise direction and anti- clockwise direction.	[7M]

UNIT – III

5 a) Describe the graphical method of determining the inertia of the connecting rod of reciprocating engine. [7M]

b) The turning moment diagram for a multi cylinder engine has been drawn to a scale of 1mm to 500 Nm of torque and 1mm to 60 of crank displacement The intercepted areas between the output torque curve and the mean resistance line taken in order from one end of the engine are -30, +410, -280+320, -330, +250, -360, +280, -260 mm2 when the engine runs at 800 rpm. The engine has a stroke of 300mm and the fluctuation of speed is not to exceed 2% of mean speed. Determine suitable diameter and cross section of the flywheel rim for a limiting value of safe centrifugal stress of 7 Mega Pascal. The material density is 720kg/m^3. Width of the rim is 5 times the thickness. [7M]

6 a) Derive an expression for the angular acceleration of the connecting rod of a reciprocating engine. [7M]

b) The effective turning moment exerted by a two stroke engine at the crank shaft is $T= 800+ 100\sin2\theta- 200\cos2\theta$ where θ is the inclination of the crank to inner dead center. The mass of the flywheel is 400kg and radius of gyration is 550 mm. The engine speed is 200 rpm. Determine the power developed, the total percentage fluctuation of speed and maximum angular retardation. [7M]

UNIT – IV

7 a) What is balancing of reciprocating masses? Explain with a neat sketch. [7M]

b) A rigid rotor has its unbalance in one plane and can be considered to consist of three masses m1 = 5 kg at an angle of 30^0 from mass m_1 in anti clockwise direction, m2 = 3 kg at an angle of 165^0 counter clockwise from m1 and m3 = 8 kg at angle 85^0 clockwise from m_1. The radii r1 = 200mm, r2 = 80mm and r3 = 140 mm. Determine the balancing mass required at a radius of 100 mm. Specify the location of this mass with respect to m1. [7M]

8 a) Derive the expression for hammer blow in locomotive balancing. [7M]

b) The cranks of a three cylinder locomotive are set at 100^0. The stroke is 110 mm, the length of the connecting rod is 140 mm, the mass of the reciprocating parts per cylinder is 1 Kg and the speed of the crank shaft is 2400 rpm. Determine the magnitude of primary and secondary balancing. [7M]

UNIT – V

9 a) Derive an expression for the natural frequency of forced longitudinal vibrations [7M]

b) A shaft 100 mm diameter and 1000 mm long is fixed at one end and the other end carries a flywheel of mass 90 kg. The radius of gyration of the flywheel is 500mm. Find the frequency of torsional vibration, if the modulus of rigidity for the shaft material is 80GN/m^2. [7M]

10 a) What is meant by the term critical damping? [7M]

b) A cantilever shaft of 50 mm diameter and 300 mm long has a disc of mass100 kg at its free end. The Young's modulus of the shaft material is 200 GN/m2. Determine the frequency of longitudinal and transverse vibrations of the shaft. [7M]

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COURSE OBJECTIVES (COs):
The course should enable the students to:

I	Understand the concept of equilibrium of a body subjected to static and dynamic forces.
II	Study the application of Gyroscopes in aero-planes, ships and automobiles.
III	Apply the phenomenon of friction in brakes and clutches for automobile application.
IV	Understand the significance of governors and its application and turning moment diagrams.

COURSE OUTCOMES (COs):

CO1	Understand the equilibrium of a body subjected to static and dynamic forces of various mechanisms.
CO2	Understand the concept of gyroscopic effect in aero-planes, ships and automobiles for stabilization.
CO3	Explore the concept of friction in various contacts of bodies.
CO4	Understand the significance of energy storage devices by studying the TMD.
CO5	Explore the equations of motion of various degree of freedom systems.

COURSE LEARNING OUTCOMES (CLOs):
Students, who complete the course, will have demonstrated the asking to do the following:

AME011.01	Understand dynamic analysis like gyroscopic forces and moments, rotation of rigid bodies.
AME011.02	Understand the gyroscopic effect on ships, planes and road vehicles.
AME011.03	Understand static force analysis of mechanisms.
AME011.04	Understand dynamic force analysis of mechanisms
AME011.05	Determine the dynamic behavior principle and operations of clutches, brakes, dynamometers.
AME011.06	Compute frictional losses, torque transmission of mechanical systems such as clutches, brakes.
AME011.07	Compute frictional losses, torque transmission of mechanical systems such as dynamometers.
AME011.08	Understand the design of centrifugal governors.
AME011.09	Determine the dynamic behavior principles and operations of flywheels and governors.
AME011.10	Understand dynamic balancing of point masses.
AME011.11	Understand dynamic balancing of rotating masses.
AME011.12	Understand the torque calculations in turning moment diagrams.
AME011.13	Understand dynamic balancing of reciprocating parts.
AME011.14	Understand how to determine the natural frequencies of continuous systems starting from the general equation of displacement.
AME011.15	Apply the different methods to solve the equation of motion in damped forced vibrations.
AME011.16	Understand the concepts of free and forced vibrations of single degree freedom systems.
AME011.17	Remember the concepts of vibration modes and natural frequencies and their measurement and estimation for multi-degree-of-freedom systems.
AME011.18	Interpret the behaviour of vibrating systems through an understanding of basic principles and the role of mass, stiffness and damping.
AME011.19	Develop the equations of motion for free and forced vibration of simple systems.

AME011.20	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.

MAPPING OF SEMESTER END EXAMINATION (SEE) TO COURSE LEARNING OUTCOMES (CLOs):

SEE Question No		Course Learning Outcomes (CLOs)		Course Outcomes	Blooms Taxonomy Level
1	a	AME011.03	Understand dynamic analysis like gyroscopic forces and moments, rotation of rigid bodies.	CO 1	Remember
	b	AME011.03	Understand dynamic analysis like gyroscopic forces and moments, rotation of rigid bodies.	CO 1	Remember
2	a	AME011.04	Understand static force analysis of mechanisms.	CO 1	Remember
	b	AME011.04	Understand static force analysis of mechanisms.	CO 1	Remember
3	a	AME011.05	Determine the dynamic behavior principle and operations of clutches, brakes, dynamometers.	CO 2	Remember
	b	AME011.06	Compute frictional losses, torque transmission of mechanical systems such as clutches, brakes.	CO 2	Remember
4	a	AME011.05	Determine the dynamic behavior principle and operations of clutches, brakes, dynamometers.	CO 2	Understand
	b	AME011.06	Compute frictional losses, torque transmission of mechanical systems such as clutches, brakes.	CO 2	Understand
5	a	AME011.12	Understand the torque calculations in turning moment diagrams	CO 3	Remember
	b	AME011.12	Understand the torque calculations in turning moment diagrams	CO 3	Remember
6	a	AME011.12	Understand the torque calculations in turning moment diagrams	CO 3	Understand
	b	AME011.12	Understand the torque calculations in turning moment diagrams	CO 3	Understand
7	a	AME011.10	Understand dynamic balancing of point masses.	CO 4	Understand
	b	AME011.11	Understand dynamic balancing of rotating masses.	CO 4	Understand
8	a	AME011.10	Understand dynamic balancing of point masses.	CO 4	Understand
	b	AME011.11	Understand dynamic balancing of rotating masses.	CO 4	Understand
9	a	AME011.15	Apply the different methods to solve the equation of motion in damped forced vibrations.	CO 5	Understand
	b	AME011.16	Understand the concepts of free and forced vibrations of single degree freedom systems.	CO 5	Understand
10	a	AME011.15	Apply the different methods to solve the equation of motion in damped forced vibrations.	CO 5	Remember
	b	AME011.16	Understand the concepts of free and forced vibrations of single degree freedom systems.	CO 5	Remember

Signature of Course Coordinator **HOD, ME**