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**ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)**

B.E / B. Tech (Full Time) END SEMESTER EXAMINATIONS – NOV/ DEC 2024

DEPARTMENT OF MECHANICAL ENGINEERING

V Semester

**ME7501 Dynamics of Machines**

(Regulation R2015)

Time: 3hrs

Max. Marks: 100

**PART- A (10 x 2 = 20 Marks)**

(Answer all Questions)

Q. No	Questions	Marks
1	Identify and define the principle which is used to convert a dynamic problem in to a static problem.	2
2	Write down the main functions of a flywheel.	2
3	What does the closed force polygon signifies?	2
4	Define the tractive force.	2
5	What is the difference between free and forced vibrations?	2
6	What do you mean by critical speed of a shaft?	2
7	Write the materials used to reduce vibrations in a machine parts.	2
8	What is transmissibility ratio?	2
9	When a governor is said to be sensitive?	2
10	How the gyroscopic effect in a two wheeler is balanced?	2

**PART- B (5 x 13 = 65 Marks)**

Q. No	Questions	Marks
11 (a)	The crank and connecting rod of a petrol engine, running at 1800 r.p.m. are 50 mm and 200 mm respectively. The diameter of the piston is 80 mm and the mass of the reciprocating parts is 1 kg. At a point during the power stroke, the pressure on the piston is $0.7 \text{ N/mm}^2$ , when it has moved 10 mm from the inner dead centre. Determine: 1. Net load on the gudgeon pin, 2. Thrust in the connecting rod, 3. Reaction between the piston and cylinder, and 4. The engine speed at which the above values become zero.	13
(OR)		
11 (b)	A single cylinder, single acting, four stroke gas engine develops 20 kW at 300 r.p.m. The work done by the gases during the expansion stroke is three times the work done on the gases during the compression stroke, the work done during the suction and exhaust strokes being negligible. If the total fluctuation of speed is not to exceed $\pm 2$ per cent of the mean speed and the turning moment diagram during compression and expansion is assumed to be triangular in shape, find the moment of inertia of the flywheel.	13
12 (a)	A shaft carries four masses in parallel planes A, B, C and D in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively, and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is $100^\circ$ and that between the masses at B and A is $190^\circ$ , both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine: 1. The magnitude of the masses at A and D; 2. the distance between planes A and D; and 3. the angular position of the mass at D.	13

(OR)

- 12 (b) The following data refer to two cylinder locomotive with cranks at  $90^\circ$ : Reciprocating mass per cylinder = 300 kg; Crank radius = 0.3 m; Driving wheel diameter = 1.8 m; Distance between cylinder centre lines = 0.65 m; Distance between the driving wheel central planes = 1.55 m. Determine: 1. the fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 km.p.h.; 2. the variation in tractive effort; and 3. the maximum swaying couple. 13

- 13 (a) A cantilever shaft 50 mm diameter and 300 mm long has a disc of mass 100 kg at its free end. The Young's modulus for the shaft material is  $200 \text{ GN/m}^2$ . Determine the frequency of longitudinal and transverse vibrations of the shaft. 13

(OR)

- 13 (b) The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find: 1. critical damping coefficient, 2. damping factor, 3. Logarithmic decrement, and 4. ratio of two consecutive amplitudes. 13

- 14 (a) 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 2 mm. The reciprocating parts of the engine have a mass of 20 kg and move through a vertical stroke of 150 mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5 kN per metre per second. Considering that the steady state of vibration is reached; determine: 1. the amplitude of forced vibrations, when the driving shaft of the engine rotates at 480 r.p.m., and 2. the speed of the driving shaft at which resonance will occur. 13

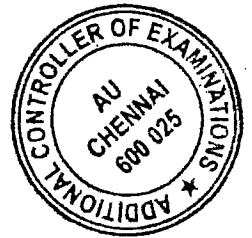
(OR)

- 14 (b) The mass of an electric motor is 120 kg and it runs at 1500 r.p.m. The armature mass is 35 kg and its C.G. lies 0.5 mm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs. Determine: 1. stiffness of each spring; 2. dynamic force transmitted to the base at the operating speed; and 3. natural frequency of the system. 13

- 15 (a) 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. 13

(OR)

- 15 (b) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: 1. when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. 2. when the ship is pitching in a simple harmonic motion, the bow falling 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 degrees. 13



**PART- C (1 x 15 = 15 Marks)**

(Q.No. 16 is Compulsory)

Q. No	Questions	Marks
16	<p>A vertical, single cylinder, single acting diesel engine has a cylinder diameter 300 mm, stroke length 500 mm, and connecting rod length 4.5 times the crank length. The engine runs at 180 r.p.m. The mass of the reciprocating parts is 280 kg. The compression ratio is 14 and the pressure remains constant during the injection of the oil for <math>1/10^{\text{th}}</math> of the stroke. If the compression and expansion follows the law <math>p.V^{1.35} = \text{constant}</math>, find: 1. Crank-pin effort, 2. Thrust on the bearings, and 3. Turning moment on the crank shaft, when the crank displacement is <math>45^\circ</math> from the inner dead centre position during expansion stroke. The suction pressure may be taken as <math>0.1 \text{ N/mm}^2</math>.</p>	15

