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B.TECH.
(SEM VI) THEORY EXAMINATION 2017-18
THEORY OF MACHINE – II

Time: 3 Hours

Total Marks: 100

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

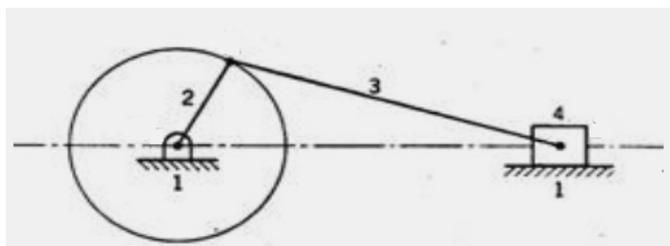
1. Attempt *all* questions in brief. 2 x 10 = 20

- a. Explain D'Alembert's principle and its importance.
- b. Define coefficient of fluctuation of energy and coefficient of fluctuation of speed.
- c. Explain condition for stable governor performance.
- d. What do you mean by offset inertia force?
- e. What do you mean by Isochronous governor?
- f. Explain sensitiveness and stability of a governor in brief.
- g. Explain the principle of gyroscopic motion.
- h. Differentiate between damping coefficient and damping factor?
- i. What do you mean by logarithmic decrement?
- j. Why flywheel used for four stroke engines is heavier than that used for two-stroke engine?

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

- 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 GN/m². Determine the frequency of longitudinal and transverse vibrations of the shaft.
- b. What is the function of a governor? Differentiate it with flywheel and explain the working of a centrifugal governor with the help of a neat sketch.
- c. Figure shows a single slider crank mechanism in which a force of 2000 N is acting on slider 4. Determine the force acting on various links and also calculates the driving torque T₂. Link AB = 30 mm, BC = 60 mm



- d. Attempt any two parts:
 - I. Dynamically equivalent system and its importance
 - II. Static and Dynamic balancing
 - III. Free and forced vibrations
- e. In a Proell governor the mass of each ball is 8 Kg and mass of sleeve is 120 Kg. Each arm is 180 mm long. The length of extension of lower arms to which the balls are attached is 80 mm. The distances of pivots of arms from axis of

rotation is 30 mm and the radius of rotation of the balls is 160 mm when the arms are inclined at 40° to the axis of rotation. Determine:

- a) The equilibrium speed
- b) The coefficient of insensitiveness if the friction at sleeve is equivalent to 30 N force.

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

- (a) The following data relate to a vertical cylinder four stroke IC engine:
- | | |
|--|-----------|
| Mass of reciprocating parts | = 8 Kg |
| Radius of crank | = 100 mm |
| Mass of connecting rod | = 12 Kg |
| Length of connecting rod | = 500 mm |
| Engine speed | = 300 rpm |
| The distance between C.G. of connecting rod and big end of the bearing | = 200 mm |

When connecting rod is suspending as pendulum from the gudgeon pin, it takes 11 seconds to complete 8 oscillations. Calculate:

- I. The radius of gyration of the connecting rod
 - II. Torque on the crankshaft when crank has turned 60° and moves down.
- (b) The torque delivered by a two-stroke engine is represented by

$$T = (1200 + 1400 \sin \theta + 210 \sin 2\theta + 21 \sin 3\theta) \text{ N-m}$$

Where θ is the angle turned by the crank from the inner dead centre. The engine speed is 210 rpm. Determine the power of the engine and the minimum mass of the flywheel if its radius of gyration is 800 mm and maximum fluctuation of speed is not to exceed 3 % of the mean speed.

4. Attempt any *one* part of the following: 10 x 1 = 10

- (a) A shaft carries four masses A, B, C, and D which are placed in parallel planes perpendicular to the longitudinal axis. The unbalanced masses at planes B and C are 3.6 Kg and 2.5 Kg respectively and both are assumed to be concentrated at a radius of 25 mm while the masses in planes A and D are both at radius of 40 mm. The angle between the planes B and C is 100° and that between B and A is 190° , both angles being measured in counterclockwise direction from the plane B. The planes containing A and B are 250 mm apart and those containing B and C are 500 mm. If the shaft is to be completely balanced, determine:
- a. Masses in the planes A and D
 - b. The distance between the planes C and D
 - c. The angular position of the mass D
- (b) What do you understand by partial balancing of reciprocating masses? Explain the effect of partial balancing in locomotive engines in detail.

5. Attempt any *one* part of the following: 10 x 1 = 10

- (a) A loaded governor of the Porter type has equal arms of 250 mm long. The mass of each ball is 2 Kg. When the ball radius is 150 mm, the valve is fully open and when the ball radius is 185 mm, the valve is fully closed. Find the maximum speed and the range of speed. If the maximum speed is to be increased 20 % by an addition of mass to the central load, find what additional mass is required?
- (b) In a spring-controlled governor of Hartung type, the lengths of ball and sleeve arms are 80 mm and 120 mm respectively. The total travel of the sleeve is 125 mm. In the mid position, each spring is compressed by 50 mm and the radius of rotation of the mass centre is 140 mm. Each ball has a mass of 4 Kg and the spring has a stiffness of 10 kN/m of compression. The equivalent mass of the governor gear at the sleeve is 16 Kg. Neglecting the moment due to the revolving masses when the arms are inclined; determine the ratio of the range of the speed to the mean speed of the governor. Also find the speed of the governor in the mid position.

6. Attempt any *one* part of the following: 10 x 1 = 10

- (a) 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 has 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
- (b) Explain the term “**Critical or Whirling Speed**” of a shaft. Prove that the whirling speed for a rotating shaft is the same as the frequency of natural transverse vibration.

7. Attempt any *one* part of the following: 10 x 1 = 10

- (a) A ship propelled by a turbine rotor, which has a mass of 5 tonnes and a speed of 2100 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions:
1. The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.
 2. The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.
 3. The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.
- (b) Derive an expression for angle of heel of a two-wheeler automobile in stability condition when taking a turn. If the engine rotates in the same direction as that of wheel.