

Manipal Institute of Technology, Manipal

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(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHANICAL ENGINEERING) END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: DYNAMICS OF MACHINERY [MME 2203]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- Answer ALL the questions.
- Missing data may be suitable assumed.
- 1A. Fig. Q1A shows a mechanism in which a force of 10 KN is applied on link 2 at B. Determine the magnitude and direction of force that must be applied on the slider link 6 for static equilibrium.
- **1B.** For the mechanism shown in the fig.Q1B, determine the torque that must be applied to the cam shaft to overcome a horizontal force P acting at the midpoint of link 5. $O_1D = 100 \text{ mm}, O_1E = 50 \text{ mm}, AC = 100 \text{ mm}, AB = 50 \text{ mm}, O_3B = 35 \text{ mm}.$
- 2A. The arms of Proell governor are 25 cm long. The upper arms are pivoted on the axis of rotation, while the lower arms are pivoted at a radius of 3.75 cm. Mass of each ball is 5.25 kg and is fixed to the extension 10 cm length of the lower arm. The central sleeve load is 100 N. At minimum radius of 16.125 cm the extension to which thee balls are attached are parallel to the governor axis. Determine the equilibrium speeds for radii of 16.125 cm and 18.75
- **2B.** Sketch a Hartnell governor. Describe its function and deduce a relation to find **05** the stiffness of the spring.
- 3A. A multi-cylinder engine runs at a speed of 1500 rpm. The turning moment diagram repeats itself for every revolution of the crankshaft. The scale of the turning moment is 1 cm = 3,000 N-m and the crank angle is plotted to a scale of 1cm = 60°. The areas below and above the mean turning moment line, taken in order are as follows: 0.3, + 4.1, 2.8, + 3.2, 3.3, + 2.5, -2.6, + 2.8 and -3.6 cm2. Find out the fluctuation of energy. Also find out the coefficient of fluctuation of speed if the weight of the rotating parts is 4000 N, and the radius of gyration is 0.3 m.
- **3B.** Explain different types of flywheels with neat sketch. **03**
- **3C.** With neat sketches describe the effect of various forces acting on the turning **03** moment diagram of a single cylinder I.C. engine.
- 4A. The rotor of the turbine of a ship has a mass of 2500 kg and rotates at a speed of 3200 rpm counter-clockwise when viewed from stern. The rotor has radius of gyration of 0.4 m. Determine the gyroscopic couple and its effect MME 2203
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when

- i. the ship steers to the left in a curve of 75 m radius at 7 m/s.
- ii. the ship pitches 6⁰ above and 6⁰ below the normal position and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with a periodic time of 40 seconds
- iii. the ship rolls and at the instant , its angular velocity is 0.45 rad/s clockwise when viewed from stern.
- **4B.** With detailed neat sketches explain in what way the gyroscopic couple **05** affects the motion of an aircraft when
 - i. The plane takes a left turn and the propeller is rotating clockwise when viewed from the rear end.
 - ii. The plane takes a left turn and the propeller is rotating counter clockwise when viewed from the rear end.
- 5A. A four crank engine as shown in fig.Q5A has two outer cranks set at 120° to each other, and their reciprocating masses are each 400 kg. The distance between the planes of rotation of adjacent cranks are 450 mm. 750 mm. and 600 mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular position for each of the inner cranks. If the length of each crank is 300 mm. length of each connecting rod is 1.2 m and the speed of rotation is 240 rpm. What is the maximum secondary unbalanced force?
- **5B.** With a neat sketch derive the expression for determining magnitudes of the **03** unbalanced primary forces in V-engines.
- 5C. A 3-cylinder air compressor has angle between each cylinder as 120° and all the connecting rods are coupled to a single crank. The stroke is 10 cm and the length of each connecting rod is 15 cm. the mass of reciprocating parts per cylinder is 0.15 kg. Using direct and reverse crank method find the maximum primary and secondary forces acting on the frame of the compressor when running at 3000 rpm.



Fig. Q1A







Fig. Q5A