

(A constituent unit of MAHE, Manipal)

IV SEMESTER B. TECH (MECHANICAL ENGG.) END SEMESTER EXAMINATIONS, MAY 2019

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 suitably assumed.
- 1A. For the stone crusher mechanism as represented in figure 1A. If the crank OA turns at a uniform speed of 60 rpm, determine the power required at the motor shaft 'O', to overcome a horizontal force of 40 KN at point X on the stone crusher. All dimensions are in mm. Draw the configuration diagram, free body and analysis diagrams.



Figure 1A

1B. For the mechanism as shown in figure 1B, determine the torque that must be applied on crank 2 to maintain static equilibrium. Angle CAB = 35° and angle ABC = 30°. The crank OA is positioned at an angle of 60° from horizontal measured in anticlockwise direction. Use the concept of resolution of forces. All dimensions are in mm. Draw the configuration diagram, free body and analysis diagrams.

Length OA = 250 mm, AB = 650 mm



Figure 1B

- 2A. A structural member is under the influence of two forces and a torque. 02 Analyse the system so as to maintain its static equilibrium.
- 2B. The turning moment diagram for a petrol engine is drawn to the following scale. Crank angle 1mm = 1°, turning moment 1mm = 5 Nm. The turning moment diagram repeats itself. The area above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960, 270 mm². The rotating parts are equivalent to a mass of 36 kg at a radius of gyration of 150 mm. The engine runs at a speed of 1800 rpm. Determine the co-efficient of fluctuation of speed.
- 2C. A machine is required to punch 4 holes of 4 cm diameter in a plate of 3 cm thickness, per minute. The work required is 700 N-m/cm² of sheared area. The punch has a stroke of 10 cm. Maximum speed of flywheel at its radius of gyration is 30 m/s. Determine the weight of flywheel if speed should not fall below 28 m/s at the radius of gyration. Also find the power of the motor.
- 2D. An inertial energy storage device is to be briefed to a team of new trainees. 02 You being the team leader of the maintenance division, develop an action plan for the same considering all varieties.
- **3A.** Derive an expression to determine the height of a Proell governor. **04**
- 3B. The extreme radii of rotation of the fly balls in case of a Hartnell governor are 40 mm and 60 mm, and the corresponding speeds are 210 rpm and 230 rpm. The mass of the fly ball is 3 kg. Determine the initial compression and the spring stiffness. Assume that lengths of the ball and the sleeve arms are equal.
- 3C. Steam engine governor manufacturing company has planned to conduct training for its graduate engineering trainees, you are the team leader of the training department. With neat illustration develop a module to make the trainees visualize the concept of steam based governor.

- 4A. Four masses A = 200 kg, B= 300 kg, C = 240 kg and D = 260 kg are attached to a shaft. These masses are revolving at radii 270 mm, 210 mm, 300 mm and 360 mm respectively in planes measured from A at 270 mm, 420 mm and 720 mm respectively. The angles measured anticlockwise are A to B is 45°, B and C 75°, C to D 135° and the distance between the planes L (reference plane) and M in which the balance masses are to be placed is 500 mm. The distance between planes A and L is 120 mm and M and D is 100 mm. If the balancing masses revolve at a radius of 720 mm. Determine their magnitude and angular positions.
- 4B. Consider a system with four disturbing masses, develop a module to make the production team analyse the concept of balancing of several rotating masses by a single mass in the same plane.
- 4C. Four masses are attached to a shaft at planes A, B, C and D at equal radii. The distance of the planes B, C and D from A are 40 cm, 50 cm and 120 cm respectively. The masses at A, B and C are 60 kg, 45kg and 70 kg respectively. If the system is in complete balance, determine the mass at D and the position of masses B, C and D with respect to A.
- **5A.** Explain the concept of balancing of reciprocating masses **02**
- **5B.** A two wheeler rider wants to take a turn towards left with an angle of heel ' θ '. **03** Evaluate the criteria for stability of the rider with the wheels.
- 5C. Rotary engine of an aircraft weights 3800 N and its radius of gyration is 300 mm when flying at a speed of 250 kmph. The aircraft takes a turn towards the right along a circular path of 55 m radius. Calculate the gyroscopic couple acting on the aircraft and explain its effect. Assume that the engine rotates at 1500 rpm in the clockwise direction when viewed from the rear end.