Q.5 i. What do you mean by static balancing and dynamic balancing? **4** Explain the method for Balancing of single Rotating masses in same plane and different planes

ii. Derive the following expressions, for an uncoupled two-cylinder **6** locomotive engine:
(a) Variation is Tractive force   (b) Swaying couple
(c) Hammer Blow

OR iii. A, B, C and D are four masses carried by a rotating shaft at radii **6** 100,125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance.

Q.6 Attempt any two:

i. A conical pivot supports a load of 20 kN, the cone angle is 120° and **5** the intensity of normal pressure is not to exceed 0.3 N/mm². The external diameter is twice the internal diameter. Find the outer and inner radii of the bearing surface. If the shaft rotates at 200 r.p.m. and the coefficient of friction is 0.1, find the power absorbed in friction. Assume uniform pressure

ii. A multi-disc clutch has three discs on the driving shaft and two on the **5** driven shaft. The outside diameter of the contact surfaces is 240 mm and inside diameter 120 mm. Assuming uniform wear and coefficient of friction as 0.3, find the maximum axial intensity of pressure between the discs for transmitting 25 kW at 1575 r.p.m.

iii. Derive an expression for the friction moment for a flat collar bearing **5** in terms of the inner radius r_1, outer radius r_2, axial thrust W and coefficient of friction µ. Assume uniform intensity of pressure.

******

Enrollment No......................................

Faculty of Engineering
End Sem (Even) Examination May-2022
ME3CO10 / RA3CO10 Dynamics of Machines

Knowledge is Power

Programme: B.Tech.   Branch/Specialisation: ME

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.
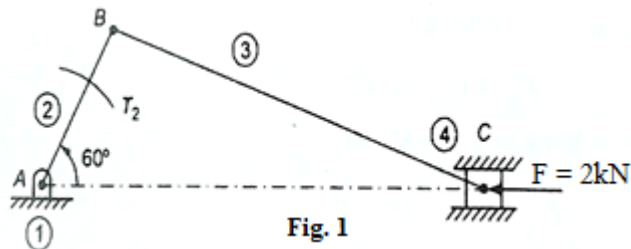
Q.1 i. For the static equilibrium of planar mechanisms- **1**
(a) $\sum F_x = 0$ (b) $\sum F_y = 0$
(c) $\sum M_o = 0$ (d) All of these

ii. In dynamically equivalent system, a uniformly distributed mass is **1** divided into _____ point masses.
(a) One   (b) Two
(c) Three   (d) Four

iii. The coefficient of fluctuation of energy is the- **1**
(a) Ratio of maximum and minimum energies
(b) Sum of maximum and minimum energies
(c) Difference of maximum and minimum energies
(d) Difference of maximum and minimum energies to the ratio of mean energy.

iv. If C_S is the coefficient of fluctuation of speed and E is the kinetic **1** energy of the flywheel at mean speed, the maximum fluctuation of energy is equal to-
(a) EC_S (b) $2EC_S$
(c) $3EC_S$ (d) $4EC_S$

v. Which of the following is a spring-controlled governor? **1**
(a) Hartnell   (b) Hartung   (c) Pickering   (d) All of these

vi. A governor is said to be hunting if the speed of the engine- **1**
(a) Remains constant at the mean speed
(b) Is above the mean speed
(c) Is below the mean speed
(d) Fluctuates continuously above and below the mean speed.

P.T.O.

vii. In order to have a complete balance of the several revolving masses **1**
in different planes-
(a) The resultant force must be zero
(b) The resultant couple must be zero
(c) Both the resultant force and couple must be zero
(d) None of these

viii. To facilitate the starting of locomotive in any position, the cranks of a **1**
locomotive, with two cylinders, are placed at.... to each other.
(a) 45°   (b) 90°   (c) 120°   (d) 180°

ix. In respect of flat pivot bearing the ratio between the frictional torques **1**
at uniform rate of wear and uniform intensity of pressure is given by
(a) 1   (b) 2/3   (c) 4/3   (d) 3/4

x. For a safe design, a friction clutch is designed assuming **1**
(a) Uniform pressure theory   (b) Uniform wear theory
(c) Both (a) and (b)   (d) None of these

Q.2 i. Define inertia force and inertia torque. Explain D'Alembert **3**
principle and write its application.

ii. In the slider crank mechanism shown in Fig. 1 the value of force **7**
applied to slider 4 is 2 kN. The dimensions of the various links are
AB =80 mm, BC =240 mm, θ =60°
Determine the forces on various links and the driving torque T$_2$.

Fig. 1

OR iii. For the mechanism shown in Fig. 2 determine the torque on the link **7**
AB for the static equilibrium of the mechanism.

Fig. 2
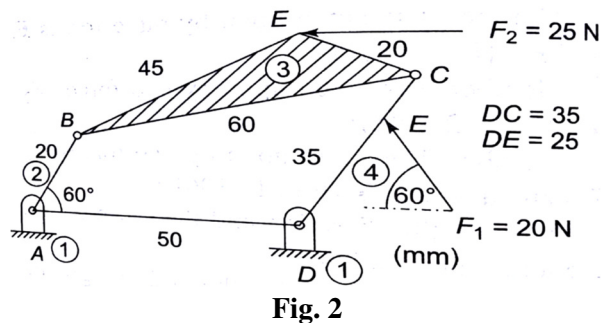
Q.3 i. The turning moment diagram for a petrol engine is drawn to the **3**
following scales:
Turning moment, 1 mm = 5 N-m; crank angle, 1 mm = 1°. The turning
moment diagram repeats itself at every half revolution of the engine
and the areas above and below the mean turning moment line taken in
order are 295, 685, 40, 340, 960, 270 mm^2. The rotating parts are
equivalent to a mass of 36 kg at a radius of gyration of 150 mm.
Determine the coefficient of fluctuation of speed when the engine runs
at 1800 r.p.m.

ii. Derive an expression for approximate analytical method for velocity **7**
and acceleration of the piston and angular velocity and acceleration of
the connecting rod.

OR iii. A vertical petrol engine 100 mm bore diameter and 120 mm stroke **7**
length has a connecting rod 250 mm long, the mass of the piston is
1.1 kg. The speed is 2000 rpm. On the expansion stroke with the crank
20° from TDC the gas pressure is 700 kN/m^2, determine:
(a) Net force on the piston
(b) Resultant load on gudgeon pin
(c) Thrust on cylinder wall
(d) Speed above which gudgeon pin load reversed.

Q.4 i. Derive an expression for the height in the case of a Porter Governor. **3**

ii. Write any two advantages of spring-loaded governor over dead weight **7**
governor. Define and explain the following terms relating to
governors-
(a) Stability, (b) Sensitiveness, (c) Isochronism, (d) Hunting, and
(e) Height of Governor.

OR iii. The arms of a Porter governor are each 250 mm long and pivoted on **7**
the governor axis. The mass of each ball is 5 kg and the mass of the
central sleeve is 30 kg. The radius of rotation of the balls is 150 mm
when the sleeve begins to rise and reaches a value of 200 mm form
maximum speed. Determine the speed range of the governor. If the
friction at the sleeve is equivalent of 20 N of load at the sleeve.
Determine how the speed range is modified.

P.T.O.

Q.1 i. For the static equilibrium of planar mechanisms- **1**
(d) All of these

ii. In dynamically equivalent system, a uniformly distributed mass is divided into _____ point masses. **1**
(b) Two

iii. The coefficient of fluctuation of energy is the- **1**
(d) Difference of maximum and minimum energies to the ratio of mean energy.

iv. If C_S is the coefficient of fluctuation of speed and E is the kinetic energy of the flywheel at mean speed, the maximum fluctuation of energy is equal to- **1**
(b) $2EC_S$

v. Which of the following is a spring-controlled governor? **1**
(d) All of these

vi. A governor is said to be hunting if the speed of the engine- **1**
(d) Fluctuates continuously above and below the mean speed.

vii. In order to have a complete balance of the several revolving masses in different planes- **1**
(c) Both the resultant force and couple must be zero

viii. To facilitate the starting of locomotive in any position, the cranks of a locomotive, with two cylinders, are placed at…. to each other. **1**
(b) 90°

ix. In respect of flat pivot bearing the ratio between the frictional torques at uniform rate of wear and uniform intensity of pressure is given by **1**
(d) 3/4

x. For a safe design, a friction clutch is designed assuming **1**
(b) Uniform wear theory

Q.2 i. Definition of inertia force and inertia torque 1.5 marks **3**
D'Alembert principle and its application 1.5 marks

ii. Determine the forces on various links and the driving torque T_2. **7**
Scaled schematic diagram 1 mark
FBD for link 2,3,4 (1 mark for each) (1 mark * 3) 3 marks
Forces on various links and driving torque T_2 3 marks

OR iii. Determine the torque on the link AB for the static equilibrium of the mechanism. **7**
Scaled Configuration diagram 1 mark
FBD for link 2,3,4 (1 mark for each) (1 mark * 3) 3 marks
Forces on various links and the torque on the link AB
3 marks

Q.3 i. The turning moment diagram for a petrol engine 1 mark **3**
Fluctuation of energy 1 mark
Coefficient of fluctuation of speed 1 mark

ii. Diagram with notation used 1 mark **7**
Expression for velocity and acceleration of the piston
3 marks
Angular velocity and acceleration of the connecting rod
3 marks

OR iii. Diagram with notation used 1 mark **7**
(a) Net force on the piston 2 marks
(b) Resultant load on gudgeon pin 1 mark
(c) Thrust on cylinder wall 1 mark
(d) Speed above which gudgeon pin load reversed 2 marks

Q.4 i. Derivation for the height in the case of a Porter Governor **3**
2 marks
Diagram with notation used 1 mark

ii. Any two advantages of spring-loaded governor over dead weight **7**
2 marks
Define and explain the following terms relating to governors-
1 mark for each (1 mark * 5) 5 marks

OR iii. Diagram of Porter Governor with notation used 2 marks **7**
Formula Used 1 mark
Speed range of the governor 2 marks
Modified speed range of the governor 2 marks

Q.5 i. Static balancing 1 mark **4**
Dynamic balancing 1 mark
Method for Balancing of single Rotating masses 2 marks

	ii.	(a) Variation is Tractive force	2 marks	**6**
		(b) Swaying couple	2 marks	
		(c) Hammer Blow	2 marks	
OR	iii.	Scaled Configuration diagram	1 mark	**6**
		Table for force and couple	2 marks	
		Force and couple polygon	2 marks	
		Required mass A and the relative angular settings of the four masses		
			1 mark	

Q.6 Attempt any two:

    i.   Conical pivot Configuration diagram with notation used   **5**

                                 1 mark

        Formula used   1 mark

        Power absorbed in friction   3 marks

    ii. Configuration diagram with notation used   1 mark   **5**

        Formula used   1 mark

        Maximum axial intensity of pressure between the discs

                                 3 marks

    iii. Flat collar bearing Configuration diagram with notation used   **5**

                                 1 mark

        Complete derivation for expression for the friction moment

                                 4 marks

******