

# Faculty of Engineering

## End Semester Examination May 2025

### ME3CO34 Dynamics of Machine

<b>Programme</b>	:	B.Tech.	<b>Branch/Specialisation</b>	:	ME
<b>Duration</b>	:	3 hours	<b>Maximum Marks</b>	:	60

**Note:** All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary.  
 Notations and symbols have their usual meaning.

#### Section 1 (Answer all question(s))

**Marks CO BL**  
 1 1 1

**Q1.** In an engine, the work done by inertia forces in a cycle is-

<b>Rubric</b>	<b>Marks</b>
Positive	1

- Positive       Zero  
 Negative       None of these

**Q2.** A rigid body, under the action of external forces, can be replaced by two masses placed at a fixed distance apart. The two masses form an equivalent dynamical system, if- 1 1 1

<b>Rubric</b>	<b>Marks</b>
All of the above	1

- The sum of two masses is equal to the total mass of the body  
 The sum of mass moment of inertia of the masses about their centre of gravity is equal to the mass moment of inertia of the body  
 The centre of gravity of the two masses coincides with that of the body  
 All of the above

**Q3.** The ratio of the maximum fluctuation of speed to the mean speed is called- 1 2 1

<b>Rubric</b>	<b>Marks</b>
Coefficient of fluctuation of speed	1

- Fluctuation of speed  
 Coefficient of fluctuation of speed  
 Maximum fluctuation of speed  
 None of these

**Q4.** The maximum fluctuation of energy is the- 1 2 1

<b>Rubric</b>	<b>Marks</b>
Difference between the maximum and minimum energies	1

- Sum of maximum and minimum energies  
 Ratio of the maximum energy and minimum energy  
 Difference between the maximum and minimum energies  
 Ratio of the mean resisting torque to the work done per cycle

**Q5.** For two governors A and B, the lift of sleeve of governor A is more than that of governor B, for a given fractional change in speed. It indicates that- 1 3 1

<b>Rubric</b>	<b>Marks</b>
Governor A is more sensitive than governor B	1

- Governor A is more sensitive than governor B
- Both governors A and B are equally sensitive
- Governor B is more sensitive than governor A
- None of the above

**Q6.** A Hartnell governor is a- 1 3 1

<b>Rubric</b>	<b>Marks</b>
Spring loaded governor	1

- Pendulum type governor
- Spring loaded governor
- Dead weight governor
- Inertia governor

**Q7.** For static balancing of a shaft,- 1 4 1

<b>Rubric</b>	<b>Marks</b>
The net dynamic force acting on the shaft is equal to zero	1

- The net dynamic force acting on the shaft is equal to zero
- Both (a) and (b)
- The net couple due to the dynamic forces acting on the shaft is equal to zero
- None of the above

**Q8.** In order to have a complete balance of the several revolving masses in different planes- 1 4 1

<b>Rubric</b>	<b>Marks</b>
Both the resultant force and couple must be zero	1

- The resultant force must be zero
- Both the resultant force and couple must be zero
- The resultant couple must be zero
- None of the above

**Q9.** When there is a reduction in amplitude over every cycle of vibration, then the body is said to have- 1 5 1

<b>Rubric</b>	<b>Marks</b>
Damped vibration	1

- Free vibration
- Damped vibration
- Forced vibration
- All of the above

**Q10.** The factor which affects the critical speed of a shaft is- 1 5 1

<b>Rubric</b>	<b>Marks</b>
All of these	1

- Diameter of the disc
- Eccentricity
- Span of the shaft
- All of these

**Section 2 (Answer all question(s))**

**Marks CO BL**

**Q11.** What is free body diagram? Explain free body diagram with four link mechanism.

4 1 1

Rubric	Marks
Definition of FBD	1
FBD of four link mechanism	1
explanation of four link mechanism FBD	2

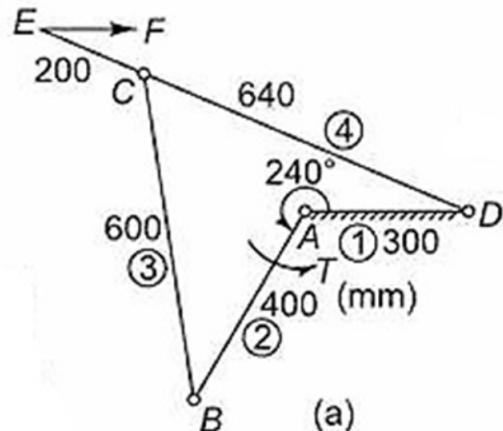
**Q12. (a)** Find the inertia force for the following data of an I.C. engine. Bore = 175 mm, stroke = 200 mm, engine speed = 500 r.p.m., length of connecting rod = 400 mm, crank angle =  $60^\circ$  from T.D.C and mass of reciprocating parts = 180 kg.

6 1 1

Rubric	Marks
inertia force 18.78 kN	6

(OR)

**(b)** A four-link mechanism with the following dimensions is acted upon by a force of 50 N on the link DC at the point E (Fig. 12.10a): AD = 300 mm, AB = 400 mm, BC = 600 mm, DC = 640 mm, DE = 840 mm.



### Section 3 (Answer all question(s))

Marks CO BL

**Q13.** Explain the importance of turning moment diagram in reciprocating engine. And also draw the turning moment diagram of Single cylinder and multicylinder engine.

4 2 1

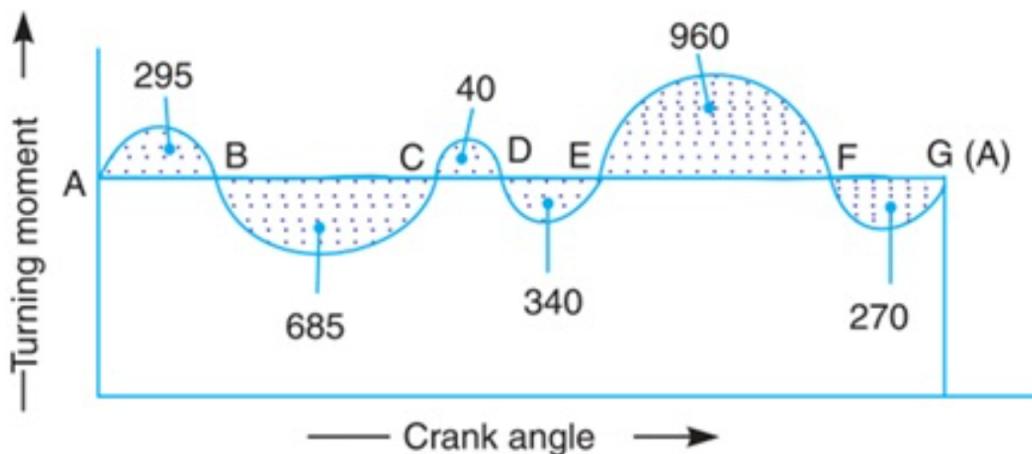
Rubric	Marks
Importance	2
turning moment diagram	2

- Q14. (a)** If the crank and the connecting rod are 300 mm and 1 m long respectively and the crank rotates at a constant speed of 200 r.p.m., determine: 1. The crank angle at which the maximum velocity occurs, and 2. Maximum velocity of the piston.

Rubric	Marks
Crank angle at which the maximum velocity occurs = 75 degree	3
Maximum velocity of the piston = 6.54 m/s	3

(OR)

- (b)** The turning moment diagram for a petrol engine is drawn to the following scales : Turning moment, 1 mm = 5 N-m ; crank angle, 1 mm =  $1^\circ$ . 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<sup>2</sup>, 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.



Rubric	Marks
Coefficient of fluctuation of speed 0.3%	6

#### Section 4 (Answer all question(s))

Marks CO BL

**Q15.** Explain the types of governors.

2 3 1

**Q16.** Explain the following: stability, isochonism and hunting.

3 3 1

**Q17. (a)** Derive the expression for height of Porter governor.

5 3 1

(OR)

- (b)** 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.

Rubric	Marks
Range of speed = 20.7 rpm	5

#### Section 5 (Answer all question(s))

Marks CO BL

**Q18.** Explain the balancing of several masses rotating in the same plane.

4 4 1

**Q19. (a)** Four masses  $m_1$ ,  $m_2$ ,  $m_3$  and  $m_4$  are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are  $45^\circ$ ,  $75^\circ$  and  $135^\circ$ . Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m.

Rubric	Marks
Angle = 201 degree	6

(OR)

- (b)** A, B, C and D are four masses carried by a rotating shaft at radii 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.

### Section 6 (Answer all question(s))

Marks CO BL

4 5 1

6 5 1

**Q20.** Explain the classification of vibrations.

**Q21. (a)** Derive the relation for natural frequency of free transverse vibration.

(OR)

- (b)** A shaft of length 0.75 m, supported freely at the ends, is carrying a body of mass 90 kg at 0.25 m from one end. Find the natural frequency of transverse vibration. Assume  $E = 200 \text{ GN/m}^2$  and shaft diameter = 50 mm.

Rubric	Marks
Frequency = 49.85 Hz	6

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