Dec. 2025

B.Tech. (ME) (Fifth Semester)

Dynamics of Machine (PCC-ME-502/21)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Drawing sheets are required to solve the problems.

Part A

1. (a) What is D-Alembert's principle ? **1.5**

(b) What is difference between static force analysis and dynamic force analysis ? **1.5**

(c) Why free body diagram are needed for static force analysis ? **1.5**

(d) What is space diagram ? **1.5**

(e) Why balancing is essential in engines ? **1.5**

(f) What is difference between 'balancing of rotating masses' and 'balancing of reciprocating masses" ? **1.5**

(g) Explain the terms 'Stability' and 'Sensitivity'. **1.5**

(h) What do you mean by controlling force ? **1.5**

(i) What is Precession ? **1.5**

(j) Explain the causes of vibrations. **1.5**

Part B

2. The crank of a reciprocating engine is rotating in clockwise direction with a constant angular velocity of 60 rad/s. The lengths of crank and connecting rod are 100 mm and 350 mm respectively. Using Klein's construction. **15**

Find :

(i) velocity of piston

(ii) velocity of mid-point of connecting rod

(iii) angular velocity of connecting rod

(iv) acceleration of piston

(v) acceleration of midpoint of connecting rod

(vi) angular acceleration of connecting rod when crank has turned through 30 degree from inner dead centre.

3. A shaft is rotating at a uniform angular speed. Four masses m_1, m_2, m_3 and m_4 of the magnitudes 300 kg, 450 kg, 360 kg and 390 kg respectively are attached rigidly to the shaft. The masses are rotating in the same plane. The corresponding radii of rotation are 200 mm, 150 mm, 250 mm and 300 mm respectively. The angles made by these masses with horizontal are 0 degree. 45 degree. 120 degree and 255 degree respectively. **15**

Find :

(i) the magnitude of the balancing mass

(ii) the position of the balancing mass if its radius of rotation is 200 mm.

4. A car is of total mass 3000 kg. It has wheel base equal to 2.5 m and track width equal to 1.5 m. The effective diameter of each wheel is 80 cm and moment of inertia of each wheel is 1.0 kg-m^2. The rear axle ratio is 4. The mass moment of inertia of engine rotating parts is 3 kg-m^2 and spin axis of engine parts is perpendicular to the spin axis of wheels. Determine the reaction at each wheel if car takes right turn of 100 m radius at 108 km/h speed. Also determine critical speed. The height of c.g is 0.5 m from ground and it is placed on the vertical line through geometric centre of wheels.

5. (a) What is Governor ? Explain the different types of governors. 5

(b) Explain the construction and working of Wilson-Hartnell governor. 10

6. (a) Explain the different types of vibrations. 5

(b) What is harmful and useful effect of vibrations ? 5

(c) Explain any *one* method of vibration analysis. 5

7. Write short notes on the following : 7,8

(a) Whirling's of shafts

(b) Balancing of reciprocating engines.

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