

Government College of Engineering, Aurangabad
(An Autonomous Institute of Government of Maharashtra)

Third Year Mechanical Engineering (Old)
End Semester Examination 2016 – 17 Semester I

ME 302: Theory of Machine

17 NOV 2016

Max. Marks: 60

Time: Four Hours

"Verify the course code and check whether you have got the correct question paper"

N.B.: - All questions are compulsory.

1. Figures to the right indicate full marks.
2. Assume suitable data if necessary and state it clearly.
3. Use of Non-programmable Calculator is allowed.

Question no 1 - Solve any one (a or b)

- (a) A two cylinder uncoupled locomotive with crank at 90° has a crank radius of 325mm. The distance between the centers of driving wheel is 1.5 m. The pitch of the cylinder is 0.6 m. The diameters of treads of driving wheel is 1.8 m. The radius of centre of gravity of balance masses is 0.65 m. The pressure due to dead load on each wheel is 40 kN. The masses of reciprocating and rotating parts per cylinder are 330 kg and 300 kg respectively. The speed of the locomotive is 60 km.p.h find: 1. The balancing masses both in magnitude and position required to place in the planes of driving wheels to balance the whole of the revolving and two-third of the reciprocating masses; 2. The swaying couple; 3. The variation in tractive force; 4. The maximum and minimum pressure on the rails ; and 5. The maximum speed at which it is possible to run the locomotive, in order that the wheels are not lifted from the rails. (12 marks)
- OR
- (b) A two cylinder uncoupled locomotive has inside cylinders 0.6 m apart. The radius of each crank is 300 mm and are at right angles. The revolving mass per cylinder is 250 kg and the reciprocating mass per cylinder is 300 kg. The whole of the revolving and two third of the reciprocating masses are to be balanced and their balanced masses are to be placed in the plane of rotation of the driving wheels, at a radius of 0.8 m apart. The driving wheels are 2 m in diameter and 1.5 m apart. If the speed of the engine is 80 kmph: find the hammer blow, maximum variation in tractive effort and maximum swaying couple. (9 marks)
- ii) Explain the term 'static balancing and 'dynamic balancing'. State the necessary conditions to achieve them. (3 marks)

Question no 2 - Solve any one (a or b)

- (a) I) Each paddle wheel of the boat have a mass of 1600 kg and the radius of gyration of 1.2 m, The boat turns in to port in a circle of 160 m radius at 24 kmph, The speed of the paddle being 90 r.p.m. Find the magnitude and effect of gyroscopic couple on boat. (6 marks)
- II) How can you compare one governor with the other? Explain the terms related to governor. (6 marks)
- OR
- (b) I) An aeroplane runs at 600 kmph. The rotor of the engine weighs 4000N with radius of gyration of 1 meter. The speed of the rotor is 3000 r.p.m in anti clockwise direction when seen from the rear side of the plane. If the plane takes a loop upwards in a curve of 100 meter radius, gyroscopic couple and its effect on the plane. (6 marks)
- ii) What is the difference between the centrifugal and inertia type governor? And how does the governor differ from fly wheel (6 marks)

Question no 3 - Solve any one (a or b)

- (a) (I) A torsion dynamometer is fitted to a propeller shaft of a marine engine. It is found that the shaft twists 2° in a length of 20 metres at 120 r.p.m. If the shaft is hollow with 400 mm external diameter and 300 mm internal diameter, find the power of the engine. Take modulus of rigidity for the shaft material as 80 GPa.
- ii) Give the classification of brakes and explain the working of Epicyclic-train Dynamometer (6 marks)

OR

- (b) (I) A band brake acts on the $\frac{3}{4}$ th of circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a braking torque of 225 N-m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the operating force when the drum rotates in the (a) anticlockwise direction, and (b) clockwise direction. (6 marks)

- ii) Give the classification of Dynamometer and explain any two of them. (6 marks)

Question no 4 - Solve any one (a or b)

- (a) (I) The crank and connecting rod of a reciprocating engine are 150 mm and 600 mm respectively. The crank makes an angle of 60° with the inner dead centre and revolves at a uniform speed of 300 r.p.m. Find, by Klein's construction 1. Velocity and acceleration of the piston, 2. Velocity and acceleration of the midpoint of the connecting rod, and 3. Angular velocity and angular acceleration of connecting rod. (12 marks)

OR

- (b) (I) In slider crank mechanism, the length of the crank and connecting rod are 100mm and 400mm respectively. The crank rotates at 600 r.p.m clockwise. When the crank has turned through 45° from the inner dead centre. Find, by Klein's construction 1. Velocity and acceleration of the slider, 2. Angular velocity and angular acceleration of connecting rod. (9 marks)

- ii) What is D'Alembert's Principle (3 marks)

Question no 5 - Solve any one (a or b)

- (a) (I) Derive an equation for natural frequency of free longitudinal vibration by equilibrium method. (9 marks)

- ii) What is critical or whirling speed of the shaft (3 marks)

OR

- (b) (I) Derive an equation for natural frequency of free Transverse vibration. (6 marks)

- ii) Discuss the effect of inertia of the constraint in longitudinal vibrations. (6 marks)