

[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
(2125)

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B. Tech 6th Semester Examination

Dynamics of Machines (OS)

ME-6001

Time : 3 Hours

Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

- Note :** (i) Attempt five questions in all, selecting one question each from Sections A, B, C & D of the paper and all sub-parts of question no. 9 of Section E.
(ii) All questions carry equal marks.
(iii) Use of Non-Programmable calculator is allowed.

SECTION - A

1. A single cylinder vertical engine has a bore of 30 cm and a stroke of 40 cm. The connecting rod is 100 cm long. The mass of the reciprocating parts is 140 kg. On the expansion stroke with the crank at 30° from the top dead centre the gas pressure is 0.7 MPa. If the engine runs at 250 r.p.m., determine: (i) net force acting on the piston, (ii) resultant load on the gudgeon pin, (iii) thrust on the cylinder walls, and (iv) the speed above which, other things remaining same, the gudgeon pin load would be reversed in direction. (20)
2. A shaft carries four rotating masses A, B, C and D in this order along its axis. The mass A may be assumed concentrated at a radius of 12 cm, B at 15 cm, C at 14 cm and D at 18 cm. The masses of A, C and D are 15 kg, 10 kg and 8 kg respectively. The planes of revolution of A and B are 15 cm apart and of B and C are 18 cm apart. The angle between A and C is 90° . If the shaft is in complete dynamic balance,

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determine: (i) the angles between the radii of A, B and D, (ii) the distance between the planes of revolution of C and D, and (iii) the mass B. (20)

SECTION - B

3. (a) Explain how the variation in pressure within a cylinder is measured by engine indicator. Also describe the construction of indicator diagram with the help of engine indicator. (8)
(b) A one-cylinder four-cycle engine has a compression ratio of 7.6 and develops 3 bhp at 300 rpm. Crank length is 2.2 cm with a 6 cm bore. Develop and plot a rounded indicator diagram using a card factor of 0.90, a mechanical efficiency of 72%, a suction pressure of 101 kPa, and a polytropic exponent of 1.3. (12)
4. The following data refer to two cylinder locomotive with cranks at 90° : Reciprocating mass per cylinder=300 kg, crank radius=0.30 m, Driving wheel diameter=1.80 m, Distance between cylinder centre lines=0.65 m, Distance between the driving wheel central planes=1.55 m. Determine (a) the fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46×10^3 N at 96.5 km/hr. (b) The variation in tractive effort. (c) The maximum swaying couple. (20)

SECTION - C

5. (a) Explain the effort and power of governor with the help of mathematical equation. (6)
(b) For a spring controlled Hartnell type governor, following data is provided: Mass of the governor ball=1.80 kg, length of the vertical arm of bell crank lever=8.75 cm, length of the other arm of bell crank lever=10 cm. The speed corresponding to radii of rotations of 12 cm and 13 cm are 296 and 304 rpm respectively. Determine the stiffness of spring. (14)

6. In a Hartnell type governor the two masses are 4 kg each and the load on the sleeve is 40N. If with the weight arms vertical, the path radius is 8 cm and the equilibrium speed neglecting friction 420 rpm, find the corresponding compression force in the spring. Find also the friction force at the sleeve which can be overcome in this position for an increase in speed of 1%. If the sleeve movement is to be 2 cm for increase in speed of 5% from the 420 rpm position, find the required spring stiffness, if gravity effect on the masses is neglected. (20)

SECTION - D

7. (a) Define dynamometer and mention their different types. Explain prony brake dynamometer with the help of well labelled diagram. (10)
- (b) In a belt transmission dynamometer the distance between the centre of driving pulley and the dead weights is one metre. Find the value of dead weights required to keep the lever in horizontal position if power transmitted is 7.5 kW and the diameter of each of the driving as well as the intermediate pulleys is equal to 400 mm. The driving pulley runs at 400 rpm. (10)
8. A racing car weighs 20kN. It has a track width 1m and height of 300mm above the ground level and lies midway between front and rear axles. The flywheel rotates at 3000rpm clockwise when viewed from the front. Moment of inertia of the flywheel is 4kgm^2 . Find the reactions between the wheels and ground when the car takes a curve of 15m radius at 30kmph, taking into account the effect of gyroscopic effect and centrifugal force. Wheel radius is 400mm. (20)

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SECTION - E (Compulsory Question)

9. Write short answers of the following:
- State the principle of superposition.
 - What is the necessity of balancing high speed machinery?
 - Explain in brief the bearing load in single cylinder engine.
 - What do you mean by primary and secondary unbalance in reciprocating engines?
 - Explain the meaning of sensitiveness, hunting and stability of a governor.
 - How gyroscopic couple affect the motion of an aeroplane while taking turn?
 - What is a transmission dynamometer? Explain.
 - Define spin and precession.
 - What is the condition of isochronism in case of Hartnell governor? Explain.
 - State the conditions for the equilibrium of a body under the following system of loading, (a) Two forces, and (b) Two forces and a torque. (2×10=20)