QP Code: **31037**

(3 Hours) [Total Marks; 80]

N.B.   1) Question No, 1 is **compulsory**

2) Answer any **Three** questions from remaining **Five**

3) Assume suitable data wherever required, justify the same

4) Answer to questions showed be grouped and written together.

Qu. 1   Solve any Four   (20)

a) What is a dynamometer? How does it differ from the brake?

b) Explain the necessity of the gearbox in automobile?

c) Differentiate between governor and flywheel.

d) Explain the following terms with reference to a governor-

(i)Sensitiveness (ii) stabillty (iii) Isochronism (iv) Coefficient of insensitiveness

e) What do you understand by dry clutch and wet clutch?

Qu. 2   a) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 rpm. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and maximum pressure is not to exceed $0.1 \times 10^6 \, N/m^2$. Also determine the axial thrust to be provided by springs. Assume uniform wear.   (10)

b)The upper arm of porter governor are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 3.76 cm from the axis. The length of the arm and suspension links are 30 cm. the weight of 60 N and the load on the sleeve is 480 N. if the extreme radii of rotation of governor balls are 20 cm and 25 cm, find the corresponding equilibrium speeds.   (10)

Qu. 3   a) A band and block brake, having 14 blocks each of which subtends an angle 15^0 at the Centre, is applied to a drum of 1m effective diameter. The drum and the flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to the pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. if a force of 200 N is applied at a distances of 750 mm from the fulcrum, find: a) Maximum braking torque.   b) Angular retardation of the drum, and c) Time taken by the system to come to rest from the rated of 360 rpm.   (12)

b) A governor of Hartnell type has equal balls of mass 3kg, set initially at a radius of 200 mm. the arms of bell crank lever are 110 mm vertically and 150 mm horizontally. Find a) The initial compressive force on the spring, if the speed for an initial ball radius of 200 mm is 240 rpm; and b) the stiffness of the spring required to permit a sleeve movement of 4 mm on a fluctuation of 7.5% in engine speed.   (08)

Qu. 4   a)The crank and connecting rod of vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240 mm respectively. The distance of the piston is 80 mm, and, mass of reciprocating part is 1.2 kg. At a point during power stroke when piston has moved 20 mm from top dead center position, the pressure on the piston is $800 \, kN/m^2$. Determine I) Net force on the piston II)

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Net load on gudgeon pin III) the thrust on cylinder walls IV) the speed at which the gudgeon pin load is reverse in direction. (10)

b) A punching press is required to punch 30 mm diameter holes in a plate of 20 mm thickness at the rate of 20 holes/min. It requires 6 Nm of energy/ mm^2 of sheared area. If the punching takes place in 1/10 of sec and rpm of the flywheel varies from 160 to 140, determine the weight of the flywheel having radius of gyration is 1 m. (10)

Qu. 5 a) An epicyclic gear train consists of three wheels A, B and C as shown in Fig. 1. Wheel A has 72 internal teeth, C has 32 external teeth. The wheel B gears with A and C and is carried on an arm which rotates about the Centre of A at 18 rpm. If the wheel A is fixed, determine the speed of wheels B and C. (10)

Fig.1
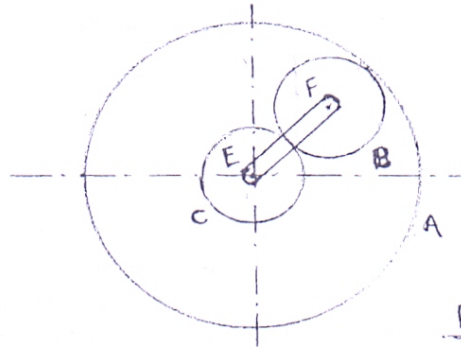
b) Total mass of four wheeled trolley car is 1800 kg. The car runs on rails of 1.6 m gauge and rounds a curve of 24 m radius at 36 kmph. The track is banked at 10°. The external diameter of wheel is 600 mm and each pair with the axel has a mass of 180 kg, with radius of gyration of 240 mm. The height of the center of the mass of the car above the wheel base is 950 mm. Determine the pressure on each rail allowing for centrifugal force and gyroscopic couple action. (10)

Qu. 6 a) Turbine rotor of a ship has a mass of 2.2 tonnes and rotate at 1800 rpm clockwise, when viewed from aft. The radius of gyration of rotor is 320 mm. Determine the gyroscopic couple and its effects, when a) the ship turns right at radius of 250 m, with speed of 25 km/h. b) The ship pitches with the bow rising at an angular velocity of 0.8 rad/sec. c) Ship rolls at an angular velocity of 0.1 rad/sec. (10)

b) The following data relate to the connecting rod of reciprocating engine:
Mass = 50 kg, Distance between bearing centers = 900 mm, Diameter of big end bearing = 100mm, Diameter of small end bearing = 80 mm, Time of oscillation when a connecting rod is suspended from big end = 1.7 sec and small end = 1.85 sec,   Determine i) the radius of gyration "k" of the rod about an axis through center of mass perpendicular to plane of oscillation. ii) The moment of inertia of the rod about same axis, and iii) The dynamically equivalent system of the connecting rod comprising two masses, one at the small end bearing center. (10)