(3 Hours) Total Marks: 100

N.B. : (1) Question No. 1 is compulsory.
(2) Attempt any four questions out of the remaining six.
(3) Assume suitable data if necessary but justify the same.
(4) Figures to the right indicate full marks.

Q1. Attempt any four (20)

A. Describe the function of a simple Watt governor. What are its limitations?

B. What is pressure angle in cams and what are the methods to control it?

C. What do you mean by rolling of a ship? Is there any gyroscopic effect during rolling? Give reasons to your answer.

D. What is a dynamometer? How does it differ from a brake?

E. Differentiate between plate clutch and cone clutch.

Q2 A. A cam with 30 mm as minimum diameter and 20 mm lift is rotating clockwise at (10) uniform speed of 1200 rpm and has to give following motion with uniform acceleration and retardation; outward stroke during 120^0, dwell for 60^0, return during 90^0, and dwell for the remaining period. Draw the displacement, velocity and acceleration diagram during the ascent and return stroke.

B. Derive the equation for the braking of a vehicle, when the vehicle is moving up the (10) plane and the brakes are applied to front wheels only.

Q3 A. A multi plate disc clutch transmits 55 kW of power at 1800 rpm. Coefficient of (10) friction for the friction surfaces is 0.1. Axial intensity of pressure is not to exceed 160 kN/m². The internal radius is 80 mm and is 0.7 times the external radius. Find the number of plates needed to transmit the required torque.

B. In a spring loaded governor of the Hartnell type, the mass of each ball is 1 Kg, length of (10) vertical arm of the bell crank lever is 100 mm and that of the horizontal arm is 50 mm. The distance of fulcrum of each bell crank lever is 80 mm from the axis of rotation of the governor. The extreme radii of rotation of the balls are 75 mm and 112.5 mm The maximum equilibrium speed is 5% greater than the minimum equilibrium speed which is 360 rpm. Find, neglecting obliquity of arms, initial compression of the spring and equilibrium speed corresponding to the radius of rotation of 100 mm.

Q4 A. A band and block brake having 12 blocks, each of which subtends an angle of 16^0 at the (10) centre, is applied to a rotating drum with a diameter of 600 mm. The blocks are 75 mm thick. The drum and the flywheel mounted on the same shaft have a mass of 1800 kg and have a combined radius of gyration of 600 mm. The two ends of the band are attached to pins on the opposite sides of the brake fulcrum at distance of 40 mm and 150 mm from it. If a force of 250 N is applied on the lever at a distance of 900 mm from the fulcrum, find the
    i) maximum braking torque
    ii) angular retardation of the drum
    iii) Time taken by the system to be stationary from the rated speed of 300 rpm.

B. Explain the construction and working of a centrifugal clutch and derive the equation (10) for the torque transmitted by it.

{Turn Over

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Q5 A. Classify cams and followers in detail. (10)

B. A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width of 1.5 m (10)
and height of C.G. 500 mm above the ground level and lies at 1 metre from the front
axle. Each wheel has an effective diameter of 0.8 m and moment of inertia of 0.8 kg-m^2.
The drive shaft, engine flywheel and transmission are rotating at 4 times the speed of
road wheel, in a clockwise direction when viewed from the front and is equivalent to a
mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of
60 m radius at 60 km/h, find the load on each wheel.

Q6 A. In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 (10)
teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction
about the center of the gear A which is fixed, determine the speed of gear B. If
the gear A instead of being fixed makes 300 rpm in the clockwise direction, what
will be the speed of gear B?

B. Derive the equation for the stability of a two wheel vehicle taking a turn (10)
considering gyroscopic and centrifugal effect.

Q7 Write short notes on:- (20)

A. Governor effort and governor power

B. Flexural Mechanism

C. Wilson Hartnell governor

D. Compound gear trains

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