

(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**.
 (4) **Figures** to the **right** indicate **full marks**.
 (5) Draw **neat sketches** wherever **required**.

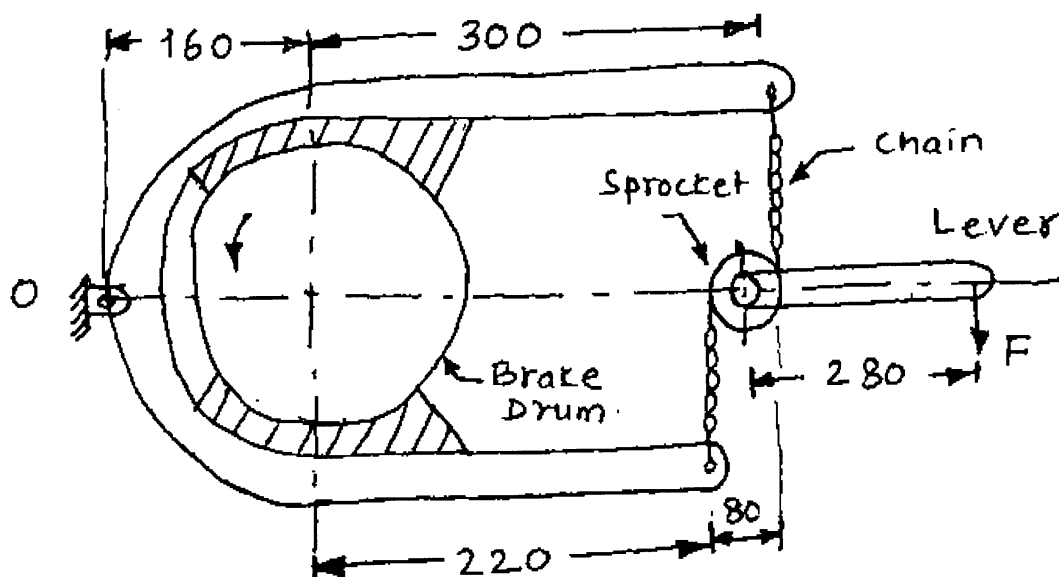
1. Answer any **four** :-

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- With the help of neat sketch explain following terms with respect to cams,
 - Angle of Dwell.
 - Angle of action.
- What do you mean by compound epicyclic gear train ?
- Find a relation for frictional torque acting on a centrifugal clutch.
- What are the leading and trailing shoes of an internal expanding shoe brake ?
- Explain the controlling force diagram with respect to Governors.

2. (a) A double block brake is operated by a sprocket and chain mechanism as shown in **figure**. As a force F is applied at the end of the lever, the sprocket causes tension in the chains. The brake drum diameter is 240 mm. The angle of contact of each block is 90° . Determine the force F required to apply the brake if a power of 1.6 kW at 300 rpm is being transmitted by the system. Assume $\mu = 0.32$.

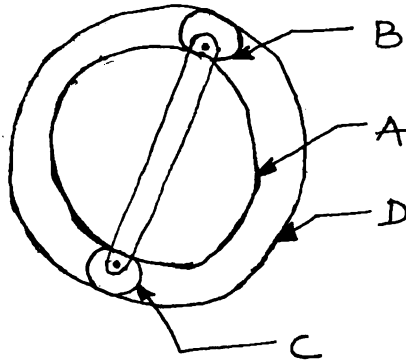
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[TURN OVER

- (b) A multiplate disc clutch transmits 75 kW of power at 2000 rpm. Coefficient of friction for the friction surfaces is 0.2. Axial intensity of pressure is not to exceed 180 kN/m². Internal radius is 100mm and is 0.8 times the external radius. Find the number of plates needed to transmit the required torque. Assume uniform wear conditions. 8
3. (a) In a Hartnell governor, the lengths of ball and sleeve arms of a bell crank lever are 120mm and 100mm respectively. The distance of the fulcrum of the bell crank lever from the governor axis is 140mm. Each governor ball has a mass of 4 kg. The governor runs at a mean speed of 300 rpm with the ball arms vertical and sleeve arms horizontal. For an increase of speed of 4%, the sleeve moves 10mm upwards. Neglecting friction, Find : 12
- (i) the minimum equilibrium speed if the total sleeve movement is limited to 20mm.
 - (ii) the spring stiffness.
 - (iii) The sensitiveness of the governor.
 - (iv) the spring stiffness if the governor is to be isochronous at 300 rpm.
- (b) Explain the terms self energizing and self locking with respect to differential band brake. Also discuss about the direction of the force applied at the end of the lever and the tensions in the band when the drum rotates in the clockwise and anticlockwise direction. 8
4. (a) A ship is propelled by a turbine rotor having a mass of 6000 kg. and a speed of 2400 rpm. The direction of rotation of rotor is anticlockwise when viewed from the bow end. The radius of gyration of rotor is 450mm. Determine the gyroscopic effect when :- 12
- (i) Ship is steering to the left in a curve of 60m radius at a speed of 18 knots (1 knot = 1860 m/hr.).
 - (ii) Ship is pitching in SHM with bow descending with maximum velocity. The time period of pitching is 18 seconds and the ship pitches 7.5° above and 7.5° below the normal position.
 - (iii) Ship is rolling and at the instant, its angular velocity is 0.035 rad/s counter clockwise when viewed from stern.
 - (iv) Also find the maximum angular acceleration during pitching.

- (b) A Proell governor has equal arms of length 300mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80mm long and parallel to the axis when the radii of rotation of the balls are 150mm and 200 mm. The mass of each ball is 10 kg. and the mass of the central load is 100 kg. Determine the range of speed of the governor. **8**
5. (a) An epicyclic train of gears is arranged as shown in **figure**. How many revolutions does the arm, to which the pinions B and C are attached make ; **12**
- (i) When A makes one revolution clockwise and D makes half a revolution anticlockwise ?
- (ii) When A makes one revolution clockwise and D is stationary. The number of teeth on gear A and D are 40 and 90 respectively.



- (b) A motor cycle with rider has a mass of 250 kg. The centre of gravity of the motor cycle and the rider falls 60 cms above the ground when running straight in vertical position. Each road wheel diameter is 60 cm with mass moment of inertia of $1\text{kg}\cdot\text{m}^2$. The engine rotates 6 times faster than the wheel in the same direction and the rotating parts of the engine have a mass moment of inertia of $0.175\text{kg}\cdot\text{m}^2$. Determine the angle of inclination of the motor cycle required, if it is speeding at 80 km/hr. and rounding a curve of radius 50m. Also find the magnitude of gyroscopic couple. **8**
6. (a) Draw the displacement, velocity and acceleration v/s cam angle diagram for the follower moving with SHM during outward and return stroke for the following data, follower advances through a distance of 50mm in $1/3$ revolution of cam, take rest for a period of $1/12$ of revolution, return to its initial position in $1/6$ of revolution and then takes rest for the remaining part of the revolution. Cam shaft runs at a speed of 360 rpm. **12**

(b) Define and explain the following terms relating to governors :-

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(i) Stability.

(ii) Sensitiveness

(iii) Isochronism

(iv) Hunting

7. Write short notes on (any **four**) :-

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(a) Classification of cams.

(b) Reverted gear train.

(c) Differentiate between plate clutch and cone clutch.

(d) Prony brake dynamometer.

(e) Gyroscopic effect on sea vessel.
