UNIT -I

PRECESSION

THEORY QUESTIONS

1) What do you understand by Gyroscopic Couple? Derive a formula for its magnitude?

2) Explain the effect of the Gyroscopic couple on the reactions of Four Wheels of a vehicle negotiating a curve?

3) How do the effects of gyroscopic couple and Centrifugal force make the rider of a 2 wheeler tilt on one side? Derive a relation for limiting speed of the vehicle?

4) Discuss the Gyroscopic effect on Sea vessels?

5) What do you mean by Spin, precession & Gyroscopic Planes?

NUMERICAL QUESTIONS:

1. An aero plane makes a complete half circle of 50m radius, towards left when flying at 20kmph. The rotary engine and the propeller of the plane has a mass of 400kg with a radius of gyration of 300mm the engine runs at 2400 rpm clock wise when viewed from rear find the gyroscopic couple on the air craft and state its effect on it what will be the effect, if the aero plane turns to right instead of left.
2. Repeat the above problem when engine runs at 2400rpm clock wise when viewed from front.
3. Repeat problem 1. When engine runs at 2400rpm anti clock wise when viewed from rear.
4. Repeat problem 1. When engine runs at 2400 rpm anti clock wise when viewed from front

Naval Ship:

5. The mass of turbine rotor of a ship is 8tons and have a radius of gyration 0.6m. It rotates at 1800rpm clock wise when looking from stern determines gyroscopic effect in the following cases.

i)If the ship is travelling at 100kmph steers to left in curve of 75m radius ii) if the ship is pitching and bow is descending with maximum velocity. The pitching is SHM the periodic time being 20 seconds and the total angular movement between extreme positions is 10^0 iii) if the ship is rolling and at a certain instant has an angular velocity of 0.03rad/sec clock wise when looking from stern In each case explain how you determine the direction in which the ship tends to move as a result of gyroscopic action

6. Each paddle wheel of a steamer has a mass of 1600kg and a radius of gyration of 1.2m. The steamer turns to port in a circle of 160m radius at 24km/hr. the speed of the paddle being 90 rpm find the magnitude and effect of gyroscopic couple acting on steamer.
7. The turbine rotor of a ship has a mass of 20tons and radius of gyration of 0.75m. its speed is 2000rpm. The ship pitches 6^0 above and below the horizontal position. One complete oscillation takes 18 seconds and motion is simple harmonic calculate i) maximum couple tending to shear holding down bolts of turbine ii) the direction in which the bow will tend to turn when rising if the rotation of rotor is clockwise when looking from rear

Four wheeler

8. A motor car takes a bend of 30m radius at speed of 60km/ hr. Determine the magnitude of gyroscopic and centrifugal couples acting on vehicle and state the effect of each of these has on the road reactions to road wheels assume that each road wheel has a MI of 3kg-m^2 and an effective road radius of 0.4m. The rotating parts of engine and transmission are equivalent to flywheel of mass 75kg with radius of gyration of 100mm. the engine turns in clock wise direction when viewed from front. The back axle ratio is 4:1, this drive through gear box being direct. The gyroscopic effect, of half shaft at back axle is to be ignored.

   The car has mass of 1200kg and its C.G is 0.6m above the road wheel and the turn is in right hand direction if the turn is in left hand direction, all other details being un altered, which answers, if any, need modification.
9. Repeat problem no 8 if engine parts rotate in the sense rotation of wheels
10. Repeat problem no 8 if engine parts rotate in the opposite sense of rotation of wheels.

11. A rail car has a mass of 4ton there are two axle each of which together with its wheels and gearing has a total M.I of 30kg.m^2. The centre distance between the two wheels and axle is 1.5m and each wheel is of 375mm radius. Each axle is driven by motor, the speed ratio between the two being 1:3. Each motor with its gear has a M.I of 15kg.m^2 and runs in a direction opposite to that of axle C.G of car is 1.05m above rails determine limiting speed for this car, when it rounds a curve of 240m radius such that no wheels leave the rail. Consider the centrifugal and gyroscopic effects completely. Assume that no cant is provided to outer rails

12. A four wheeler trolley car of total mass 2000kg running on rails of 1.6m gauge rounds a curve of 30m radius at 54km\h. The track is banked at 8^0. The wheels have an external diameter of 0.7m and each pair with axle has mass of 200kg radius of gyration for each pair is 0.3m. Height of C.G of car above wheel base is 1m. Determine, allowing for centrifugal force and gyroscopic couple action. The pressure on each rail.

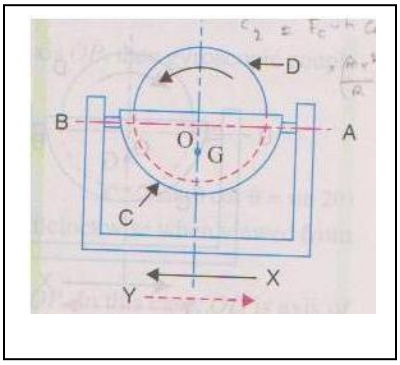
13. A pair of locomotive driving wheels with the axle, have a moment of inertia 180kg.m^2. the diameter of wheel tread is 1.8m and the distance between wheel centre's is 1.5m when the locomotive is travelling on a level track at 95km\h, defective ballasting causes one wheel to fall 6mm and to rise again in a total time of 0.1seconds. If the displacement of the wheel takes place with SHM. Find (i) the gyroscopic couple set up (ii) the reaction between the wheel and rail due to this couple

Two Wheeler:

Each road wheel of a motor cycle has a M.I of 1.5kg.m^2 rotating parts of engine of motor cycle has M.I of 0.25kg.m^2 speed of engine is 5 times speed of wheels and in the same sense. Mass of the motor cycle with its rider is 250 kg and its C.G is 0.6m above ground level. Find the angle of heel if the cycle is travelling at 50kmph and is taking a turn of 30m radius. The wheel diameter is 0.6m.

14. A uniform disc of 150 mm diameter has a mass of 5kg. It is mounted centrally in bearings which maintain its axle in a horizontal plane. The disc spins about its axle with a constant speed of 1000 rpm while the axle precesses uniformly about vertical at 60rpm. Direction of rotation is as shown in figure. If the distance between bearings

is 100mm, find the resultant reacting at each bearing due to the mass and gyroscopic effects.



15. A gyrowheel D of mass 0.5kg. with a radius of gyration of 20mm, is mounted in a pivoted frame C as shown in the axis AB of pivots passes through the centre of rotation o of the wheel , but the centre of gravity G of the frame C is rotation of the wheel is 3000 r.p.m. in the anticlockwise direction as shown.
16. The entire unit is mounted on a vehicle so that the axis AB is parallel to the direction of motion of the vehicle. If the vehicle travels at 15 m/s in curve of 50 meters radius, find the inclination of the gyrowheel from the vertical, when i) The vehicle moves in the direction of the arrow 'X' taking a left hand turn along the curve, and ii) the vehicle reverse at the same speed in the direction of arrow 'Y' along the same path.
17. A shaft carries a uniform thin disc of 0.6m diameter and mass 30kg. the disc is out of truth and makes an angle of 1^0 with a plane at right angles to the axis of the shaft . find the gyroscopic couple acting on the bearing when the shaft rotates at 1200 r.p.m
18. A racing motor cyclist travels at 140km/h round a curve of 120m radius measured horizontally. The cycle and rider have mass of 150kg and their centre of gravity lies at 0.7m above the ground level when the motor cycle is vertical. Each wheel is 0.6 m in diameter and has moment of inertia about its axis of rotation1.5kg-m^2. The engine has rotating parts whose moment of inertia about their axis of rotation is 0.25kg- m^2 and it rotates at five times the wheel speed in the same direction. Find:1. The correct angle of banking of the track so that there id no tendency to side slip, and 2. The correct angle of inclination of the cycle and rider to the vertical

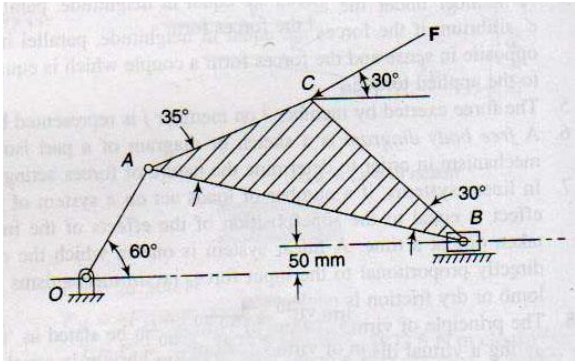
STATIC AND DYNAMIC FORCE ANALYSIS OF PLANAR MECHANISMS

Theory questions:

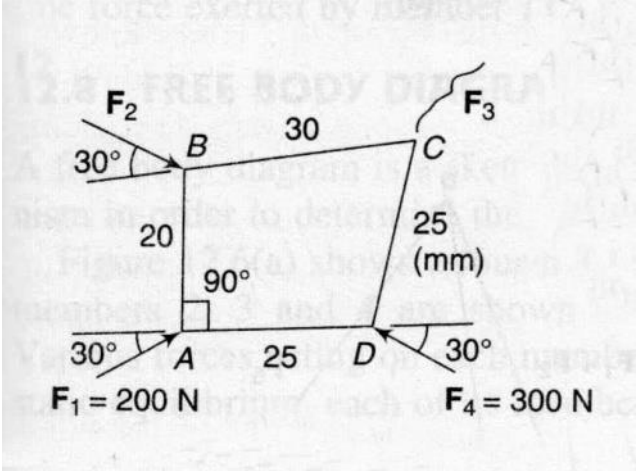
1. What do you mean by applied and constraint forces? Explain.
2. What are conditions for a body to be in equilibrium under action of two forces, three forces and two forces and a torque?
3. What are free body diagrams of a mechanism? How are they helpful in finding various forces acting on various members of the mechanism?
4. Define and explain superposition theorem as applicable to a system of forces acting on a mechanism.
5. State and explain D'Alembert's principle.
6. What do you mean by equivalent offset inertia force? Explain.
7. Derive an expression for velocity and acceleration of piston and angular acceleration of connecting rod.
8. What do you mean by piston effort and crank effort?

Numerical Problems:

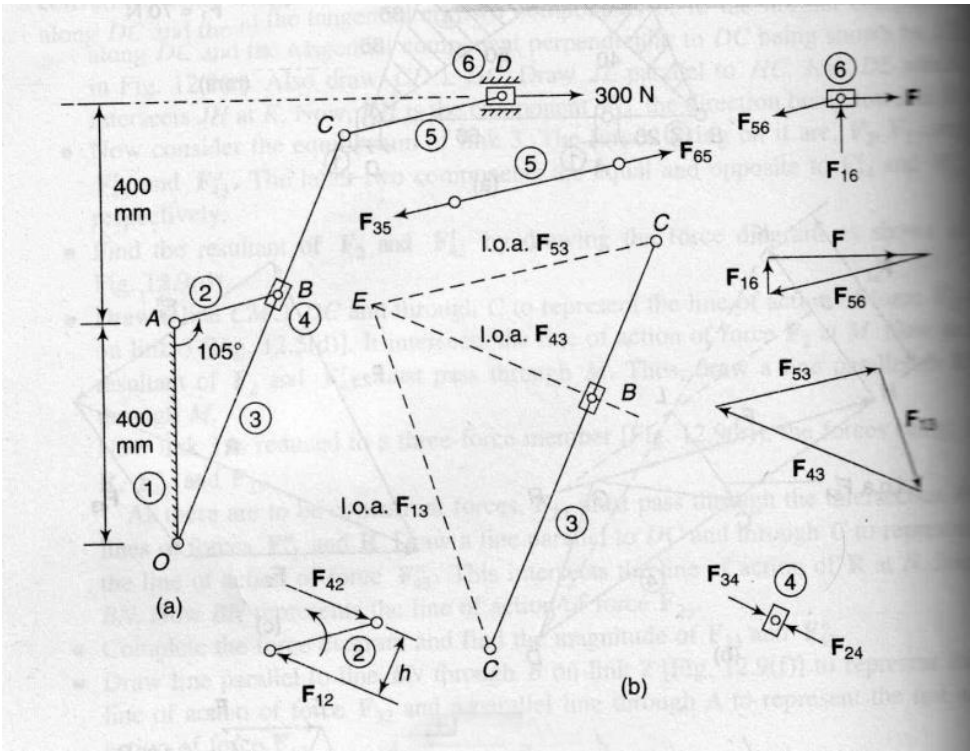
1. A four link mechanism with the following dimensions is acted upon by a force of 80 angle 150^o N on link DC. AD=50mm; AB=40mm, BC=100mm, DC=75mm, DE=35mm. Determine the input torque 'T' on the link AB for the static equilibrium of the mechanism for the given configuration i.e. Angle DAB=120^o
2. For the mechanism shown in fig, find the required input torque for the static equilibrium. Take OA=250mm, AB=650mm and F=500N.



3. Fig. shows a quaternary link 'ABCD' under the action of forces F1, F2, F3, and F4 acting at A, B, C and D respectively. The link is in static equilibrium. Determine the magnitude of forces F2 and F3 and the direction of F3



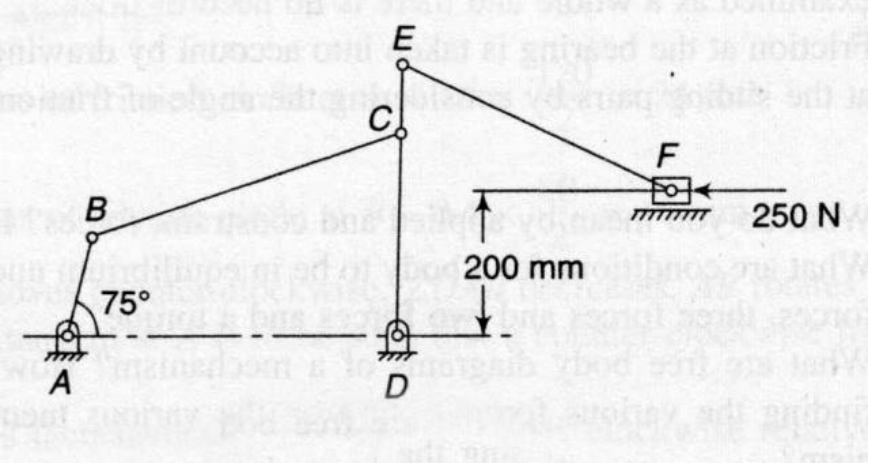
4. For static equilibrium of quick return mechanism shown in fig., determine the input torque ‘T2’ to be applied on link ‘AB’ for a force of 300N on slider D. take OA=400mm, AB=200mm, OC=800mm, CD=300mm.



5. Determine the required input torque on the crank of a slider-crank mechanism for the static equilibrium when the applied piston load is 1500 N. the lengths of the crank and the

connecting rod are 40mm, and 100mm, respectively and the crank has turned through 45^0 from the inner-dead centre.

6. For static equilibrium of mechanism shown in fig., find required input Torque. Take AB=150mm, BC=AD=500mm, DC=300mm, CE=100mm and EF=450mm.



7. In a four-link mechanism ABCD, the link AB revolves with an angular velocity of 10 rad / S and angular acceleration of 25 rad / S^2 at the instant when it makes angle of 45^o with AD, the fixed link. The lengths of the links are:

   AB = CD = 800mm, BC = 1000mm and AD = 1500mm.

   The mass of the links is 4 kg / m length. Determine the torque required to overcome the inertia forces, neglecting the gravitational effects. Assume all links to be of uniform cross-sections.

8. The effective steam pressure on the piston of a vertical steam engine is 200 KN/m^2 N when the crank is 40^0 from the inner-dead centre on the down stroke. The crank length is 300 mm and the connecting rod length 1200 mm. the diameter of the cylinder is 800 mm. what will be the torque on the crankshaft if the engine speed is 300 rpm and the mass of the reciprocating parts 250 kg?
9. The length of the connecting rod of a gas engine is 500 mm and its centre of gravity lies at 165 mm from the crank pin centre. The rod has a mass of 80 kg and a radius of gyration of 182 mm about an axis through the centre of mass. The stroke of piston is 225 mm and the crank speed is 300 rpm. Determine the inertia force on the crankshaft when the crank has turned(a) 30^o and (b) 135^o from the inner-dead centre. (302.3N.m; 226.7N.m)

UNIT-2
FLYWHEEL AND TURNING MOMENT DIAGRAM

THEORY QUESTIONS:

1) Write short notes on turning moment diagram of (i) Double acting steam engine (ii) 4-stroke engine
2) Write short notes on
   (i) Co-efficient of fluctuation of speed (ii) Max fluctuation of energy
3) What is the function of a flywheel? How does it differ from that of governor?
4) Derive an equation for maximum fluctuation of energy in Flywheel of Punching press?
5) Derive the expression for the acceleration of the piston of a reciprocating engine

NUMERICAL QUESTIONS:

1. A vertical double acting steam engine develops 75kw at 250rpm maximum fluctuation of energy is 30% of work done per stroke maximum and minimum permissible speeds are not to vary more than 1% on either side of mean speed .Find the mass of the flywheel if the radius of gyration is 0.6m also determine angular acceleration of flywheel and kinetic energy of flywheel after 10 seconds from start.

2. The turning moment diagram for a multi cylinder engine has been drawn to scale of 1mm= 4500N-m vertically and 1mm=2.4^0 horizontally the intercepted areas between output torque curve and mean resistance line taken in order from one end are 342,-23,+245,-303,+115,-232,+227,-164mm^2 when the engine is running at 150rpm if mass of fly wheel is 1000kg and total fluctuation of speed doesn't exceed 3% of mean speed, find the minimum value of radius of gyration.

   Determine suitable diameter and cross section of fly wheel rim for a limiting value of safe centrifugal stress of 7Mpa. Density of material of flywheel is 7200kg/m^2 width of the flywheel rim is to be 5 times thickness.

3. In the above problem if hub and spokes provide 5% of rotational inertia of flywheel determine suitable dimensions of flywheel rim.

4. The turning moment diagram for a 4 stroke gas engine may be assumed, for simplicity, to be represented by 4 triangles. The area of which from the line of zero pressure are as follows.

   Expansion stroke = 3550mm^2 , exhaust stroke = 500mm^2, suction stroke = 350mm^2, compression stroke= 1400mm^2, each mm^2 represents 3N-m assuming the resisting torque to be uniform find the mass of the rim of the flywheel required to keep mean speed 200rpm within +or- 2% . mean radius of rim may be taken as 0.75m also determine crank positions for minimum and maximum speed.

5. A single cylinder single acting four stroke cycle gas engine develops 20kw at 250rpm the work done by the gas during expansion stroke is 3 times work done on the gas during the compression stroke work done on suction and exhaust strokes may be neglected if the flywheel has a mass of 1.5tons and has a radius of gyration of 0.6m, find the cyclic fluctuations of energy and coefficient of fluctuation of speed

6. A shaft fitted with a flywheel rotates at 250rpm and drives a machine, torque of the machine varies in a cyclic manner over a period of 3 revolutions the torque raises from 750N-m to 3000N-m uniformly during half revolution and remains constant for the following revolution. It then falls uniformly to 750N-m during next ½ revolution and remains constant for the following revolution the cycle being repeated thereafter determine power required to drive the machine and percentage fluctuation m=500 and k=0.6.
   Also determine the cross –sectional dimension of the rim if rim contributes 92% of the rotational inertia of the flywheel and allowable tensile stress of the rim material.

7. During forward stroke of piston of double acting steam engine, the turning moment has a maximum value of 2000N-m when crank makes an angle of 80^0 with IDC. During backward stroke, the maximum turning moment is 1500N-m when crank makes an angle of 80^0 with ODC the turning moment diagram for the engine may be assumed for simplicity to be represented by two triangles.
   If the crank makes 100rpm and radius of gyration of flywheel is 1.75m, find coefficient of fluctuation of energy and mass of flywheel to keep speed within +or -0.75% of mean speed also determine the crank angle at which speed has its minimum and maximum value.

8. An Otto cycle engine develops 50kw at 150rpm with 75 explosions per minute the change of speed from the commencement to end of power stroke must not exceed 0.5% of mean speed on either side find the mean diameter of flywheel and a suitable rim cross section having width four times the depth so that hoop stress doesn't exceed 4mpa assume that flywheel stores 16/15 times the energy stored by rim and work done during power stroke is 1.4 times work done during the cycle take density(ρ) of rim material is 7200 kg/m^3

9. The Torque delivered by a two stroke engine is represented by $T=(1000+300\sin 2\theta-500\cos 2\theta)$N-m. When '$\theta$' is the angle turned by crank from inner dead centre. Engine speed is 250rpm mass of the flywheel is 400kg and radius of gyration is 400mm determine the (i) power developed (ii) total % of fluctuation of speed (iii) angular acceleration of flywheel when crank has rotated through 60^0 from IDC(iv) maximum angular acceleration and retardation of flywheel.

10. The torque developed by a two stroke engine is represented by $T=(1200+1400\sin\theta+210\sin 2\theta+21\sin 3\theta)$N-m where '$\theta$' is the angle turned by the crank from IDC. Engine speed is 210 rpm. Determine power of the engine and the minimum

mass of flywheel if its radius of gyration is 800mm and maximum fluctuation of speed is to +or- 1.5% of the mean.

11. A three cylinder single acting engine has its cranks at 120^0 the turning moment diagram for each cycle is a triangle for the power stroke with a maximum torque of 60N-m at 60^0 after TDC of the corresponding crank there is no torque on the return stroke. Engine runs at 400rpm determine (i) power developed (ii) C_s if the mass of flywheel is 10kg and radius of gyration is 88mm (iii) coefficient of fluctuation of energy (iv) maximum angular acceleration of flywheel.

12. A constant torque of 4kw motor drives a riveting machine. A flywheel of mass 130kg and radius of gyration 0.5m is fitted to riveting machine each riveting operation takes 1 second and requires 9000n-m of energy. If speed of flywheel is 420rpm before riveting find (i) the fall in speed of flywheel after riveting and (ii) the number of rivets fitted per hour.

13. A machine has to carryout punching operation at the rate of 10holes per minute. It does 6KN-m of work per mm^2 of sheared area in cutting 25mm diameter hole in 20mm thick plate. A flywheel is fitted to the machine shaft which is driven by a constant torque. Fluctuation of speed is between 180 and 200rpm. The actual punching takes 1.5seconds. Frictional losses are equivalent to 1/6 of work done during punching find (i) power required to drive the punching machine (ii) mass of flywheel, if radius of gyration of wheel is 0.5m

UNIT-3
CLUTCHS BRAKES AND DYNAMOMETERS:

THEORY QUESTIONS:

1) What is a brake & what is the difference between a brake and a Clutch?

2) What is meant by self-locking and self energizing of brake?

3) Describe the working of a band & block brake with the help of a neat sketch .Deduce the relation for ratio of tight & slack side tensions?

4) Derive an expression for braking torque of internal expanding shoe brake with the help of a neat sketch?

5) What is a dynamometer? Differentiate between absorption dynamometer and Transmission dynamometer?

6) Describe with neat sketch the epicyclic train dynamometer?

7) Establish a formula for the maximum torque transmitted by a single plate clutch of external and internal radii r_1, and r_2 , If the limiting co-efficient of friction is μ and the axial spring load is W .

Assuming (i) uniform pressure condition (ii) uniform wear condition

NUMERICAL PROBLEMS:

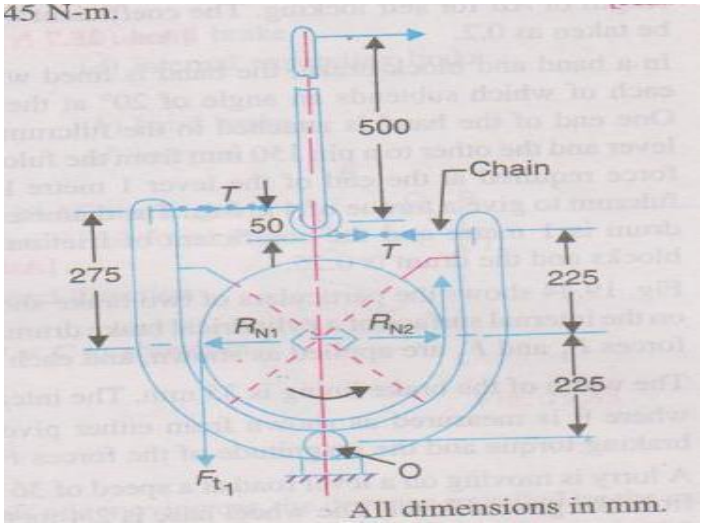
Single block brake:-

1. A single block brake as shown in fig has the drum diameter of 250mm. the angle of contact is 90^0 and coefficient of friction between drum and lining is 0.35. if the operating force of 650N is applied at the end of the lever determine the torque that may be transmitted by the block brake assuming drum rotation in
    i. Clock wise direction
    ii. ACW direction.
2. In the above problem determine distance between hinge point and centre point of brake drum (axis) when brake is self locking.
3. A bicycle and rider, travelling at 12kmph on a level road has a mass of 105kg a brake is applied to rear wheels which is 800mm in dia pressure on the brake is 800N and coefficient of friction is 0.06. Find the distance covered by bicycle and number of turns of its wheel before coming to rest.
4. A brake drum of 440mm in dia is used in a braking system as shown in fig. The brake lever is inclined at an angle of 20^0 with the horizontal a vertical force of 400N magnitude in applied at the end of lever. Coefficient of friction is 0.35. Brake drum has a mass of 160kg and it rotates at 1500rpm. Determine (i). Braking torque. (ii). No. Of revolutions

made by the drum and the time taken before coming to rest from the instant the brake is applied.

Double Block brake:-

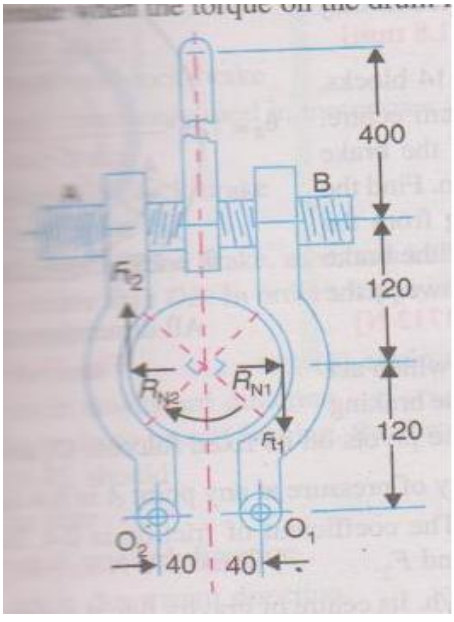
5. The layout and dimensions of the block are shown in the figure given below. Diameter of wheel is 300mm and contact angle for each block is 90^0 if coefficient of friction between brake lining and wheel is 0.4 and torque on wheel is 30N-m, find the force 'P' on the operating arm required to set the brake for anti clockwise rotation of wheel. Also determine width of the shoe if bearing pressure on lining material is not to exceed $0.28N/mm^2$.



6. The arrangement of a transmission brake is shown in fig. the arms are pivoted at 'o_1' and 'o_2' and when force is applied at the end of the hand lever, the screw 'AB' rotates. The left and right hand threads working in nuts on the ends of the arm moves the arms together and thus apply the brake. The force on hand lever is applied 400mm from axis of the screw. The drum is 240mm in dia and angle subtended by each is $90^{0.}$ The screw has '6' square threads with a mean dia of 20mm and a lead of 55mm assuming coefficient of friction for braking surfaces as 0.3 and for threads is 0.15, determine the force on the hand lever required to set the brake when torque on drum is 245N-m

Simple Band brake:-

7. A simple band brake is operated by a lever of length 500mm. the brake drum has a diameter 500mm and brake band embraces 5/8 of circumference. One end of the brake is attached to fulcrum of the lever while the other end is attached to a pin on the lever 100mm from fulcrum. If the effort applied to of lever is 2KN and coefficient of friction is



of

end

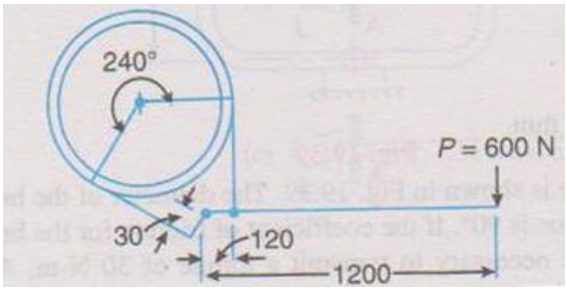
0.25

find the maximum braking torque of the drum.

8. A simple band brake is applied to a shaft carrying a flywheel of 250kg mass and of radius of gyration of 300mm. shaft speed is 200rpm drum diameter is 200mm and μ=0.25 determine (i)brake torque when a force of 120N is applied at lever end (ii) no. of turns of fly wheel before it comes to rest (iii) time taken by flywheel to come to rest (iv) width of steel band of 3mm thick if maximum tensile stress is not to exceed $50N/m^2$
9. A simple band brake is applied to a drum of 560mm dia which rotates at 240rpm. Angle of contact of band is 270^0 one end of band is fastened to a fixed pin and other end to brake lever at a point 140 mm from the fixed pin. Brake lever is 800mm long and is placed perpendicular to diameter that bisects angle of contact. Take μ as 0.3 determine the necessary pull at end of the lever to stop the drum if 40kw of power is being absorbed. Also find width of the band if its thickness is 3mm and maximum tensile stress is limited to $40N/mm^2$.

Differential band brake:-

10. A differential band brake acting on ¾ of circumference of a drum of 450mm dia, is to provide a braking a torque of 225N-m one end of band is attached to a pin 100mm from fulcrum of lever and other end to another pin 25mm from fulcrum on other side of it where operating force is also acting if operating force is applied at 500mm from fulcrum and μ= 0.25 find two values of operating force corresponding to two directions of rotation of drum.
11. A differential band brake is shown in figure. Diameter of drum is 800mm coefficient of friction between band and drum is 0.3 and angle of embrace is 240^0 when a force of 600N is applied at free end of lever find



OA=30mm

OB=120mm

OC=1200mm

(i) Maximum and minimum force in band (ii) torque which can be applied by brake (iii) determine value of 'OA' for brake to be self locking.

12. In a winch the rope supports a load 'w' and is wound around a barrel of 450mm dia A differential band brake acts on a drum of 800mm dia which is keyed to same shaft as the barrel the two ends of bands are attached to pins on opposite sides of fulcrum of brake lever and at a distance of 25mm and 100mm from the fulcrum. Angle of lap of brake band is 250^0 and μ=0.25 what is the maximum load 'w' which can be supported by brake when a force of 750N is applied to lever at a distance of 3000mm from fulcrum.

Band block brake:-

13. In a band and block brake, the band is lined with 14 blocks each of which subtends an angle of 20^0 at drum centre one end of band is attached to fulcrum of brake lever and the

other to a pin 150mm from fulcrum. Find the force required at end of lever I m long from fulcrum to give a torque of 4KN-Mdiameter of brake drum is 1m, μ=0.25.

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

Internal expanding shoe brake:-

15. Fig. shows particulars of two brake shoes which act on internal surface of cylindrical brake drum. Braking forces F_1 and F_2 are applied as shown and each shoe pivots on fixed fulcrum O_1 and O_2 . width of brake lining is 35mm intensity of pressure at any point A is $0.4\text{Sin}\theta$ N/mm^2 where θ is measured as shown from each pivot . μ=0.4 determine braking torque and magnitude of forces 'F_1' and 'F_2'.

Braking Vehicle:-

16. The following data refer to a car in which brakes are applied to front wheels. Wheel base=2.8m; centre of mass from rear axle= 1.3m; centre of mass above ground level=0.96m, μ=0.4
    If speed of car is 40kmph, find the distance travelled by car before coming to rest when the car (i) moves up an inclined plane '1' in '16' (ii) moves down the plane '1' in '16' (iii) moves on a level track.

CLUTCHES (Disc):-

17. A multiple plate clutch has three pairs of contact surface. Outer and inner radius of contact surfaces are 100mm and 50mm respectively. Maximum axial spring force is limited to 1KN. If μ=0.35, assuming uniform wear find power transmitted by clutch at 1500rpm.
18. A car engine has its rated output of 12kw maximum torque developed is 100N-m. The clutch used is of single plate type having two active surfaces axial pressure is not to exceed 85kn/m^2 external diameter of friction plate is 1.25 times internal diameter determine dimension of friction plate and axial force exerted by spring . take μ=0.3
19. A rotor is driven by a coaxial motor through a single plate clutch both sides of plate being effective. External and internal diameters are 220mm and 160mm and total spring load pressing plates together is 570N. the motor armature and shaft has mass of 800kg with an effective radius of gyration of 200mm. the rotor has a man of 1300kg with an effective radius of gyration of 180mm. Take μ=0.35. The driving motor is brought up to a speed of 1250rpm when current is switched off and clutch is suddenly engaged determine (i) find speed of motor and rotor (ii) time to reach this speed (iii) kinetic energy lost during period of slipping?How long would the slipping continue if it is assumed that the contact resisting torque of 60 N-M was present? If instead of a resisting torque ,it is assumed that a contact driving torque of 60 N-m is maintained on armature shaft what would be slipping time?

Cone clutch:-

20. A cone clutch is to transmit 7.5 kw at 900 rpm. The cone has a face angle of 12^0 width of the face is half of the mean radius and normal pressure between contact faces is not to

exceed 0.09N/mm^2. Assuming uniform wear and μ=0.2 find main dimensions of clutch and axial force required to engage clutch.

21. A cone clutch with a cone angle of 20^0 is to transmit 7.5Kw at 750rpm. Normal intensity of pressure between contact surfaces is not to exceed 0.12N/mm^2. Take μ=0.2. if face width is 1/5 of mean diameter find (i) main dimension of clutch (ii) axial force required while running centrifugal

clutch:-

22. A centrifugal friction clutch has a driving member consisting of a spider carrying four shoes which are kept from contact with the clutch case by means of flat springs until increase of centrifugal force overcomes the resistance of springs
    Determine necessary mass of each shoe if 22.5kw is to be transmitted at 750rpm with engagement beginning at 75% of running speed. Inside dia of drum is 300mm radial distance of C.G of each shoe from shaft axis 125mm take μ=0.25.