# DYNAMICS OF MACHINERY QUASTION BANK

**UNIT 1**

1. Write simple notes on Friction Circle.
2. An engine developing 22kW at 1000 rpm is fitted with a cone clutch having meandiameter of 300mm. The cone has a face angle of 120. If the normal pressure on theclutch face is not to exceed 0.09 N/mm2 and the coefficient of friction is 0.2,determine (a) the face width of the clutch, and (b) the axial spring force necessaryto engage the clutch.
3. Which of the two assumptions-uniform intensity of pressure or uniform rate ofwear, would you make use of in designing friction clutch and why?A cone clutch with cone angle 200 is to transmit 7.5 kW at 750 rpm. The normal intensity of pressure between the contact faces is not to exceed 0.12N/mm2. The coefficient of friction is 0.2. If face width is 1/5th of meandiameter, find: The main dimensions of the clutch and Axial force required while running.
4. Explain about film lubrication.
5. The force required just to move a body on a rough horizontal surface by pulling is 320N inclined at 300 and by pushing 380N at the same angle. Find the weight of the body and coefficient of friction.
6. Derive the expression for the torque transmitting capacity of a single plate clutch by considering uniform wear.
7. The inner and outer radii of a single plate clutch are 40mm and 80mm respectively.Determine the maximum, minimum and average pressure when the axial force is 3kN.
8. Derive an expression for efficiency of an inclined plane when a body moves up the plane.
9. A shaft has a number of collars, external diameter of each is 35 cm and the shaft

diameter is 20 cm. Assuming uniform intensity of pressure as 30 N/cm2 and coefficient of friction as 0.06. Determine the power absorbed in overcoming friction when the shaft runs at 100 r.p.m and carries a load of 120 kN. Also find the number of collars required.

1. A conical pivot bearing supports a vertical shaft of 200mm diameter. It is subjected to load of 30kN. The angle of cone is 1200 and the coefficient of friction is 0.025. Find the power lost in friction when the speed is 140 rpm. Assuming (i). Uniform wear (ii).Uniform pressure.

# UNIT 2

1. Explain with a neat sketch the functioning of a belt transmission dynamometer.
2. Describe epicyclic train dynamometer with the help of a sketch.
3. The layout and dimensions of a double shoe brake . The diameter of the brake drum is 300 mm and the contact angle for each shoe is 90°. If the coefficient of friction for the brake lining and the drum is 0.4, find the spring force necessary to transmit a torque of 30 N-m. AlsoN determine the width of the brake shoes, if the bearing pressure on the lining material is not to exceed 0.28 N/mm2.
4. A simple band brake is operated by a lever of length 500 mm. The brake drum has a diameter of 500mm and the brake band embraces 5/8 of the circumference. One end of the band is attached to thefulcrum of the lever while the other end is attached to a pin on the lever 100 mm from the fulcrum. Ifthe effort applied to the end of the lever is 2 kN and the coefficient of friction is 0.25, find the maximum braking torque on the drum.
5. A differential band brake acting on the 3/4 th of the circumference of a drum of 450 mm diameter, is to provide a braking torque of 225 N-m. One end of the band is attached to a pin 100 mm from the fulcrum of the lever and the other end to another pin 25 mm from the fulcrum on the other side of it where the operating force is also acting. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, find the two values of the operating force corresponding to two directions of rotation of the drum.
6. In a band and block brake, the band is lined with 14 blocks, each of which subtends an angle of 20° at the drum centre. One end of the band is attached to the fulcrum of the brake lever and the other to a pin 150 mm from the fulcrum. Find the force required at the end of the lever 1 metre long from the fulcrum to give a torque of 4 kN-m. The diameter of the brake drum is 1 metre and the coefficient of friction between the blocks and the drum is 0.25.
7. A lorry is moving on a level road at a speed of 36 km/h. Its centre of gravity lies at a distance of 0.6 m from the ground level. The wheel base is 2.4 metres and the distance of C.G. from the rear wheels is 0.9 m. Find the distance travelled by the car before coming to rest when brakes are applied, (a) to the rear wheels, (b) to the front wheels, and (c) to all the four wheels. The coefficient of friction between the tyres and the road surface is 0.45.

# UNIT 3

1. What is meant by Gyroscope? Differentiate ‘Natural Precession’ from ‘Forced Precession’?
2. The turbine rotor of a ship has a mass of 20 tones and a radius of gyration 0.75.Its speed is 2000 rpm.The ship pitches 6° above and below the horizontalposition .One complete oscillation takes 18 seconds and the motion is simpleharmonic. Determine(i) the maximum couple tending to shear the holding down bolt of theturbine(ii) The maximumangular acceleration of the ship duringpitching.The direction in which the bow will tend toturn while, if the rotation of therotor is clockwise whenlooking from rear.
3. What is meant by Dynamically Equivalent System.
4. Derive the expression for Gyroscopic Couple.
5. The connecting rod of a gasoline engine is 300 mm long between its centres. It has a mass of 15 kg and mass moment of inertia of 7000 kg-mm2. Its centre of gravity is at 200 mm from its small end centre. Determine the dynamical equivalent two-mass system of the connecting rod if one of the masses is located at the small end centre.
6. A disc with radius of gyration of 60mm and a mass of 4kg is mounted centrally on a horizontal axle of 80mm length between the bearings. It spins about the axle at 800rpm counter-clockwise when viewed from the right hand side bearing. The axle processes about a vertical axis at 50rpm in the clockwise direction when viewed from above.Determine the resultant reaction at each bearing due to the mass and the gyroscopic effect.
7. Define the following (i) Axis of spin (ii) Axis of precession (iii) gyroscope.
8. The turbine rotor of a ship weighs 200 kN has a radius of gyration of 0.8 m. If the ship pitches with simple harmonic motion having amplitude of 8 degrees and time period of 15

seconds, determine the maximum couple that tends to shear the holding down bolts of the turbine. Also determine the maximum acceleration of the ship during pitching.

1. A horizontal, double acting steam engine has a stroke of 300 mm and runs at 240 r.p.m. The cylinder diameter is 200 mm, connecting rod is 750 mm long and the mass of the reciprocating parts is 70 kg.The steam is admitted at 600 kN/m2 for one-third of the stroke, after which expansion takes place according to the hyperbolic law p.V = constant. The exhaust pressure is 20 kN/m2. Neglecting the effect of clearance and the diameter of the piston rod, find : 1. Thrust in the connecting rod, and 2. Effective turning moment on the crankshaft when the crank has turned through 120° from inner dead centre.
2. A small connecting rod 220 mm long between centres has a mass of 2 kg and a moment of inertia of 0.02 kg-m2 about its centre of gravity. The centre of gravity is located at a distance of 150 mm from the small end centre. Determine the dynamically equivalent two mass system when one mass is located at the small end centre. If the connecting rod is replaced by two masses located at the two centres, find the correction couple that must be applied for complete dynamical equivalence of the system when the angular acceleration of the connecting rod is 20 000 rad/s2 anticlockwise.

# UNIT 4

1. Derive the equation for the energy stored in fly wheels?
2. The turning moment diagram for a four stroke gas engine may be assumed for simplicity to be represented by four triangles, the areas of which from the line of zero pressure are as follows: Expansion stroke = 3550 mm2; Exhaust stroke = 500 mm2; Suction stroke = 350 mm2; and compression stroke = 1400 mm2. each mm2 represents 3 N-m. Assuming the resisting moment to be uniform, find the mass of the rim of a fly wheel required to keep the mean speed 200 rpm within ±2%. The mean radius of the rim may be taken as 0.75 m. Also determine the crank positions for the maximum and minimum speeds
3. Explain the terms ‘fluctuation of energy’ and ‘fluctuation of speed’ as applied to flywheels.
4. What is turning movement diagram? Mention its uses & Derive the equation K Where K=coefficient of fluctuation of speed, explain ?
5. A machine shaft running at an average speed of 360 r.p.m requires a constant torque of 1.5 kN-m during two revolutions and a constant torque of 400 N-m duringnext three revolutions and this cycle repeats. Determine the power of the motorrequired and moment of inertia of a flywheel in order that the total fluctuation of speedshall not exceed 6 percent of mean speed of 320 r.p.m.
6. The torque delivered by two stroke engine represented by T=1000+300 sin2\_-500cos\_ Nm where \_ is the angle made by the crank from IDC. The engine speed is 250 rpm. The mass of flywheel is 400 kg and radius of gyration is 400 mm. Determine (i) Total percentage of fluctuation of speed. (ii) The angular acceleration of flywheel when the crank has rotated through an angle of 60° from IDC. (iii) The maximum angular retardation of flywheel.

# UNIT 5

1. Differentiate Governor from Flywheel ?
2. The lengths of the upper and lower arms of a porter governor are 200mm and 250mm respectively. Both the arms are pivoted on the axis of rotation. The central load is 150N, the weight of the each ball is 20N and the friction of the sleeve together with the resistance of the operating gear is equivalent to a force of 30N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40° taking friction in to account. Find the range of speed of the governor.
3. Define and explain “Isochronism” relating to governors.
4. Derive the expression for the height of Proell governor.
5. Calculate the minimum speed of a proell governor, which has equal arms each 20mm and are pivoted on the axis of rotation. The mass of each ball is 4kg and the central mass on the sleeve is 20kg. The extension arms of the lower links are each 60mm long and parallel to the axis when the minimum radius of the ball is 20mm.
6. The arms of a porter governor are 35 cm long. The upper arms are pivoted on the axis of rotation while the lower arms attached to the sleeve at a distance of 4 cm from the axis of rotation. The load on the sleeve is 800 N and each ball weighs 100 N. If friction of mechanism is equivalent to a force of 50 N at the sleeve, corresponding to a radius of

rotation of 25 cm, determine, (i) equilibrium speed and (ii) speed when the sleeve has a tendency to ascend for the given configuration.

1. Define the terms controlling force and effort of a governor.
2. A porter governor carries a central load of 30 kgf and each ball weighs 4.5 kgf. The upper links are 20 cm long and the lower links are 30 cm long. The points of suspensions of upper and lower links are 5 cm from axis of spindle. Calculate, (i). The speed of the governor in rpm if the radius of revolution of the governor balls is 12.5 cm and (ii) The effort of the governor for increase of speed of 1%.
3. A loaded governor of the Porter type has equal arms and links each 250 mm long. The mass of each ball is 2 kg and the central mass is 12 kg. When the ball radius is 150 mm, the valve is fully open and when the radius is 185 mm, the valve is closed. Find the maximum speed and the range of speed. If the maximum speed is to be increased 20% by an addition of mass to the central load, find what additional mass is required.

# UNIT 6

1. Why Reciprocating Engines are partially balanced?
2. Differentiate Static Balancing from Dynamic Balancing?
3. The firing order in a 6 cylinder vertical 2-stroke in line engine is 1-4-5-2-3-6. Thepiston stroke is 100 mm and length of each connecting rod is 200 mm. Thecylinder center lines are spaced at 300 mm. In the end view, the cranks are 60oapart the mass of reciprocating parts is 100 kg per cylinder and that of rotatingparts 50 kg per crank. The engine rotates at 200 rpm. Examine the engine for thebalance of primary and secondary forces and couples. Find the maximum unbalanced forced and couples.
4. Four masses M1, M2, M3 and M4 are 200kg, 300kg, 240kg and 260kg respectively. The corresponding radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively and the angle between successive masses are 45°, 75° and 135°. Find the position and magnitude of balance mass required if its radius ofrotation is 0.25m
5. Discuss how a single revolving mass is balanced by two masses revolving in different planes.
6. The following data refer to two cylinder locomotive with cranks at 90°: Reciprocating mass per cylinder = 300 kg ; Crank radius = 0.3 m ; Driving wheel diameter = 1.8 m ; Distance between cylinder centre lines = 0.65 m ; Distance between the driving wheel central planes

= 1.55 m. Determine i) the fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 kmph, ii) the variation in tractive effort and iii) the maximum swaying couple.

1. What is the necessity of balancing? & Three masses of 8kg, 12kg and 15kg attached at radial distances of 80mm, 100mm and60mm respectively to a disc on a shaft are in complete balance. Determine the angular positions of the masses of 12kg and 15kg relative to 8kg mass Explain the balancing of outside cylinder locomotive. Develop the expressions for hammer blow, swaying couple and variation in an tractive effort.
2. A three cylinder radial engine driven by a common crank has the cylinders speed at 1200.The stroke is 100mm, length of the connecting rod 200mm and the reciprocating mass per cylinder 1.5kg. Calculate the primary and secondary forces at crank shaft speed of 1500rpm.
3. Four masses A, B, C and D rotating in different planes are to be arranged to give complete balance. Planes containing B and C are 60 cm apart. The masses B and C are at right angles to each other while the mass D makes angles of 150 degrees and 240 degrees respectively with the masses B and C in the same sense. Determine the position of the planes containing the masses A and D and the magnitude and angular position of the mass A, if the mass of B is 220 kg at a radius of 60 cm, the mass of C is 350 kg at a radius of 30 cm, the mass of D is 240 kg at a radius of 50 cm and the mass A is at a radius of 40 cm.