Code No: 2320304 **Set No. 1**

III B.Tech II Semester Regular Examinations, April/May 2009
DYNAMICS OF MACHINERY
(Common to Mechanical Engineering, Mechatronics, Production Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. For the reciprocating engine mechanism following data is given:
   Length of crank=10cm
   Length of connecting rod=30cm
   Distance of centre of gravity of link 2 from main bearing =5cm
   Distance of centre of gravity of link 3 from crank pin =15cm
   Crank angle from line of stroke $=60^0$
   Crank speed=1800rpm counter clock wise
   Mass of link 2=2.5kg
   Mass of link 3=3.2kg
   Mass of link 4=4kg
   Mass moment of inertia of link 2 $=60 kgcm^2$
   Mass moment of inertia of link 3 $=500 kgcm^2$
   Determine the magnitude and direction of inertia of forces of links 2,3 and 4. [16]

2. (a) Derive the expression for the force required to move the body up through the inclined plane.
   (b) A 150 mm diameter valve, against which a steam pressure of 2 MN/m^2 is acting, is closed by means of a square threaded screw 50 mm in external diameter with 6 mm pitch. If the coefficient of friction is 0.12, find the torque required to turn the handle. [6+10]

3. Write short notes on the following:
   (a) Cone clutch.
   (b) Double shoe brake.
   (c) Absorption dynamometer. [16]

4. (a) State how the size of the flywheel calculated.
   (b) A single cylinder four stroke oil engine develops 15kW at a speed of 400 rpm and drives a machine at 750 rpm. the engine shaft carries a flywheel with a moment of inertia of 114 kg-m^2.The machine shaft also carries a flywheel with the moment of inertia of 8 kg-m^2. If the fluctuation of energy is 80If the coefficient of fluctuation of speed is required to be lowered to a total value of 1%, what is the moment of inertia of the additional rotating mass to be fitted to the machine shaft? [6+10]

5. A governor of the Proell type has each arm 250 mm long. The pivots of the upper and lower arms are 25 mm, from the axis. The central load acting on the sleeve has a mass of 25 kg and each rotating ball has a mass of 3.2 kg when the governor sleeve is in mid position, the extension link of the lower arm is vertical and the radius of path of rotation of the masses is 175 mm. the vertical height of the governor is 200 mm. if the speed of governor is 160 rpm, when in mid position, find:
   (a) Length of the extension link and
   (b) Tension in the upper arm. [16]

6. A, B, C and D are four masses carried by a rotating shaft at radii of 10 cm, 12.5 cm, 20 cm and 15 cm respectively. The planes in which the masses revolve are 60 cm apart and the mass of B, C and D are 10 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular setting of the four masses so that the shaft is in complete balance. (Assuming the plane of mass as the reference plane.) [16]

7. The following data relate to a single cylinder reciprocating engine.
   Mass of reciprocating parts = 40 kg
   Mass of revolving parts = 30 kg at 180mm radius.
   Speed = 150 rpm
   Stroke length = 350 mm
   If 60% of the reciprocating parts and all the revolving parts to be balanced, determine the
   (a) Balanced mass required at a radius of 320 mm.
   (b) The unbalanced force when the crank has turned 450 from the top dead center. [16]

8. (a) Determine natural frequency of the pendulum system.
   (b) Define:
      i. Free vibrations
      ii. Forced vibrations
      iii. Damping. [16]

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Code No: 2320304 **Set No. 2**

III B.Tech II Semester Regular Examinations, April/May 2009
DYNAMICS OF MACHINERY
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) What are free body diagrams of a mechanism? How are they helpful in finding various forces acting on various members of a mechanism?
   (b) The following data relate to a four link mechanism:

Link	Length	Mass	MOI about an axis through centre of Mass
AB	60mm	0.2Kg	80Kg mm^2
BC	200mm	0.4Kg	1600Kg mm^2
CD	100mm	0.6Kg	400Kg mm^2
AD	140mm		

   AD is the fixed link. The centre of mass for the links BC and CD lie at their mid points where as the centre of mass for link AB lies at A. Find the drive torque in the link AB at the instant when it rotates at an angular velocity of 47.5 Rad/s counter clockwise and angle DAB 135^0. Neglect gravity effects. [4+12]

2. (a) What do you mean by friction circle? Explain.
   (b) A load of 10kN is raised by means of a screw jack, having a screw threaded screw of 12mm pitch and of diameter 50 mm. If a force of 100 N is applied at the end of a lever to raise the load, what should be the given length of the lever used? Take coefficient of friction =0.15. What should be the mechanical advantage obtained? State whether the screw is self locking. [6+10]

3. (a) Derive the expression for the torque transmitting capacity of a cone clutch by considering uniform wear.
   (b) A cone clutch is to be designed to transmit a torque of 1000rpm. The outside and inside radii are 75mm and 45mm respectively. The semi cone angle is 15 degrees. The coefficient of friction of friction lining is 0.35. Using the uniform wear theory, find the required clamping force. If the friction lining wears out by 0.4mm, what reduction in the torque capacity of the clutch. [4+12]

4. (a) What is the function of the flywheel in a punching press?
   (b) For a certain engine having an average speed of 1200 rpm. A flywheel approximated as a solid disc, is required for keeping the fluctuation of speed within 2% about the average speed. The fluctuation of kinetic energy per cycle is found to be 2 kJ. What is the least possible mass of the flywheel if its diameter is not to exceed 1m? [4+12]

5. In a Porter governor, the arms and links are each 25 cms long and intersect on main axis. Each ball weighs 3kgf and the central load 27.25 kgf. The sleeve is in the lowest position when the arms are inclined at 27^0 with the axis. The lift of the sleeve is 5 cm. What is the force of the friction at the sleeve if the speed at the beginning of ascent at the lowest position is equal to the speed at the beginning of descent from the highest position? [16]

6. Four masses A, B, C and D are to be completely balanced. The planes centering masses B and C are 30 cm apart. The angle between planes containing masses B and C is 90^0. C and B make angles of 120^0 and 210^0 respectively with D in the same sense. Find:

   (a) The weight and angular position of mass A.

   (b) The position of planes A and D. [16]

   Details of rotating masses.

Mass	Weight (kg)	Radius (cm)
A	W	18
B	30	24
C	50	12
D	40	15

7. The following data relate to a single cylinder reciprocating engine.
   Mass of reciprocating parts = 40 kg
   Mass of revolving parts = 30 kg at 180mm radius.
   Speed = 150 rpm
   Stroke length = 350 mm
   If 60% of the reciprocating parts and all the revolving parts to be balanced, determine the

   (a) Balanced mass required at a radius of 320 mm.

   (b) The unbalanced force when the crank has turned 450 from the top dead center. [16]

8. A shaft 50 mm diameter and 3 m long . It is simply supported at the ends and carries three masses 100 kg, 120 kg and 80 kg at 1.0 m, 1.75 m and 2.5 m respectively from the left support. Taking E = 20 GN/m^2. Find the frequency of transverse vibrations using Rayleigh's method. [16]

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Code No: 2320304 **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. For the reciprocating engine mechanism following data is given:
   Length of I/P crank=25cm
   Length of connecting rod=30cm
   Length of O/P crank=30cm
   Base link length=50cm
   Crank angle=60^0
   Crank speed=2500rpm counter clock wise (261.8 rad/sec)
   Angular acceleration of the crank=0
   Mass of link 2=2.5kg
   Mass of link 3=1kg
   Mass of link 4=2.5kg
   Mass moment of inertia of link 2 =225kgcm^2
   Mass moment of inertia of link 3 =120kgcm^2
   Mass moment of inertia of link 4 =225kgcm^2
   C.G of all the links is located at their mid points.
   Determine the inertia of the couple of the coupler and driven link. [16]

2. (a) What do you mean by friction circle? Explain.
   (b) A load of 10kN is raised by means of a screw jack, having a screw threaded screw of 12mm pitch and of diameter 50 mm. If a force of 100 N is applied at the end of a lever to raise the load, what should be the given length of the lever used? Take coefficient of friction =0.15. What should be the mechanical advantage obtained? State whether the screw is self locking. [6+10]

3. Write short notes on the following:
   (a) Prony brake dynamometer.
   (b) Rope brake dynamometer.
   (c) Cone clutch. [16]

4. (a) Derive the expression for energy stored in a flywheel.
   (b) An oil Engine working on four stroke cycle has a Power of 30kW.Its speed is 300 rpm Permissible fluctuation of speed is ± 3 % of mean. The ratio of work done during power stroke to the work done during compression stroke is 2.5. Assuming that work done during suction and exhaust strokes as negligible and assuming constant resistance, find

i. Energy stored by the flywheel, and
ii. Moment of inertia of the flywheel required. [6+10]

5. A governor of the Proell type has each arm 250 mm long. The pivots of the upper and lower arms are 25 mm, from the axis. The central load acting on the sleeve has a mass of 25 kg and each rotating ball has a mass of 3.2 kg when the governor sleeve is in mid position, the extension link of the lower arm is vertical and the radius of path of rotation of the masses is 175 mm. the vertical height of the governor is 200 mm. if the speed of governor is 160 rpm, when in mid position, find:
   (a) Length of the extension link and
   (b) Tension in the upper arm. [16]

6. A shaft 3 m span between the bearings carries two masses of 5 kg and 10 kg acting at the extremities of the arms 0.45 m and 0.6 m long respectively. The planes in which the masses rotate are 1.2 m and 2.4 m respectively from the left hand bearing and the angle between the arms is 60^0. If the speed of rotation is 100 rpm. Find the displacing force on the two bearings of the machine. If the masses are balanced by two additional rotating masses acting at a radius 0.3 and placed 0.3 m from each bearing, Estimate the magnitude of the two balanced masses and the angles at which they may be set with respect to the two arms. [16]

7. A 2-Cylinder uncoupled locomotive with cranks at 90^0 has a crank radius of 32.5 cms. The distance between centers of driving wheel is 150 cms. The pitch of cylinders is 60 cms. The diameter of Freads of driving wheels is 180 cms. The radius of center of gravity of balance weights is 65 cms. The pressure due to dead load on each wheel is 4 tones. The weight of reciprocating and rotating parts per cylinder are 330 kg respectively. The speed of locomotive is 60kmph. Find:
   (a) The balancing weights both in magnitude and position required to be placed in the planes of driving wheels to balance whole of the revolving and 2/3 of reciprocating masses.
   (b) Swaying couple.
   (c) The variation of tractive force.
   (d) The maximum and minimum pressure in rails. What is the maximum speed at which it is possible to run the locomotive, in order that the wheels are not lifted from the rail? [16]

8. A mass weighing 85 kgf is supported on springs which deflects 1.8 cm under the weight of the mass. The vibration of the mass are constrained to be linear and vertical and are damped by a dashpot which reduces the amplitude to one-quarter of its initial value in two complete oscillations, find:
   (a) The magnitude of the damping force at unit speed and
   (b) Periodic time of damped vibrations. [16]

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. A four wheel motor car weighing 1.4KN has its center of gravity 60cms above the ground level. The wheel base and the track are 3m and 50m respectively. Each wheel has an effective dia 0.75m and moment of inertia 0.75kg m^2. In top gear the transmission rotates at 4 times the road wheel speed in clockwise direction when viewed from the front and is equivalent to a weight of 700N and a radius of gyration 9cm. If the front wheels together carry 0.6 of the weight when the vehicle is stationery. Determine the load on each while traversing in horizontal bend of 60m radius and 60km/hr and taking a
   (a) Left turn and
   (b) Right turn. [16]

2. (a) Explain that the coefficient of friction for film or viscous friction depends upon the square root of velocity of body and inversely proportional to the intensity of bearing pressure.
   (b) A screw jack has a screw thread, 7.5 cm mean diameter and 1.5 cm pitch. The load on the jack revolves with the screw. The coefficient of friction at the screw threads is 0.05.
      i. Find the tangential force to be applied to the jack at 36 cm radius so as to lift a load of 600 N.
      ii. State whether the jack is self-locking.If it is, find the torque necessary to lower the load.If not, find the torque which must be applied to keep the load from descending. [6+10]

3. (a) Describe with neat sketch the bevis-gibson flashlight torsion dynamometer.
   (b) A differential band brake acting on the 3/4th of the circumference of a drum of 450mm diameter is to provide a braking torque of 300Nm. One end of the band is attached to a pin 100mm from the fulcrum of the lever and the other end to another pin 25mm from the fulcrum on the other side of it where the operating force is also acting. If the operating force is applied at 500mm from the fulcrum and the coefficient of friction is 0.25 find the two values of the operating force corresponding to the two directions of rotation of the drum. [6+10]

4. A vertical single cylinder gas engine has a bore of 8 cm and a stroke of 10 cm. the connecting rod length is 20 cm and the reciprocating part weigh 15 N. the gas

pressure on the piston is 0.6 MPa when it has moved 1.5 cm from the inner dead center on its power stroke. Determine the net load on the gudgeon pin whether engine runs at 200 rpm. At what engine speed will this load be zero. [16]

5. A governor of the Proell type has each arm 250 mm long. The pivots of the upper and lower arms are 25 mm, from the axis. The central load acting on the sleeve has a mass of 25 kg and each rotating ball has a mass of 3.2 kg when the governor sleeve is in mid position, the extension link of the lower arm is vertical and the radius of path of rotation of the masses is 175 mm. the vertical height of the governor is 200 mm. if the speed of governor is 160 rpm, when in mid position, find:
   (a) Length of the extension link and
   (b) Tension in the upper arm. [16]

6. Two weights of 8 kg and 16 kg rotate in the same plane at radii of 1.5 and 2.25 m respectively. The radii of these weights are 60^0 apart. Find the position of the third weight of the magnitude of 12 kg in the same plane which can produce static balance of the system. [16]

7. A four coupled-wheel locomotive with two inside cylinders has reciprocating and revolving parts per cylinder as 300 kgf and 250 kgf respectively. The distance between planes of driving wheels is 150 cms. The pitch of cylinders is 60 cms. The diameter of tread and driving wheels is 190 cms and the distance between planes of coupling rod cranks in 190 cms. The revolving parts for each coupling rod crank are 125 kgf. The angle between engine cranks is 90^0 and the length of coupling rod crank 22 cms. The angle made by coupling rod crank with adjustment crank is 18^0. The distance of center of gravity of balance weights in planes of driving wheels from a scale center is 75 cms. Crank radius is 32 cms. Determine:
   (a) The magnitude and position of balance weights required in leading and trailing wheels to balance2/3 of reciprocating and whole of revolving parts if half of the required reciprocating parts are to be balanced in each pair of coupled wheels.
   (b) The maximum variation of tractive force and hammer blow when locomotive speed is 100kmph. [16]

8. A mass weighing 85 kgf is supported on springs which deflects 1.8 cm under the weight of the mass. The vibration of the mass are constrained to be linear and vertical and are damped by a dashpot which reduces the amplitude to one-quarter of its initial value in two complete oscillations, find:
   (a) The magnitude of the damping force at unit speed and
   (b) Periodic time of damped vibrations. [16]

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