

Code No: RR320304

RR

Set No. 2

III B.Tech II Semester Examinations, December 2010

DYNAMICS OF MACHINES

Common to Mechanical Engineering, Mechatronics, Production
Engineering, Automobile Engineering

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Derive an equation for the transverse vibration of a uniformly loaded shaft.
(b) A rigid massless bar of length L is hinged at its end and carries a spring K_2 with mass at its right end. The bar is also supported by a spring K_1 at a distance from the left hinge. Determine the natural frequency of the bar. [8+8]
2. A vertical internal combustion engine has a cylinder bore of 14 cm and a stroke of 16 cm. The speed is 500 r.p.m. The connecting rod is 82 cm long and the mass of the parts moving with the piston is 22.5 kg. On working stroke, the gas pressure is 22 bar when the piston has moved down wards a distance corresponding to a rotation of 30° of the crank. Determine graphically the velocity and acceleration of the piston for this piston. Also find the turning moment exerted on the crankshaft taking into account the mass inertia of the piston. [16]
3. A two cylinder uncoupled locomotive with cranks at 90° has a crank radius of 325mm. The distance between the centres of driving wheels is 1.5m. The pitch of cylinders is 0.6m. The diameter of driving wheels is 1.8m. The radius of centres of gravity of balance masses is 0.65m. The pressure due to dead load on each wheel is 40kN. The masses of reciprocating and rotating parts per cylinder are 330kg and 300kg respectively. The speed of the locomotive is 60km.p.h. Find:
 - (a) The balancing masses both in magnitude and position required to be placed in the planes of driving wheels to balance whole of the revolving and two-third of the reciprocating masses;
 - (b) The swaying couple;
 - (c) The variation in tractive force;
 - (d) The maximum and minimum pressure on rails;
 - (e) The maximum speed at which it is possible to run the locomotive, in order that the wheels are not lifted from the rails. [16]
4. A vertical single cylinder, diesel engine running at 300 rpm has a cylinder diameter 250 mm and stroke 400 mm. The mass of the reciprocating parts is 200 kg. The length of the connecting rod is 0.8 m. the ratio of compression is 14 and the pressure remains constant during injection of oil for $1/10^{th}$ of stroke. If the index of the law of expansion and compression is 1.35, find the torque on the crankshaft when it makes an angle of 60° with the top dead centre during the expansion stroke. The suction pressure may be taken as 0.1 N/mm². [16]

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5. A single cylinder reciprocating engine runs at 150 r.p.m. The stroke is 30 cm, mass of reciprocating parts 100 kg, mass of revolving parts assumed concentrated at the crank pin is 120 kg. Find the magnitude of the balance mass required to be placed opposite at the crank at a radius of 16 cm, which is equivalent to all of the revolving and two thirds of the reciprocating masses. If the crank turns 45° from the inner dead centre, find the magnitude of unbalance force due to the balance mass. [16]
6. The spring controlled governor of the Hartung type, the lengths of the horizontal and vertical arms of the bell crank levers are 100 mm and 80 mm respectively. The fulcrum of the bell crank lever is at a distance of 120 mm from the axis of the governor. The each revolving mass is 9 kg. The stiffness of the spring is 25 kN/m. If the length of each spring is 120 mm when the radius of rotation is 70 mm and the equilibrium speed is 360 r.p.m., find the free length of the spring. If the radius of rotation increases to 120 mm, what will be the corresponding percentage increase in speed? [16]
7. (a) From first principles, deduce an expression for the friction moment of a flat pivot bearing, stating clearly the assumptions made.
(b) Which of the two assumptions - uniform intensity of pressure or uniform rate of wear, would you make use of in designing friction clutch and why? Explain. [10+6]
8. A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft of mass 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find
(a) maximum braking torque,
(b) angular retardation of the drum and
(c) time taken by the system to come to rest from the rated speed of 360 r.p.m. [16]

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1. A vertical single cylinder, diesel engine running at 300 rpm has a cylinder diameter 250 mm and stroke 400 mm. The mass of the reciprocating parts is 200 kg. The length of the connecting rod is 0.8 m. the ratio of compression is 14 and the pressure remains constant during injection of oil for $1/10^{th}$ of stroke. If the index of the law of expansion and compression is 1.35, find the torque on the crankshaft when it makes an angle of 60° with the top dead centre during the expansion stroke. The suction pressure may be taken as 0.1 N/mm^2 . [16]
2. (a) Derive an equation for the transverse vibration of a uniformly loaded shaft.
(b) A rigid massless bar of length L is hinged at its end and carries a spring K_2 with mass at its right end. The bar is also supported by a spring K_1 at a distance from the left hinge. Determine the natural frequency of the bar. [8+8]
3. The spring controlled governor of the Hartung type, the lengths of the horizontal and vertical arms of the bell crank levers are 100 mm and 80 mm respectively. The fulcrum of the bell crank lever is at a distance of 120 mm from the axis of the governor. The each revolving mass is 9 kg. The stiffness of the spring is 25 kN/m. If the length of each spring is 120 mm when the radius of rotation is 70 mm and the equilibrium speed is 360 r.p.m., find the free length of the spring. If the radius of rotation increases to 120 mm, what will be the corresponding percentage increase in speed? [16]
4. A vertical internal combustion engine has a cylinder bore of 14 cm and a stroke of 16 cm. The speed is 500 r.p.m. The connecting rod is 82 cm long and the mass of the parts moving with the piston is 22.5 kg. On working stroke, the gas pressure is 22 bar when the piston has moved down wards a distance corresponding to a rotation of 30° of the crank. Determine graphically the velocity and acceleration of the piston for this piston. Also find the turning moment exerted on the crankshaft taking into account the mass inertia of the piston. [16]
5. A single cylinder reciprocating engine runs at 150 r.p.m. The stroke is 30 cm, mass of reciprocating parts 100 kg, mass of revolving parts assumed concentrated at the crank pin is 120 kg. Find the magnitude of the balance mass required to be placed opposite at the crank at a radius of 16 cm, which is equivalent to all of the revolving and two thirds of the reciprocating masses. If the crank turns 45° from the inner dead centre, find the magnitude of unbalance force due to the balance mass. [16]

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6. A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft of mass 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find
- maximum braking torque,
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7. (a) From first principles, deduce an expression for the friction moment of a flat pivot bearing, stating clearly the assumptions made.
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8. A two cylinder uncoupled locomotive with cranks at 90° has a crank radius of 325mm. The distance between the centres of driving wheels is 1.5m. The pitch of cylinders is 0.6m. The diameter of driving wheels is 1.8m. The radius of centres of gravity of balance masses is 0.65m. The pressure due to dead load on each wheel is 40kN. The masses of reciprocating and rotating parts per cylinder are 330kg and 300kg respectively. The speed of the locomotive is 60km.p.h. Find:
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 - The swaying couple;
 - The variation in tractive force;
 - The maximum and minimum pressure on rails;
 - The maximum speed at which it is possible to run the locomotive, in order that the wheels are not lifted from the rails.
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5. A vertical single cylinder, diesel engine running at 300 rpm has a cylinder diameter 250 mm and stroke 400 mm. The mass of the reciprocating parts is 200 kg. The length of the connecting rod is 0.8 m. the ratio of compression is 14 and the pressure remains constant during injection of oil for $1/10^{th}$ of stroke. If the index of the law of expansion and compression is 1.35, find the torque on the crankshaft when it makes an angle of 60° with the top dead centre during the expansion stroke. The suction pressure may be taken as 0.1 N/mm^2 . [16]
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