Registration no: | | | | | | | | | | |

Total Number of Pages: 02 **B.TECH**

PCME4301

5th Semester Regular / Back Examination 2016-17

MACHINE DYNAMICS

BRANCH: AUTO, MECH

Time: 3 Hours

Max Marks: 70

Q.CODE: Y175

Answer Question No.1 which is compulsory and any five from the rest.

The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2 x 10)**

a) What is the condition for correct steering?

b) What is the minimum speed of the driven shaft of single Hooke's joint?

c) How can the interference in involute tooth profile be avoided?

d) Define contact ration in connection with toothed gears.

e) The angular velocity of connecting rod in an IC engine is given by_____.

f) What will be the effect of gyroscopic couple on a naval ship if its engine rotates in clockwise direction when seen from the tail end and it rolls counter clockwise when viewed from front?

g) What is meant by pressure angle in cam mechanism?

h) Define logarithmic decrement.

i) What is meant by coefficient of fluctuation of energy in a flywheel?

j) What is meant by primary balancing?

Q2 **a)** Two shafts are to be connected by a Hook's joint. The driving shaft rotates at 600 rpm. The speed of the driven shafts must lie between 500 rpm and 550 rpm. Determine the maximum permissible angle between the shafts. **(5)**

b) A car with a track of 1.5m and a wheel base of 2.9m has a steering gear mechanism of the Ackermann type. The distance between the front stub axle pivots is 1.3m. The length of each track arm is 150mm and the length of track rod is 1.2m. Find the angle turned through by the outer wheel if the angle turned through by the inner wheel is 30^0. **(5)**

Q3 **a)** A pinion with 24 involute teeth of 150mm pitch circle diameter drives a rack. The addendum of the pinion is 6mm. Find the least pressure angle which can be used if undercutting of the teeth is to be avoided. Using this pressure angle find the length of the arc of contact and the minimum number of teeth in contact at one time. **(5)**

b) A machine has to carry out punching operation at the rate of 10 holes per minute. It does 6 kN.m of work per mm^2 of the sheared area in cutting 25mm diameter holes in 20mm thick plates. A flywheel is fitted to the machine shaft which is driven by constant torque. The fluctuation of speed is between 180 and 200 rpm. The actual punching operation takes 2 seconds. The frictional loss is equivalent to one sixth of the work done during punching. Find the power required to drive the punching machine and the mass of the flywheel if the radius of gyration of the wheel is 0.5m. **(5)**

Q4 A 4-wheel vehicle of mass 2200 kg has a wheel base of 2.8m track width 1.5m and height of centre of gravity 0.6m above the ground level and lies at 1.2m from the front axle. Each wheel has an effective diameter of 0.8m and a moment of inertia of 0.8 kg.m^2. The drive shaft, engine flywheel and transmission are rotating at four times the speed of the road wheel in clockwise direction when viewed from the front and is equivalent to a mass of 70 kg having a radius of gyration of 90mm. If the vehicle is negotiating a right turn of 60m radius at 60km/h. Determine the reaction at each wheel **(10)**

Q5 **a)** A Hartnell governor balls are of 30 N each. The balls radius is 120mm in the mean position when the ball arms are vertical and the speed is 150 rpm with the sleeve rising. The length of the ball arm is 150mm and sleeve arm 100mm. The stiffness of the spring is 8 N/mm and the total sleeve movement is 15 mm from the mean position. Allowing for a constant frictional force of 15 N acting at the sleeve, determine the speed range of the governor in the lowest and highest position of the sleeve. Neglect the obliquity of the arms. **(7)**

b) Draw the controlling force diagram for a Hartnell governor and describe about stable, unstable and isochronous governor. **(3)**

Q6 A cam rotating at a uniform speed of 200 rpm operates a reciprocating roller follower. The roller radius is 25mm and the distance between the axis of the follower and cam centre is 25mm. The least radius of the cam is 50mm and the lift of the follower is 50mm.Ascent takes place during 75^0 of cam rotation with simple harmonic motion and descent with uniform acceleration and retardation during 90^0 of cam rotation. Dwell between ascent and descent corresponds to $60^0$of cam rotation. Draw the profile of the cam and determine velocity and acceleration of follower when the cam has rotated 30^0 during ascent **(10)**

Q7 **a)** A rotating shaft carries four radial masses A=8 kg, B=C=6 kg and D=5 kg. The mass centres are 30 mm, 40 mm, 40 mm and 50 mm respectively from the axis of the shaft. The axial distance between the planes of rotation of A and B is 400 mm and between B and C is 500 mm. The masses A and C are at right angles to each other. Determine for a complete balance, the angle between the masses B and D from mass A, the axial distance between the planes of rotation of C and D and the magnitude of mass B. **(7)**

b) Find the natural frequency of block of mass 10kg placed at the mid-span of a simply supported beam of length 1m. Young's modulus and moment of inertia of the beam are $2.1x10^5$N/mm^2 and 312.5mm^4 respectively. **(3)**

Q8 **a)** A vibrating system is defined by the following parameters: **(5)**
m=5kg, k=100kN/m, C=3N.s/m.
Determine the damping factor, natural frequency of damped vibration and logarithmic decrement.

b) A vertical single cylinder engine has a cylinder diameter of 240 mm and a stroke of 420 mm. The mass of the reciprocating parts is 200 kg. The length of the connecting rod is 4.25 times the crank radius and the speed is 340 rpm. The net pressure on piston when the crank has turned through 40^0 from the top dead centre is 1 MPa. Calculate the effective turning moment on the crank shaft for this piston. **(5)**