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

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

PCME4301

5th Semester Regular / Back Examination 2015-16

MACHINE DYNAMICS

BRANCH: AUTO,MECH

Time: 3 Hours

Max marks: 70

Q.CODE: T166

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) A vehicle using Davis steering gear mechanism Has wheel base 2.8 m and the distance between the pivots of front stub axle is 1.2 m. Determine the angle made by the track arm with the longitudinal axis for correct steering condition.

b) The angle between two shafts connected by hooks joint is 15^o. Calculate the maximum acceleration of the driven shaft when the driving shaft's angular velocity is 40^o rad/sec.

c) An aeroplane moving with a velocity of 300 kmph negotiate a turn along a circular path of radius 600 m. Determine the gyroscopic couple if the angular velocity of the rotating parts of plane is 120 rad/s and the moment of inertia of rotating parts is 60 kg m^2.

d) A spur gear with 32 teeth and module 4mm is rotating at 400 rpm. Determine its circular pitch and pitch line velocity.

e) Define hammer blow and swaying couple in context of balancing of locomotive's reciprocating masses.

f) Briefly explain the effort and power of a governor.

g) Define pressure angle and prime circle in context of the cam.

h) In a slider crank mechanism the length of connecting rod is 300mm and the stroke length is 100mm. Determine the acceleration of the piston when the crank is at an angle of 60^o from inner dead centre. The crank rotates at 300 rpm.

i) What is the minimum number of teeth for a pinion driving a rack having 20^o involute. The addendum may be taken as 1 module.

j) How many times the speed of driven shaft becomes equal to the speed of driving shaft connected by hooks joint during one rotation of driving shaft.

Q2 a) Two standard 20^o full depth gears have a module of 8 mm. The larger gear has 30 teeth while the pinion has 15 teeth. Determine whether the gear will interfere with the pinion assume addendum as one module. (5)

b) Two 20^o gears have a module of 6mm. The pinion has 28 teeth and the gear has 56 teeth. What will be the pressure angle if the centre distance is increased by 5mm. (5)

Q3 a) The moment of inertia of an aeroplane air screw is 6.75kg m^2 and rotates at 1200 rpm. The aircraft makes a complete half circle turn in 10 seconds. Calculate the gyroscopic couple in the aircraft and calculate its effect. The air screw rotates clockwise when viewed from rear. (5)

b) A solo motor cycle, complete with rider weighs 200 kg. The centre of gravity of the cycle rider combined being 60cm above the ground when in vertical position. The moment of inertia of each road wheel is 10500 kg cm^2 and the rolling diameter is 60cm. The engine rotates at 6 times the speed of the road wheels and in the same sense. The engine rotating parts have a moment of inertia of 1685 kg cm^2. Determine the angle of the heel necessary if the motor (5)

cycle is moving at a speed of 60 kmph round a circle of 30 m radius.

Q4 a) A horizontal, single cylinder, single acting Otto cycle gas engine has a bore of 300 mm and a stroke of 500 mm. The engine runs at 180 rpm. The ratio of compression is 5.5. The maximum pressure is 2.2 N/mm^2 gauge and the expansion follows the law $pV^{1.2}$ = constant. If the mass of the piston is 150 kg and the connecting rod is 1.25 m long, calculate the turning moment on the crank shaft when the crank has turned through 60^o from the inner dead centre. The atmospheric pressure is 0.1 N/mm^2. (5)

b) The turning moment diagram for a multi cylinder engine has been drawn to a scale of 1 cm = 600 kg m vertically and 1 cm = 30^o horizontally. The intercepted areas between the output torque curve and the mean resistance line taken in order from one end is as follows : +0.52, -1.24, +0.92, -1.4, +0.85, -0.72, +1.07 sq-cm. The engine is running at a speed of 500 rpm. If the total fluctuation of speed for maximum to minimum is not to exceed 1.5% of mean speed. Find the necessary weight of fly wheel if its radius of gyration is 40 cm. (5)

Q5 A Hartnell governor has two rotating balls of mass 2.7 kg each. The ball radius is 125 mm in the mean position when the ball arms are vertical & the speed is 150 rpm with the sleeve rising. The length of the ball arm is 140 mm and the length of the sleeve arm is 90 mm. The stiffness of the spring is 7 kN/m and the total sleeve movement is 13 mm from the mean position. Allowing for a constant friction force of 14 N acting at the sleeve, determine the speed range of governor in the lowest and heights sleeve position. Neglect the obliquity of the ball arm. (10)

Q6 A single cylinder engine runs at 250 rpm and has a stroke of 180 mm. The reciprocating parts have a mass of 120 kg and the revolving parts are equivalent to a mass of 70 kg at a radius of 90 mm. A mass is placed opposite to the crank at a radius of 150 mm to balance the whole of the revolving mass and $2/3^{rd}$ of the reciprocating mass. Determine the magnitude of the balancing mass and the resultant residual unbalanced force when the crank has turned 30^o from inner dead centre. (10)

Q7 a) A steel bar 2.5 cm wide and 5 cm deep is freely supported at two points 1 m apart and carries a load of 200 kg in the middle of the bar. Neglecting the weight of the bar find the frequency of the transverse vibration. If an additional load of 200 kg is distributed uniformly over the length of bar, what will be the frequency of vibration. (5)

b) A vibrating system consists of a weight of 8 kg, spring of stiffness 5.6 kg/cm and a dashpot of damping coefficient 0.04 kg/cm s. Find (5)

i) Damping factor
ii) Logarithmic decrement
iii) Ratio of the two consecutive amplitudes

Q8 Design a cam to raise a valve with simple harmonic motion through 5 cm in $1/3^{rd}$ of revolution, keep it fully raised through $1/12^{th}$ of revolution and to lower it with harmonic motion in $1/6^{th}$ of revolution. The valve remaining closed during the rest of the revolution. The diameter of the roller is 2 cm and the minimum radius of the cam is 2.5 cm. If the cam rotates at uniform speed of 100 rpm, find the maximum velocity and acceleration of the valve during rising and lowering. (10)