Registration No. : | | | | | | | | | | |

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B. Tech

PCME 4301

Fifth Semester Back Examination – 2014

MACHINE DYNAMICS

BRANCH : MECH

QUESTION CODE : L 221

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which are compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) What is the condition for correct steering of a device steering gear mechanism ?

   (b) In a single Hook's joint the speed of driving shaft and driving shaft and driven shaft are for how many times ? Explain.

   (c) What is interference ? State its significance and how it can be avoided ?

   (d) Explain law of gearing and also various conditions for gear mechanism.

   (e) Give the comparison of cycloidal and involute tooth forms.

   (f) Explain D'Alemberts principle and its significance and application.

   (g) Define logarithmic decrement and indicate its significance.

   (h) What is Damping factor ? Explain its importance in free damped vibration.

   (i) Give the relevant comparisons related to the function of a governor and flywheel of an engine.

   (j) Differentiate between static and dynamic balancing.

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2. A Hook's joint connects two shafts whose axes intersects at 15°. The driving shaft rotates at a uniform speed of 200 rpm. The driving shaft with attached masses has a mass of 70 kg and radius of gyration of 125 mm. Determine the torque required at the driving shaft if a steady torque of 185N-m resists rotation of the driving shaft and the angle of rotation is 45°. Also find the angle between the shafts at which the total fluctuation of speed of the driving shaft is limited to 20 rpm. 10

3. (a) Discuss the effect of gyroscopic couple on a two wheeled vehicle when taking a turn. 4

(b) An aeroplane flying at 240km/hr turns towards left and completes a quarter circle of radius 60 cm. The mass of the rotary engine and the propeller of the plane amounts to 450kg with a radius of gyration of 330mm. The engine speed is 250 rpm clockwise when viewed from the rear. Determine the gyroscopic couple on the air craft and state its effect. In what ways is the effect changed when

(i) the aeroplane turns towards right

(ii) the engine rotates clockwise when viewed from the front (nose end) and the aeroplane turns to left and also turns to right. 6

4. In a spring-loaded Hartnell type of governer, the mass of each ball is 4kg and the lift of the sleeve is 45 mm. The governor begins to float at 220 rpm. When the radius of the ball path is 95 mm. The mean working speed of the governor is 16 times the range of speed, when friction is neglected. The length of the ball and roller arms of the bell crank levers are 100 mm and 80 mm respectively. The pivot centre and the axis of the governor are 115 mm apart. Determine the initial compression of the spring, taking into account the obliquity of arms. Assume the friction at the sleeve to be equivalent to force of 16 N, determine the total alternation in speed before the sleeve begins to move from mid-position. 10

5. The torque delivered by a two-stroke engine is represented by $T = (1050 + 350 \sin 2\theta - 550 \cos 2\theta)$ N-m. where 'θ' is the angle turned by the crank from the inner-dead centre. The engine speed is 300 rpm. The mass of the flywheel is 420kg and radius of gyration is 420mm. 10

Determine

(i) The power delivered

(ii) The total percentage fluctuation of speed

(iii) the angular acceleration of flywheel when the crank has rotated through an angle of 65° from the inner-dead centre.

(iv) the maximum angular acceleration and retardation of the flywheel.

6. (a) Following data refer to two meshing gears having 20° involute teeth

Number of teeth of gear wheel = 52, Number of teeth of pinion = 20, speed of pinion = 360rpm, module = 8mm.

If the addendum of each gear is such that the path of approach and path of recess are half of their maximum possible values, determine the addendum for the gear and the length of arc of contact. 7

(b) The following data relate to two meshing gears : 3

Velocity ratio = 1/3, Module = 4mm Pressure angle = 20°, centre distance = 200 mm. Determine the number of teeth and the base circle radius of gear wheel.

7. (a) A shaft carries four rotating masses A, B, C and D in this order along its axis. The mass 'A' may be assumed concentrated at a radius of 12 cm, B at 15 cm, cat 14 cm and D at 18 cm. The masses of A, C and D are 15 kg, 10 kg and 8 kg respectively. The planes of revolution of A and B are 15cm apart and of B and C are 18 cm apart. The angle between A and C is 90^0. If the shaft is in complete dynamic balance, determine 8

(i) the angles between the radius of A, B and D.

(ii) The distance between the planes of revolution of C and D and

(iii) the mass 'B'

(b) Compare between Transverse vibration and Longitudinal vibration along with diagrams. 2

8. (a) A vibrating system is defined by the following parameters M = 3 kg, K =100 kN/m, C = 3 N-s/m. Determine the damping factor, natural frequency of damped vibration and longitudinal decrement. 4

(b) A hollow shaft 2 m long is supported in flexible bearings. It carries a wheel of 1000 N weight at the centre. The external and internal diameters of the shaft are 50 mm and 40 mm respectively. Determine the transverse vibration, if the elastic modulus of material is 210 GN/m^2. 6