Total No. of printed pages = 8

ME 131403

Roll No. of candidate | | | | | | | | | | |

2017

B. Tech 4th Semester End-Term Examination

MECHANISM AND MACHINES II

Full Marks–100 Pass Marks–35 Time–Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 3×10=30

(i) What inference can be drawn from the following statement ?

"For a given fractional change in speed, the lift of sleeve of governor **A** is more than that of governor **B**."

(ii) If M is the mass of load on the sleeve, m is the mass of the ball and the length of arms and links are equal, what would be the ratio of the height of a Porter governor to the height of a Watt's governor ?

[Turn over

(iii) You have designed a system with three revolving masses in the same plane. However, during analysis it was found that the system is not dynamically balanced. How will you modify your design to negate the problem without using additional masses ?

(iv) What is the usual practice to facilitate the starting of two cylinder locomotive, in any position, with reference to the position of the cranks ?

(v) You are at sea on a boat and your compass breaks down, but you know that if you go straight, you will reach your destination. However, a large wave is approaching you from the front that will lift and then drop the bow end of your boat. Considering that the boat engine is rotating in the clockwise direction when viewed from the stern end and you know moment of inertia of the engine rotating parts as well as the angular velocity of spin of the engine and the pitching angle that will be caused by the wave, how will you maintain a straight path of the boat if you have the ability to apply a measured quantity of torque ?

(vi) A Motor GP racer negotiates a particular right turn at a speed of 80km/hr and then again at 90 km/hr in the next lap. How will the angle of heel of the motorcycle change in the later lap if the direction of spin of the wheels and the engine are parallel and in the same sense ?

(vii) Consider a weightless shaft whose one end is fixed and the other end carries a heavy disc. What are the types of vibratory motion possible for the shaft ?

(viii) A rotating shaft has a natural frequency of transverse vibration equal to 40 Hz. Determine the whirling speed of the shaft in revolutions per minute.

(ix) Consider an elastic shaft fixed at both ends subjected to transverse vibration. It is observed that the shaft eventually comes to rest. What are the factors which decreases the vibration of the shaft ?

(x) There are two vibrartory systems **A** and **B**. It is observed that the amplitude decreases to one-fourth of the initial value in four and six consecutive cycles for **A** and **B** respectively. Calculate the ratio of their logarithmic decrement.

2. Answer any *four* of the following questions : 10×4=40

(i) Define *sensitiveness* and *hunting* of a governor. When is a governor said to be isochronous ? Show that a Porter governor cannot be isochronous. 4+2+4=10

(ii) A single cylinder reciprocating engine has speed 240 rpm, stroke 300 mm, mass of reciprocating parts 50 kg, mass of revolving parts at 150 mm radius 37 kg. If two-third of the reciprocating parts and all the revolving parts are to be balanced, find the balance mass required at a radius of 400mm and the residual unbalanced force when the crank has rotated 60° from top dead centre. 5+5=10

(iii) An aeroplane makes a complete half circle of 50 metres radius, towards left, when flying at 200 km/hr. The rotary engine and the propeller of the plane has a mass of 400 kg with a radius of gyration of 300mm. The engine runs at 2400 rpm clockwise, when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. What will be the effect, if the aeroplane turns to its right instead of to the left ? 5+5=10

(iv) A cantilever shaft 50mm diameter and 300mm long has a disc of mass 100kg at its free end. The Young's modulus for the shaft material is 200 GN/m². Determine the frequency of longitudinal and transverse vibrations of the shaft. 5+5=10

(v) A vibrating system consists of a mass of 200 kg, a spring of stiffness 80 N/mm and a damper with damping coefficient of 800 N/m/s. Determine the frequency of un-damped and damped vibration of the system. 5+5=10

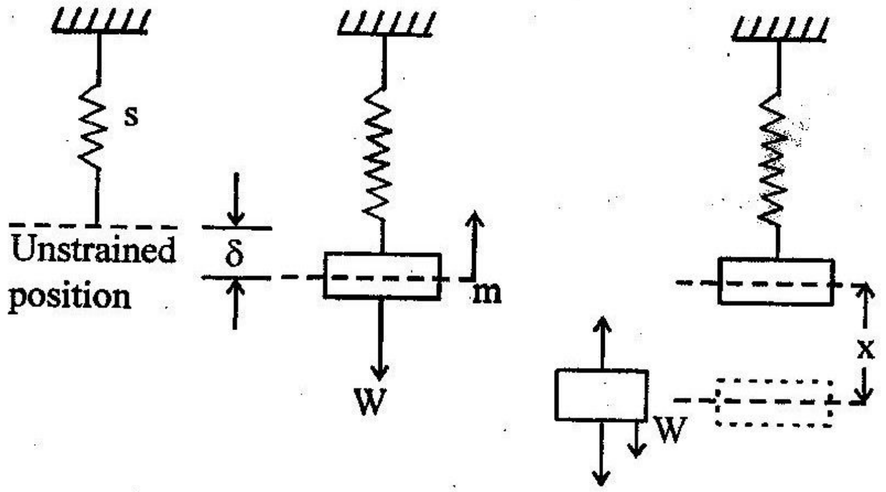
3. Answer any *three* of the following questions : 10×3=30

(i) Porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5kg and the mass of the central load one the sleeve is 25kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor.

(ii) Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 24 kg, 20 kg, 36 kg and 30 kg respectively and their radii of rotations are 20 mm, 25 mm, 30 mm and 15 mm. The angular position of the masses B, C and D are 45°, 120° and 330° from the mass A. Find the magnitude and position of the balancing mass at a radius of 50 mm.

(iii) You are alone and enjoying the breeze from a standing fan, the blades of which are spinning on its axis at 9 rad/s. The moment of inertia of the rotating parts of the fan is 7 kg-m². Four of your friends now join you and also want to enjoy the breeze. You put the fan on swing mode. In the swing mode, the fan reverses its direction of precision at the end of each semi-circle. So you all sit in a semi-circle. The fan has the ability to deliver a gyroscopic torque of 10 N-m about an axis normal to it for the swinging action. What fraction of time will the breeze be directly available to each of you (considering all are spaced equally within the semi-circle) ?

(iv) The figure below shows a spring in the unstrained position (Fig.a), equilibrium position with a state deflection δ when loaded with a weight W (Fig.b) and subjected to displacement x (Fig.c)



(a) (b) (c)

Show that the natural frequency of longitudinal vibration of the system is :

$$f_n = \frac{0.4985}{\sqrt{\delta}}.$$

(v) The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give

an equivalent spring of stiffness 5.4N/mm. If the vibrating system has a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find the critical damping coefficient, damping factor, logarithmic decrement and ratio of two consecutive amplitudes.