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B.Tech. Degree IV Semester Examination in Marine Engineering June 2014

MRE 401 MECHANICS OF MACHINERY

Time : 3 Hours   Maximum Marks : 100

(5 x 20 = 100)

I.   (a)   Determine the mobility of the mechanism shown in fig.

(b)   Figure shows the mechanism of a sewing machine needle box. Find the velocity and acceleration of the needle fitted to the slider D when the crank OA rotates at 40 rad/s.

OR

II.   (a)   Derive the expression for the coriolis acceleration when a slider is moving in a rotating link.

(b)   Fig. shows a crank and slotted link quick return mechanism used in a shaping machine with dimensions OA = 400mm, AR = 700mm, OP=200mm, and RS = 300mm. For the configuration shown, determine the acceleration of the cutting tool fitted to the slider S when the crank rotates at a speed of 200 rpm.

III. (a) Explain the working of a pantograph.

(b) The following data relate to a cam profile in which the follower moves with uniform acceleration and deceleration during ascent and descent.

Minimum radius of the cam	25mm
Roller diameter	10mm
Lift	30mm
Offset of the follower axis	15mm to the right
Angle of ascent	60^0
Angle of descent	90^0
Angle of dwell between ascent and descent	45^0

Draw the profile of the cam and determine the maximum velocity and the uniform acceleration of the follower during the rise and return.

OR

IV. (a) Explain the working of paucellieur mechanism.

(b) A tangent cam with a base circle diameter of 50mm operates a roller follower 20mm in diameter. The line of stroke of the roller follower passes through the axis of the cam. The angle between the tangential faces of the cam is 60°, speed of the cam shaft is 200 rpm and the lift of the follower is 15mm. Calculate (i) the main dimension of the cam (ii) the acceleration of the follower at the beginning of the lift, at the point where the flank touches the nose and at the apex of the nose.

V. Each arm of a porter governor is 200mm long and is hinged at a distance of 40mm from the axis of rotation. The mass of each ball is 1.5 kg and the sleeve is 25 kg. when the links are at 30° to the vertical, the sleeve begins to rise at 260 rpm. Assuming that the friction force is constant, find the maximum and minimum speeds of rotation when the inclination of the arms to the vertical is 45°.

OR

VI. In a spring loaded hartnell governor, the lengths of the horizontal and the vertical arms of the bell-crank lever are 40 mm and 80 mm respectively. The mass of each ball is 1.2kg. The extreme radii of rotation of the balls are 70mm and 105mm. The distance of the fulcrum of each bell crank lever is 75 mm from the axis of rotation of the governor. The minimum equilibrium speed is 420 rpm and the maximum equilibrium speed is 4% higher than this. Neglecting the obliquity of the arms, determine (i) the spring stiffness (ii) the initial compression (iii) the equilibrium speed corresponding to radius of rotation of 95 mm.

VII. A pinion of 20° involute teeth rotating at 275 rpm meshes with a gear and provides a gear ratio of 1.8. The number of teeth on the pinion is 20 and the module is 8mm. If the interference is just avoided, determine (i) the addenda on the wheel and the pinion (ii) the path of contact (iii) the maximum velocity of sliding on both sides of the pitch point.

OR

VIII. The figure shows a humpage gear used in a lathe headstock. The number of teeth on the wheels B, C, D, E and F are 18, 54, 22, 44 and 72 respectively. If the shaft G rotates at 200 rpm, what will be the speed of the shaft when (i) F is held stationary (ii) F rotates at 30 rpm opposite to G?

IX. A V-belt drive with the following data transmits power from an electric motor to a compressor.

Power transmitted	= 100 kW	Speed of the electric motor	= 750 rpm
Speed of the compressor	= 300 rpm	Diameter of the compressor pulley	= 800 mm
Center distance between the pulleys	= 1.5 m	Maximum speed of the belt	= 30 m/s.
Mass density of the belt	= 900 kg/m^3	Cross sectional area of the belt	= 350 m^2
Allowable stress in the belt	= 2.2 N/m^2	Grove angle of the pulley	= 38°
Coefficient of friction	= 0.28		

Determine the number of belts required and the length of each belt.

OR

X. A multiplate disc clutch transmits 30 kW of power at 1800 rpm. It has four discs on the driving shaft and three on the driven providing 6 pairs of contact surfaces. The external and internal diameters of the contact surfaces are 200 mm and 100 mm respectively. Assuming the clutch to be new, find the total spring load pressing the plates together. Also determine the maximum power transmitted when the contact surfaces have worn out by 0.4 mm. There are 8 springs and the stiffness of each spring is 15 kN/m. The coefficient of friction is 0.3.

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