B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, Nov/Dec 2011

AGRICULTURAL AND IRRIGATION ENGINEERING BRANCH

THIRD SEMESTER

AI 9202 – THEORY OF MACHINES

Time : 3 hr. Max. Mark :100

Answer ALL Questions

Part A (10 x 2 = 20 Marks)

1 State the condition for i) self-energizing and ii) self-locking of a single block brake.

2 Differentiate the purpose of a governor from that of flywheel.

3 State Kennedy's theorem on instantaneous centre.

4 How does viscosity and oiliness control fluid friction independently?

5 *Figure.1* shows a Dump truck mechanism and its skeleton sketch. Correct the mistake in the naming of the links and determine the mobility (DOF) using Grubler's criterion for planar mechanism.

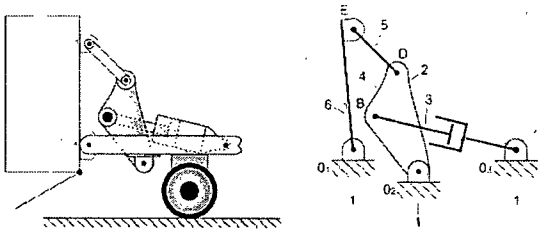

Figure 1

6 A schematic diagram of a cam operated valve mechanism is shown in *Figure.2.* What is 'α' representing in the figure? Suggest a way to control it in cam design?

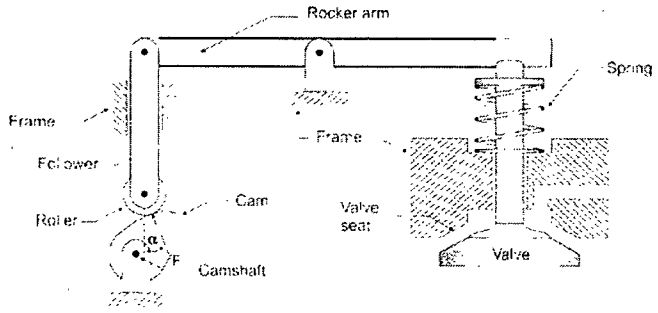

Figure 2

7 Where does maximum and minimum (zero) velocity of sliding occur during meshing of a pair of gear tooth?

8 Why is a cycloidal motion of cam follower most suitable for high speed cams? What is the condition for the minimum radius of curvature on cam profile in case of a roller type cam follower?

9 What are antifriction bearings? Mention one of its types used in combined load (both radial and thrust) application.

10 State the law of gearing. Mention two significant advantages of involute gears over cycloidal gears?

PART B (5 x 16 = 80 Marks)

11 Use the following data in drawing the profile of a cam which rotates counter-clockwise and a knife edged follower is raised with uniform acceleration and deceleration and is lowered with SHM:
Least radius of cam = 60 mm; Lift of the follower = 45 mm;
Angle of ascent = 60^0; Angle of dwell between ascent and descent = 30^0
Angle of descent = 90^0
If the cam rotates at 180 rpm (ccw), determine the maximum velocity and acceleration during ascent and descent, and their respective cam angle. Measure the approx. pressure angle of the cam at the mid position during ascent. (16)

12a An exhaust fan fitted with 900 mm diameter pulley is driven by a flat belt from a 30 kW, 950 rpm squirrel cage motor. The pulley diameter on the motor shaft is 250 mm and the center distance between the fan and the motor is 2.25 m. The belt is 100 mm wide and has a coefficient of friction of 0.3 with motor pulley and 0.25 with fan pulley. If allowable stress in the belt is not to exceed 3 MPa, determine the necessary thickness of the belt and its total length. Density of the belt is 1000 kg/m^3. Consider effect of centrifugal tension and neglect belt thickness in calculations. (16)

[OR]

12b Derive the power transmitted by friction in a single disc clutch assuming
i) Uniform wear condition and ii) uniform pressure condition (16)

13a Briefly explain the theory of thin film (greasy or boundary) and thick film lubrication in journal bearings with figure. Give a comparison in terms of load capacity, pressure distribution and frictional resistance. (16)

[OR]

13b A shaft of diameter 240 mm carries a thrust load of 120 kN and runs at 120 rpm. It has a number of integral collars, all of diameter 360 mm. If allowed pressure is 400 kN/m^2 and coefficient of friction is 0.06, determine the power absorbed by friction and the number of collars required assuming uniform pressure condition. (16)

14a In the inverted slider crank shown in *Figure.3*, when the crank angle AOB = 60°, the angular velocity and acceleration of the crank are measured to be 1 rad/s clockwise and 1 rad/s^2 (clockwise) respectively. Point E is an extension of BA, where EA = 450 mm. [Take velocity scale as 1mm = 480 mm/s and acceleration scale as 1mm = 240 mm/s^2]

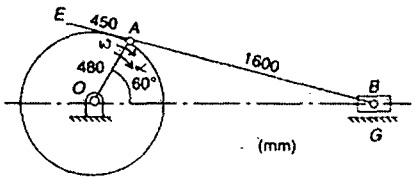

Figure 3

Using vector polygon (graphical) method, determine

i) Angular velocity and angular acceleration (and their directions) of the point E. (8)

ii) Sliding velocity and acceleration (and their directions) of slider link. (8)

[OR]

14b A four bar mechanism is shown in *Figure.4*.

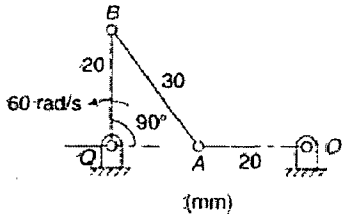

Figure 4

Using Instantaneous centre method, determine the angular velocities (and their directions) of links AB and OA. (16)

15a i) A rotor has pointed masses 3 kg and 4 kg, both placed at a radius of 150 mm on plane and 90^0 apart circumferentially. Obtain a dynamic balance by introducing two planes B and C, 500 mm apart, such that plane A is at the centre of B and C. It is allowed to place counter masses on planes B and C at radius of 200 mm and 150 mm respectively. Find the unknown counter masses, radial directions on planes B and C. (8)

ii) The turning moment diagram of an engine is drawn to a vertical scale of 1mm to 6 Nm and a horizontal scale of 1 mm to 1^0. The diagram repeats itself after every half revolution of engine. The areas above and below the mean torque line are: 305, 710, 50, 350, 980 and 275 mm^2. The rotatory mass is 40 kg at a radius of gyration of 140 mm. Calculate the coefficient of fluctuation of speed if the engine rotates at 1500 rpm. (8)

[OR]

15b i) Determine the number of minimum teeth required on a pinion to avoid interference with any rack of pressure angle 20^0 and addendum equal to the module. If only the pressure angle is increased to 25^0, what is the number of minimum teeth to avoid interference? (8)

ii) A reverted gear train, shown in *Fig.5*, has a speed ratio of 16. The module of gears A and B is 4 mm and of gears C and D is 2 mm. The centre distance between the shafts is 200 mm. Calculate suitable numbers of teeth for the gears. Assume speed ratio between A-B to be same as C-D. (8)

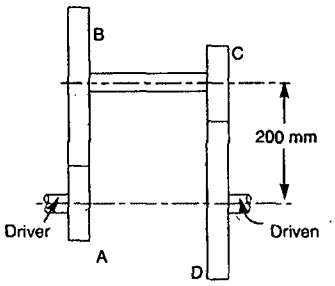

Figure 5