Menoufiya University
Faculty of Engineering
Shebin -El- Kom
Time allowed: Three Hours ,   Date: 10 -6-2017 ,

Post – Graduate Diploma Level 500
Mechanical Design and Prod. Dept.
Subject: Theory of Machine
Total Marks: 100

Attempt Answering only Five Questions, and neat sketches are to be drawn, wherever required.

Question.1:   (20 Marks)

a) What are the advantages of an open chain as compared to a closed chain? And what is meaning the composite mechanism.

b) Can you visualize the four different inversions for a simple slider crank mechanism?

c) Explain Grashoff's law, with application example.

d) Explain with net sketch, why the four – bar chain is considered to be the basic chain?

e) Find and describe four – bar mechanism that use a Universal joint.

Question.2:   (20 Marks)

a) Explain synthesis of mechanism with application examples.

b) Describe the classifications of synthesis problem, and what is the difference between the analysis and synthesis of mechanism

c) Derive the expressions for displacement, velocity and acceleration of a simple slider crank mechanism

d) In a slider crank mechanism, the crank $AB = 100$ mm and the connecting rod $BC = 300$ mm. When the crank is at 120° from the inner dead centre, the crank shaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s2 both clockwise. Find at an interval of 60°

1. The linear velocity and acceleration of the slider, and

2. The angular velocity and angular acceleration of the rod, when

(*I*) The line of stroke of the slider is offset by 30 mm, and

(*II*) The line of stroke of the slider is along the axis of rotation of the crank.

Question.3:   (20 Marks)

a) What is the function of a flywheel? Explain the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to flywheels.

b) Define the terms 'coefficient of fluctuation of energy' and 'coefficient of fluctuation of speed', in the case of flywheels.

c) A punching press is driven by a constant torque electric motor. The press is provided with a flywheel that rotates at maximum speed of 225 r.p.m. The radius of gyration of the flywheel is 0.5 m. The press punches 720 holes per hour; each punching operation takes 2 second and requires 15 kN-m of energy. Find the power of the motor, and the minimum mass of the flywheel if speed of the same is not to fall below 200 r. p. m.

(P.T.O)

Question.4: (20 Marks)

a. What is the function of a governor? How does it differ from that of a flywheel?
b. State the different types of governors. What is the difference between centrifugal and inertia type governors? Why is the former preferred to the latter?
c. Explain the term height of the governor. Derive an expression for the height in the case of a Watt governor. What are the limitations of a Watt governor?
d. A Porter governor has links 150 mm long and is attached to pivots at a radial distance of 30 mm from the vertical axis of the governor. The mass of each ball is 1.75 kg and the mass of the sleeve is 25 kg. The governor sleeve begins to rise at 300 r.p.m. when the links are at 30° to the vertical. Assuming the friction force to be constant, find the minimum and maximum speed of rotation when the inclination of the links is 45° to the vertical.

Question.5: (20 Marks)

a) Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving mass.
b) Write a short note on primary and secondary balancing in reciprocating system
c) The camshaft of high speed pump consists of a parallel shaft 25 mm diameter and 480 mm long. It carries three eccentrics, each of diameter 60 mm and a uniform thickness of 18 mm. The assembly is symmetrical as shown in figure and the bearings are at A and B. The angle between the eccentrics is 120° and the eccentricity of each is 12.5 mm. The material density is 7000 kg/m3, and the speed of rotation is 1430 r.p.m.(All dimensions in mm.). Find dynamic load on each bearing, and kinetic energy of complete assembly.
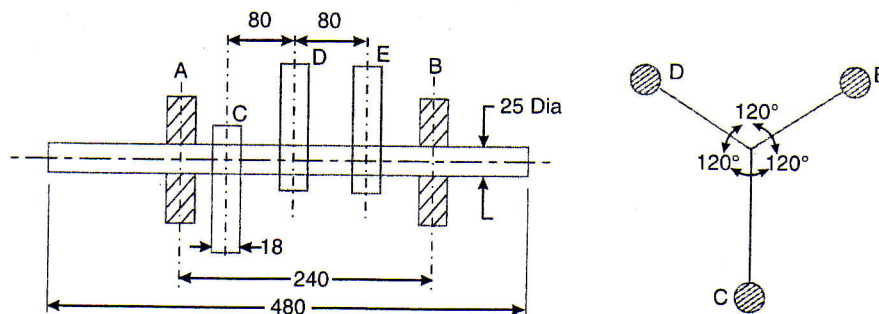
All dimensions in mm.

Question.6: (20 Marks)

a. Write a short note on gyroscope.
b. What do you understand by gyroscopic couple? Derive a formula for its magnitude.
c. Explain the application of gyroscopic principles to aircrafts.
d. Discuss the effect of the gyroscopic couple on a two wheeled vehicle when taking a turn.
e. What will be the effect of the gyroscopic couple on a disc fixed at a certain angle to a rotating shaft?

With good luck . S.M,GHONEAM