SUBJECT CODE NO:- P-244
FACULTY OF ENGINEERING AND TECHNOLOGY
S.E.(Mech./Prod.) Examination May/June 2017
Theory of Machines-I
(Revised)

[Time: four Hours] **[Max.Marks:80]**

Please check whether you have got the right question paper.

N.B   i) Q. No.1 and 6 are compulsory. Solve any two questions out of the remaining in each section.
   ii) Draw neat sketches wherever necessary.
   iii) Assume suitable additional data if required.

Section A

Q.1   Solve the following questions. (Any five).   10

1) When the elements of the pair are kept in contact by the action of the external forces, the pair is said to be a.
(a) Lower pair   (b) Higher pair
(c) Self closed pair   (d) Force closed pair

2) In a mechanism, the fixed instantaneous centers are those centers which.
(a) Remain in the same place for all configurations of the mechanisms
(b) Vary with the configuration of the mechanism
(c) Moves as the mechanism moves, but joints are of permanent nature.
(d) None of the above

3) The direction of the linear velocity of any point on a link with respect to another point on the same link is.
(a) parallel to the link joining the points
(b) perpendicular to the link joining the points
(c) at 45^0 to the link joining the points
(d) None of these

4) The Coriolis component of acceleration is taken into account for.
(a) Slider crank mechanism   (b) Four bar chain mechanism
(c) Quick return motion mechanism   (d) None of these

5) The example of rolling pair is.
(a) Bolt and nut   (b) Lead screw of a lathe
(c) Ball and socket joint   (d) Ball wearing and roller wearing
(e) All of the above

6) The purpose of a link is to.
(a) Transmit motion   (b) Guide other links
(c) Act as a support   (d) All of the above

7) The acceleration of particle at any instant has two components i.e. radial component and tangential component. These two components will be.

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(a) Inclined at 45^0 (b) Opposite to each other

(c) Parallel to each other   (d) Perpendicular to each other

8) When a slider moves on a fixed link having curved surface, their instantaneous centers lies.

(a) On their point of contact   (b) At the center of curvature

(c) At the pin joint   (d) At the center of circle

9) Angular acceleration of a link can be determined by dividing the

(a) centripetal component of acceleration with length of link

(b) Tangential component of acceleration with length of link

(c) Resultant acceleration with length of link

(d) All of the above

10) Coriolis component of acceleration exists whenever a point moves along a path that has.

a) Linear displacement

b) Rotational motion

c) Tangential acceleration

d) Centripetal acceleration

Q.2 The dimensions of various links in a mechanism, as shown in Fig.1 are as follows: AB = 60mm,   15
BC = 400mm, CD = 150mm, DE = 115mm and EF = 225mm. Find the velocity of slider F when crank AB
rotates uniformly in clockwise direction at a speed of 60 rpm.

Q.3 In the mechanism shown in the following figure 2, link AB rotates clockwise about A at 75 rpm. For the   15
mechanism shown, locate all the instantaneous centers of rotation and hence find the velocity of piston C
and E.

Q.4 For the steam engine mechanism shown in fig 3, determine the sliding acceleration of the slider F and the 15
angular acceleration of link CE, for a crank speed of 143 rpm. Dimensions of the various links are:

OA = 300mm, AB = 120mm, BC = 450mm, CE = 1200mm and EF = 1200mm.

Q.5 Figure 4 shows a four bar mechanism, using shortcut method determine,   15

1. Velocity and acceleration of point C,

2. Angular velocity and angular acceleration of link BC, and CD.

Section B

Q.6 Solve the following questions. (Any five).   10

I. In reciprocating engines primary forces

a) Are completely balanced

b) Are partially balanced

c) Are balanced by secondary forces

d) Cannot be balanced

II. A rigid body, under the action of external forces, can be replaced by two masses placed at a fixed distance
apart. The two masses form an equivalent dynamical system, if.

a) The sum of two masses is equal to the total mass of the body.

b) The center of gravity of two masses coincides with that of the body

c) The sum of mass moment of inertia of the masses about their center of gravity is equal to the mass
moment of inertia of the body.

d) All of the above

III. The cam profile and pitch curve are same for.

a) Roller follower

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b) Flat faced follower
c) Mushroom follower
d) Knife edge follower

IV. The brakes commonly used in railway trains is.
a) Shoe brake
b) Band brake
c) Band and block brake
d) Internal expanding brake

V. Static balancing involves balancing of-------------.
a) Forces
b) Couples
c) Both
d) Masses

VI. Hammer blow in locomotives result in.
a) Pulsating torque
b) Uneven speed
c) Tendency to lift wheels from rails
d) Variable horizontal force

VII. Angle of ascent of cam is defined as the angle.
a) During which the follower returns to its initial position
b) Moved by the cam from the instant the follower begins to rise, till it reaches its highest position.
c) During which the follower remains in highest position.
d) Moved by the cam from beginning of ascent to the termination of descent.

VIII. A circle passing through the pitch point with its center at the center of cam axis is known as.
a) Pitch circle
b) Base circle
c) Prime circle
d) Outer circle

IX. The magnitude of the secondary force is----------the primary force.
a) More than
b) Less than
c) Equal to

X. If rotating system is dynamically balanced, it is statically----------.
a) Balanced
b) Unbalanced
c) Partially balanced

Q.7 A single cylinder horizontal steam engine has a stroke of 0.75 m and a connecting rod 1.8m long. The mass of reciprocating parts is 520 kg and that of the connecting rod is 230 kg. Center of gravity of the connecting rod is 0.8 m from the crank pin and the moment of inertia about an axis through the center of gravity perpendicular to the plane of motion is 100 kg m^2. For an engine speed of 90 rpm and a crank position of 45^0 from the inner dead center, determine torque of the crankshaft due to the inertia of these parts by graphical method.   15

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Q.8 The following data relate to a cam operating an oscillating roller follower:-   15
Minimum radius of cam = 30mm, radius of roller = 10mm,   distance of fulcrum center from cam center = 55mm, length of follower arm = 45mm, angle of ascent =80^0, angle of descent = 100^0, angle of dwell between ascent and descent = 50^0, angle of oscillation of follower = 30^0, Draw the profile of the cam if the follower moves outward with S.H.M. and returns with uniform acceleration and retardation.

Q.9 A,B,C and D are four masses carried by a rotating shaft at radii of 10 cm, 12.5 cm, 20 cm and 15 cm respectively.   15
The planes in which the masses revolve are 60 cm apart and the mass of B, C and D are   10 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular setting of the four masses so that the shaft is in complete balance. (Assuming the plane of the mass as the reference plane).

Q.10 A 2-cylinder uncoupled locomotive with cranks at 90^0 has a crank radius of 32.5 cms. The distance between centers 15 of driving wheel is 150 cms. The pitch of cylinders is 60 cms. The diameter of Treads of driving wheels is 180 cms. The radius of center of gravity of balance weighs is 65 cms. The pressure due to dead load on each wheel is 4 tones. The weight of the reciprocating and rotating parts per cylinder are 330 kg respectively. The speed of locomotive is 60kmph. Find:
- a) The balancing weights both in magnitude and position required to be placed in the planes of driving wheels to balance whole of the revolving and 2/3 of reciprocating masses.
- b) Swaying couple
- c) The variation of tractive force
- d) The maximum and minimum pressures in rails. What is the maximum speed at which it is possible to run the locomotive, in order that the wheels are not lifted from the rail?
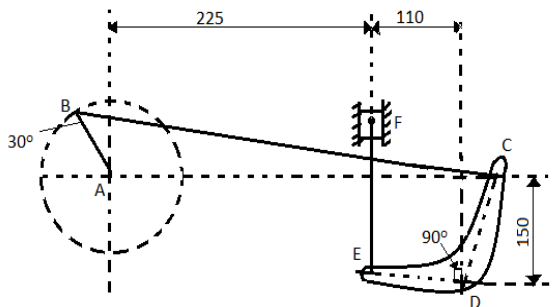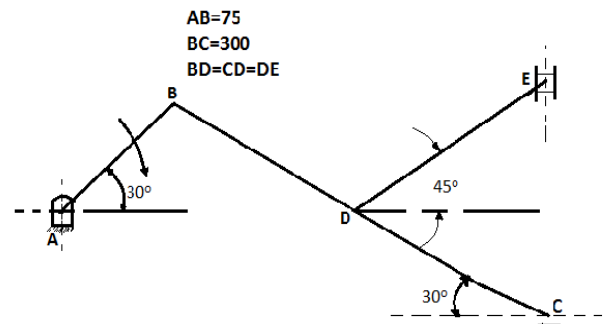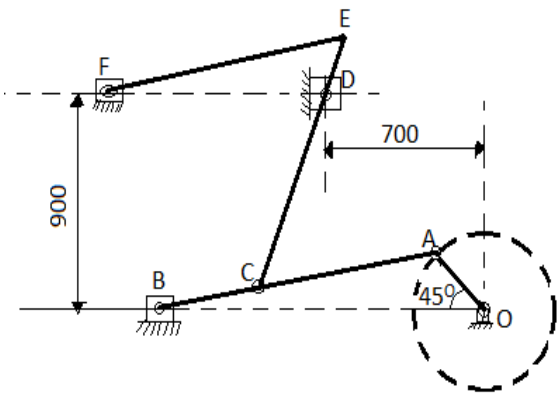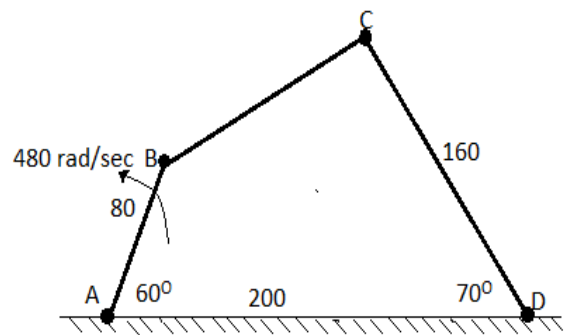
Figure 1

Figure 2

Figure 3

Figure 4

All dimensions are in mm.