Total No. of printed pages = 6

END SEMESTER (REGULAR/RETEST) EXAMINATION, MAY/JUNE – 2025

Semester : 4th

Subject Code : Me-404

THEORY OF MACHINE

Full Marks – 70

Time – Three hours

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

Instructions :

(i) Question No. 1 is compulsory.

(ii) Answer any *five* questions from the rest.

1. (A) Fill in the blanks : 1×5=5

(a) When the sleeve of a Porter governor moves downward, the governor speeds _____ .

(b) The particles of a body move in a circle in _____ vibrations.

(c) The radial distance of a tooth from the pitch circle to the bottom of the tooth is called_____.

[Turn over

(d) The motion of a piston in the cylinder of a steam engine is an example of _____ constrained motion.

(e) The centrifugal tension in the belts have no effect on _____ .

(B) Choose the correct answer : 1×5=5

(a) The power transmitted by a belt is maximum when the maximum tension in the belt (T) is equal to

(i) T_c (ii) $2T_c$

(iii) $3T_c$ (iv) $4T_c$

(b) For static balancing of a shaft

(i) The net dynamic force acting on the shaft is equal to zero

(ii) The net couple due to dynamic force acting on the shaft is equal to zero

(iii) Both (i) and (ii)

(iv) None of the above

(c) The cam follower extensively used in automobile engine is

(i) Knife edge follower

(ii) Spherical faced follower

(iii) Flat faced follower

(iv) Roller follower

(d) The attachment of a car mirror is an example of

(i) Screw pair

(ii) Turning pair

(iii) Rolling pair

(iv) Spherical pair

(e) The relation between the number of pairs (p) forming a kinematic chain and number of links(l) is

(i) $l = 2p - 2$

(ii) $l = 2p - 3$

(iii) $l = 2p - 4$

(iv) $l = 2p - 5$.

(C) Write True or False : 1×5=5

(a) A rigid link is one which does not undergo any deformation while transmitting motion.

(b) A porter governor can not be isochronous.

(c) When the motion of the follower is along an axis away from the axis of the cam centre, it is called radial follower.

(d) When the belt speed increases, power transmitted increases to a maximum value and then decreases.

(e) When there is a reduction in amplitude over every cycle of vibration, then the body is said to have forced vibration.

2. (a) What is the function of a governor ? 2

(b) Define the following terms relating to relating to governors : 3

(i) Isochronism

(ii) Hunting

(iii) Sensitiveness.

(c) The arms of a Porter governor are of 25 cm long. The upper arms are pivoted on the axis of rotation. The lower arms are attached to a sleeve at a distance of 3 cm from the axis of rotation. The mass of the central sleeve is 65 kg and the mass of each ball is 10 kg. Determine the equilibrium speed when the radius of rotation of the ball is 20cm. If the friction is equivalent to a load of 20N at the sleeve, what will be range of speed for this position ? 6

3. (a) What do you mean by an unbalanced system ? 2

(b) State the necessary condition to achieve "Dynamic balancing" of a system. 3

(c) Five weight of magnitude 5 kg, 8 kg, 10 kg, 6 kg and 15 kg at radii 6 cm, 5 cm, 7 cm, 10 cm and 6 cm respectively are attached to a shaft and revolve in the same plane. The angular position of weight 8 kg, 10 kg, 6 kg and 15 kg measured in anticlockwise direction from the 5 kg weight are respectively 60°, 135°, 210° and 330°. Find the magnitude and position of balance weight required at a radii of 15 cm for complete balance. 6

4. (a) When is the cross-belt used instead of open belt drive ? 2

(b) Deduce an expression of velocity ratio of a compound belt drive. 3

(c) A flat belt 10 cm wide and 10 mm thick, running over a pulley of 1 m diameter is to transmit power at 300 rpm. The co-efficient of friction between the belt and pulley surface is 0.25 and angle of lap is 165^0. If the safe permissible stress on the belt section is 15 kg/cm^2, calculate the power transmitted. 6

5. (a) Define the term "inversion of mechanism". 2

(b) Define the term Kinematic link. Give the classification of Kinematic link. 3

(c) Differentiate with example, between a machine and a structure. 4

(d) Give one example of each of the following : Sliding pair, Turning pair, Spherical pair and Rolling pair. 2

6. (a) Explain with neat sketches the longitudinal, transverse and torsional free vibrations. 5

(b) What is the difference between absorption and transmission type dynamometers ? With neat sketch describe the Rope Brake dynamometer. 2+4=6

7. (a) Define the followings in terms of gear : 4

(i) Module (ii) Clearance

(iii) Addendum (iv) Pitch circle.

(b) What are idle gears ? Show that idle gears have no effect on velocity ratio of a simple gear train. 4

(c) A gear with 40 teeth and 10 mm module running at 90 rpm, drives another wheel at 180 rpm. Find the diameter of the wheels and the distance between the centres of wheel. 3