Registration No :

B.Tech
PME4I101

4ᵗʰ Semester Regular / Back Examination 2018-19
MECHANISM & MACHINES
BRANCH : MECH
Max Marks : 100
Time : 3 Hours
Q.CODE : F850

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1   **Only Short Answer Type Questions (Answer All-10)**   **(2 x 10)**

  a) Why ackerman steering gear mechanism is preferred over the davis steering gear mechanism.

  b) How many times the speed of driven shaft becomes equal to the speed of driving shaft connected by a hookes joint during one rotation of the driving shaft.

  c) How can the interference in involute tooth profile be avoided.

  d) What is meant by co-efficient of fluctuation of energy in a flywheel?

  e) What will be the effect of gyroscopic couple on a naval ship if its engine rotates in clockwise direction when seen from the tail end takes a left turn viewed from the top?

  f) What is the function of a governor? Is it same as that of the flywheel?

  g) What is meant by pressure angle in a cam mechanism?

  h) Using revolving mass only a part of the unbalanced force due to reciprocating masses is balanced. Why?

  i) Define logarithmic decrement.

  j) Explain the term 'whirling speed' and 'critical speed' of a shaft.

Part- II

Q2   **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)**   **(6 x 8)**

  a) Determine the maximum possible angle between the axes of the shaft of a universal joint, if the driving shaft of the universal joint rotates at a uniform speed of 800 rpm and the total fluctuation of speed in the driven shaft does not exceed 60 rpm. Also find the maximum and minimum speed of the shaft.

  b) Draw the displacement, velocity and acceleration diagram of a follower when it moves with uniform acceleration and uniform retardation motion.

  c) A punching press is required to punch 30 mm diameter holes in a plate of thickness at the rate of 20 holes per minute. It requires 6 Nm of energy per mm² of sheared area. If punching takes place in 0.1 second and the speed of the flywheel varies from 140 rpm to 160 rpm, determine the mass of the flywheel having radius of gyration of 1 meter.

  d) Two 20° involute spur gears have a module of 10 mm. The addendum is equal to one module. The largest gear has 40 teeth while the pinion has 20 teeth. Will the gear interfere with the pinion?

e) An aircraft consists of an engine of mass moment of inertia 150 kg-m^2. The engine rotates at 3600 rpm in a sense clockwise looking from the rear. The aircraft completes half circle of radius 100m flying at 360 km/hr. Determine the gyroscopic couple on the aircraft and state its effect if the aircraft
  (i) Turns towards left.
  (ii) Turns towards right.

f) Calculate the minimum speed and maximum speed of a porter governor which has equal arms each of 200 mm long and pivoted on the axis of rotation. The mass of each ball is 4 kg and the central mass on the sleeve is 20 kg. The radius of rotation of the ball is 100 mm when the governor begins to lift and 130 mm when the governor is at maximum speed.

g) The mass of turbine rotor of a ship is 8000 kg and a radius of gyration 0.6 m. It rotates at 1800 rpm clockwise when looking from the stern. Determine the gyroscopic couple and its effect in the following cases
  (i) The ship travelling at 100 km/hr steers to left in a curve of 75m radius.
  (ii) If the ship is pitching and the bow is descending with maximum velocity. The pitching is simple harmonic motion with time period of 20 seconds and total angular movement between the extreme positions is 20°.

h) Draw the controlling force diagram of a Hartnell governor and describe about stable, unstable and isochronous governor.

i) What is the condition for correct steering? Sketch and show the two main types of steering gears and discuss their relative advantages.

j) A shaft is rotating at a speed of 240 rpm. Four masses of magnitude 100 kg, 150 kg, 120 kg and 130 kg respectively are rigidly attached to the shaft. The masses are rotating in the same plane. The corresponding radii of rotation are 400 mm, 300 mm, 500 mm and 600 mm respectively. The angles made by these masses with horizontal are 0°, 45°, 120° and 255° respectively. Find
  (i) The magnitude of the balancing mass.
  (ii) The position of the balancing mass if the radius of rotation is 400 mm.

k) A single cylinder reciprocating engine has the following data:
Speed of engine= 120 rpm; stroke= 320 mm; mass of reciprocating parts= 45 kg and mass of revolving parts= 35 kg at crank radius. If 60% of the reciprocating parts and all the revolving parts are to be balanced, the find:
  (i) The balancing mass required at a radius of 300 mm.
  (ii) The unbalance force when the crank has rotated 60° from top dead centre.

l) Find the logarithmic decrement and the ratio of any two consecutive amplitude of a vibrating system, which consists of a mass of 3.5 kg, a spring of stiffness 2.5 N/mm and a damper of damping co-efficient 0.018 N-s/mm.

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 a) The turning moment diagram for a multi cylinder engine has been drawn to a scale of 1 mm = 4500 Nm vertically and 1 mm = 2.4° horizontally. The intercepted area between output torque curve and mean resistance line taken in order from one end are 342, 230, 245, 303, 115, 232, 227, 164 mm^2, when the engine is running at 150 rpm. If the mass of the flywheel is 1000 kg and the total fluctuation of speed does not exceed 3% of the mean speed, find the minimum value of radius of gyration. **(8)**

b) A pinion having 20 involute teeth of module pitch 6mm rotates at 200 rpm and transmits 1.5 kW to a gear wheel having 50 teeth. The addendum on both the wheels is 1/4 of the circular pitch. The angle of obliquity is 20°. Find **(8)**

   (i) The length of path of approach.
   (ii) The length of arc of approach.

Q4 A cam with a minimum radius of 25 mm is to be designed for a knife-edge follower with the following data: **(16)**

-To raise the follower through 35 mm during 60° rotation of the cam.
-Dwell for next 40° of the cam rotation.
-Descending of the follower during the next 90° of the cam rotation.
-Dwell during the rest of the cam rotation.

Draw the profile of the cam if the ascending and descending of the cam is with SHM and the line of stroke of the follower is 10 mm offset from the axis of the cam shaft.

What is the maximum velocity and acceleration of the follower during the ascent and descent if the cam rotates at 150 rpm?

Q5 A hartnell governor has two rotating balls of mass 2.7 kg each. The ball radius is 125 mm in the mean position, when the balls are vertical and the speed is 150 rpm and the sleeve is rising. The length of the ball arm is 140 mm and length of the sleeve arm is 90 mm. The stiffness of the spring is 7 kN/m and the total sleeve movement is ±12 mm from the mean position. Allowing for a constant frictional force of 14 N acting at the sleeve, determine the speed range of the governor at lowest and highest sleeve positions. Neglect obliquity of arms. **(16)**

Q6 **a)** Define the terms: vibration isolation and transmissibility. Derive the expression for transmissibility at resonance. **(8)**

   b) A body of mass 50 kg is supported by an elastic structure of stiffness 10 kN/m. The motion of the body is controlled by a dashpot such that the amplitude of vibration decreases to (1/10)th of its original value after two complete vibrations. Determine **(8)**

   (i) Damping force at 1m/s.
   (ii) The damping factor.
   (iii)The natural frequency of damped vibration.