* K D - 6 4 3 1 *

KD-6431

B. E. II (Sem. IV) (Chemical) Examination

December – 2012

Theory of Machines & Machine Design

Time : Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. 2 (Sem. 4) (Chemical)**

Name of the Subject :

☛ **Theory of Machines & Machine Design**

☛Subject Code No. : **6 4 3 1** ☛Section No. (1, 2,.....) : **Nil**

Seat No. :

Student's Signature

(2) Questions 1 and 5 are compulsory.

(3) Attempt any two questions from questions 2, 3 and 4 and any two from questions 6, 7, and 8.

(4) Use of scientific calculator and design data-book is permitted.

(5) Assume suitable data, if necessary.

1 (a) What do you understand by the following joints in a chain ? Binary joint, Ternary joint, Quaternary joint. Give figure. **5**

(b) Define : (i) Rigid link, (ii) Structure. Give difference between a machine and a structure. **5**

2 What are the different types of motions of a follower in a cam-follower assembly ? Draw the profile of a cam operating a roller reciprocating follower and with the following data : **20**

Minimum radius of cam = 25 mm

Lift = 30 mm

Roller follower = 15 mm

The cam lifts the follower for 120° with SHM followed by a dwell period of 30°. Then the follower lowers down during 150° of cam rotation with uniform acceleration and deceleration followed by a dwell period.

3 (a) Give classification of gears. Define the following terms : circular pitch, module, addendum, pressure angle, path of contact **10**

(b) The following data relate to two meshing gears : Velocity ratio = 1/3, Module = 4 mm, Pressure angle = 20°, Centre distance = 200 mm. Determine the number of teeth and base circle radius of the gear wheel. **5**

(c) Each of two gears in a mesh has 48 teeth and a module of 8 mm. Teeth are of 20° involute profile. The arc of contact is 2.25 times the circular pitch. Determine the addendum. **5**

4 (a) A body is to be moved up an inclined plane by applying a force parallel to the plane surface. If 3 kN is required to just move it up the plane when angle of inclination is 10° whereas the force needed increases to 4 kN when angle of inclination is increased to 15°, determine the weight of the body and the coefficient of friction. **7**

(b) Screw efficiency of square threads is given by **7**

$$\eta = \frac{\tan\alpha}{\tan(\alpha+\varphi)}$$

where, α = helix angle of thread, φ = angle of friction.

Show that efficiency becomes maximum when $\alpha = \frac{\pi - 2\varphi}{4}$

(c) A load of 15 kN is raised by a screw jack. The mean diameter of square threaded screw is 42 mm and pitch is 10 mm. A force of 120 N is applied at the end of its lever to raise the load. Determine the length of lever used. Take μ = 0.12. **6**

5 Attempt the following : **10**

(i) The _____ fillet welded joint is designed for shear strength. (transverse/parallel)

(ii) Name the important terms (terminology) used in riveted joints.

(iii) Which joint is used to connect piston rod with crosshead in a stream engine ?

(iv) Define 'module' for a spur gear.

(v) What are the standard pressure angle values for gears ?

(vi) Define : factor of safety.

(vii) Write the relation between diameter of rivet hole d and thickness of plate t.

(viii) What are the types of rigid couplings ?

(ix) What is dedendum ?

(x) Tension in the slack side of the belt is _____ tension in the tight side of the belt. (=,<,>)

6 (a) Design a rigid flange coupling to transmit a torque of 250 N-m between two coaxial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. **14**

The permissible stress are :
Shear stress on shaft = 100 MPa
Bearing or crushing stress on shaft = 250 MPa
Shear stress on keys = 100 MPa
Bearing stress on keys = 250 MPa
Shearing stress on cast iron = 200 MPa
Shear stress on bolts = 100 MPa.

(b) Show that a square key is equally strong in shearing and crushing. **6**

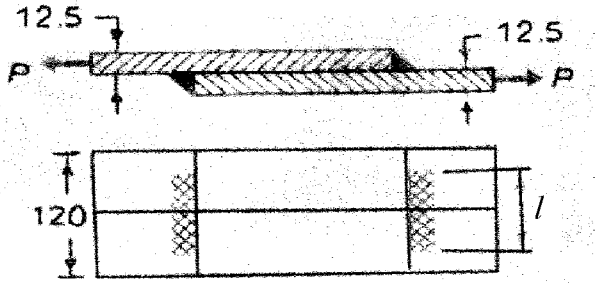
7 (a) A belt drive consists of two v-belts in parallel, on grooved pulleys of same size. The angle of groove is 30^{o}. The cross-sectional area of each belt is $750\ mm^2$ and $\mu = 0.12$. Density of belt material is $1200\ kg/m^3$ and maximum safe stress is 7 MPa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 rpm. **5**

(b) An electric motor drives an exhaust fan. Following data are given : **8**

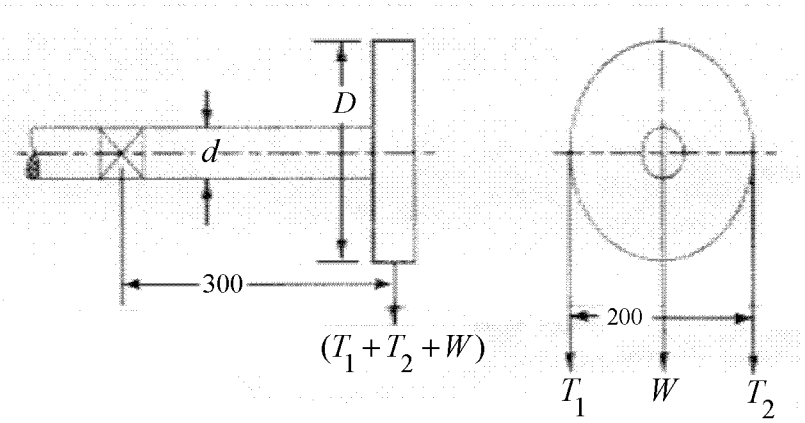
	Motor pulley	Fan pulley
Diameter	400 mm	1600 mm
Angle of wrap	2.5 radian	3.78 radian
Coefficient of friction	0.3	0.3
Speed	700 rpm	-
Power transmitted	22.5 kW	-

Calculate width of flat belt if its thickness is 5mm. Take permissible stress for belt as 2.3 MPa.

(c) Two steel plates, 120 mm wide and 12.5 mm thick, are joined together by means of double transverse fillet welds as shown in Fig. The maximum tensile stress for the plates and the welding material should not exceed 110 N/mm^2. Find the required length of weld, if the strength of weld is equal to the strength of the plate. **7**



8 (a) A pulley is overhung from a shaft as shown in figure. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and maximum power transmitted through the flat-belt of this pulley is 1 kW at 120 rpm. The angle of lap of the belt is 180° and μ = 0.3. Calculate equivalent twisting moment and find out diameter of the shaft if allowable shear stress is 35 MPa. **7**



(b) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 80 kN. The ultimate strength of material of the rod against tearing is 420 MPa. The ultimate tensile and shearing strength of the pin material are 510 MPa and 396 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 6. **13**