A helical compression spring with an objective of minimizing weight, using the following data is to be designed

i) Spring Index = 6
ii) Maximum permissible deflection = 25 mm
iii) Minimum permissible deflection = 10 mm
iv) Axial (Static) load = 1200 N
v) Allowable shear stress for alloy steel spring = 1200 N/mm^2
vi) Modulus of rigidity for spring material = 85 GN/m^2
vii) Density of spring material = 8000 kg/m^3

Use the relations $C = \frac{D}{q}$

$$K_s = \left[1 + \frac{0.5}{C}\right]$$

$$\tau = Ks\left[\frac{8WC}{\pi d^2}\right]$$

$$K = \frac{W}{S} = \frac{Gd}{8C^3 n}$$

With the usual meaning of notations.

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Roll No .....

ME - 802

B.E. VIII Semester

Examination, June 2014

Machine Design

Time : Three Hours

Maximum Marks : 70

Note: 1. Answer all five questions.
2. Use of Design Data Book is permitted.
3. All questions carry equal marks.

1. A Flat belt drive is used to derive a reciprocating compressor running at 720 rpm by a 15KW, 1440 rpm electric motor the required centre distance is 2.1m. Select a FLAT BELT for the drive from the MANUFACTURER'S CATALOGUE the power rating per mm width of the belt per ply at 180° Arc of contact and 10m/s belt speed is 0.024KW.

OR

Write down the standard procedure for the selection of ROLLER CHAINS from MANUFACTURER'S CATALOGUE.

2. A pair of SPUR GEARS is to be used to transmit 4KW power from the pinion rotating at 480 rpm to the gear rotating at 120rpm. The teeth are 20° full depth involute and the centre distance should be as small as possible. Design the gear pair based on the BEAM STRENGTH CONSIDERATION.

OR

A helical pinion having 20 teeth transmits 30KW power at 30 revolution per second. The normal module is 4mm while the FACE WIDTH is 36mm. The normal pressure angle is 20° and the helix angle is 30°. If the gear pair is made of steel. Determine the maximum contact stress in the tooth.

3. Following is the data pertaining to a single cylinder 4-stroke I.C engine. Find the suitable dimensions of the cross section of the connecting rod under gas load and check the design under inertia load due to self weight of the connecting rod.

   i) Power 10 KW at 800 rpm.
   ii) Maximum explosion pressure = 2.2 N/mm² at T.D.C
   iii) Gas pressure at maximum torque position = 1.2N/mm²at θ=40°
   iv) Mass of the reciprocating parts = 2 kg
   v) Density of the connecting rod material = 7.2kg/1000cm³
   vi) Cylinder diameter = 110 mm
   vii) Stroke = 160 mm
   viii) Length of the connecting rod = 360 mm

   Assume any other data required suitably.

OR

Find the thickness of the PISTON CROWN for a 4-stroke engine with the following specifications:

   i) Mean effective pressure = 0.7 N/mm²
   ii) B.S.F.C = 0.26 kg/KW-hr
   iii) *l*/r = 4
   iv) Engine speed = 1500 rpm
   v) Piston diameter = 87 mm
   vi) Length of stroke = 96 mm

   vii) Heat conducted through crown = 10% of the heat generated during combustion
   viii) Calorific value of the fuel = 42 MJ/kg

   Assume that the piston is made of Aluminium alloy with thermal conductivity of 175 W/m°C and allowable temperature difference = 110°C. Assume any other data required suitably.

4. Two mild steel shafts which are alignment are to be connected by a coupling. The coupling is required to transmit 12 KW at 300 rpm. The maximum torque to be transmitted is 30% greater than the mean torque. Due to frictional requirement of the system the angle of twist of the shaft must not exceed 1° in a length of 20 diameters.

   Design a suitable coupling so that it allows easy disassembly of the driving and driven machines.

OR

A cast iron pipe is to be used for carrying 18m³ per minute of compressed air at a pressure of 125 N/mm². The velocity of the air in the pipe is limited to 10 m/s. If the allowable tensile stress for the pipe is 15 N/mm². Calculate the dimensions of the pipe.

5. Define the following terms

   a) Linear and Non Linear Programming Problems.
   b) Constrained and Unconstrained optimization problems.
   c) Static and Dynamic optimization problems.
   d) Single objective and Multiobjective programming problems.

OR