TE /V/PROD/ED/CBGS/V

Engg. Design

02.06.16

QP Code : 31213

(3 Hours)

Total Marks: - 80

N.B. : (1) **Question No. 1 is compulsory.**
(2) Attempt **any three** questions out of the remaining five questions.
(3) Figures to the right indicate full marks.
(4) Furnish neat sketches wherever necessary.
(5) Assume any additional date if required, clearly mentioning the same.
(6) Use of PSG Design Data Book is permitted.

Q.1 Attempt **any four** of the following:-

(a) Sketch the various end connections used for compression and tension springs, and explain their implications in design and applications. *5*

(b) Explain how would you check for bending and ensure the safety of the pin used in a knuckle joint. *5*

(c) Explain how you would determine the efficiency of a riveted joint. Furnish appropriate sketches and relevant equations. *5*

(d) What is stress concentration? What are its sources? Explain various approaches used in design to minimize the level of stress concentration hazards. *5*

(e) Enumerate with sketches various types of keys and their selection criteria. *5*

Q2. (a) Design and sketch a turn buckle for connecting two tie rods and to sustain an axial load of 20 kN. The axial adjustment to be achieved between the tie rods is around 50 mm. Select appropriate materials and safe stresses for different parts of the turn buckle, with justification. *10*

(b) Design a double riveted butt joint with two cover plates for riveting the longitudinal seams of a steam boiler shell of 1 m internal diameter. The operating pressure of the boiler is 1 N/mm^2 and the riveted joint must have an efficiency of 80%. The allowable tensile stress in the shell plates is 90 N/mm^2. The permissible shear and crushing stress in the rivets are 60 N/mm^2 and 130 N/mm^2 respectively. Assume the design pressure to be 5% more than the operating pressure and a corrosion allowance of 1.5 mm. The design should conform to Indian Boiler Regulations (IBR). Prepare a neat sketch of your design. *10*

Q3. (a) Design a flange coupling to connect two shafts in order to transmit 15 kW at 720 rpm. Assume the following safe stresses. *12*
Shear stress in the material of the shafts and keys = 40 N/mm^2
Shear stress in the material of the bolts = 25 N/mm^2
Shear stress in the material of the flanges = 15 N/mm^2
Crushing stress in bolts and keys = 90 N/mm^2
Prepare a neat sketch of your design depicting the assembly of the coupling.

(b) The critical cross section of a crane hook, in its simplified form, is trapezoidal in shape with 100 mm and 60 mm as lengths of it's parallel sides and 120 mm as it's depth. The capacity of the crane hook is 80 kN and it's bed diameter is 200 mm. Determine the resultant stresses at the extreme fibers at the critical cross section. *8*

Q4. (a) With the help of neat sketches bring out the constructional and design features of a semi elliptical leaf spring. *4*

(b) A laminated steel spring with a span of 0.8 m is to support a load of 5 kN. If the maximum deflection of the spring is not to exceed 40 mm and max. stress is limited to 250 N/mm^2, design the required thickness and number of leaves. The width of each leaf is to be 75 mm. Take E = 200 GPa. *6*

[Turn Over]

(c) A pair of spur gears is to transmit 20 kW from a shaft running at 1000 rpm to another shaft to run at 500 rpm. The pinion is made up of plain carbon steel with an ultimate stress of 400 N/mm^2 and the gear made up of cast iron has an ultimate stress of 200 N/mm^2. Both the pinion and gear wheels are of full depth, involute teeth with pressure angle of 20°. Design and sketch both the pinion and gear. Use following data. *10*

Service factor = 1.2

Factor of safety = 2

Face width = 20 module

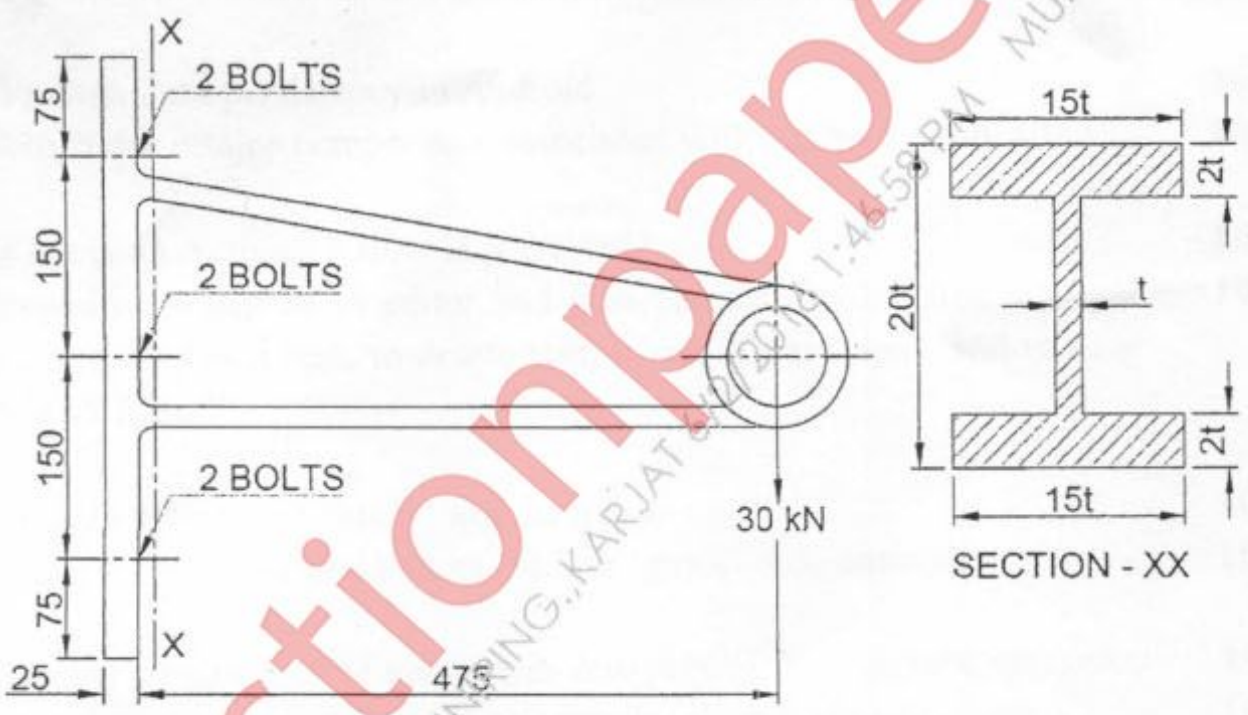
Number of teeth on pinion = 20

Tooth form factor, $Y = 0.154 - \frac{0.912}{Z}$, Z = Number of teeth.

Velocity factor = $\frac{3}{3+V}$, V = Pitch line velocity in m/sec.

Q5. (a) Discuss about the principle involved in designing bolts for applications involving fluid tight, leak proof joints. What is meant by 'bolts of uniform strength'? *5*

(b) A cast iron bracket is fixed to a wall with 6 bolts as shown in figure.



i) Design the bracket cross section at section x-x, allowing the following safe stresses. *7*
$f_t = 15\ N/mm^2$ and $f_c = 200\ N/mm^2$.

ii) Design the size of the 6 bolts required to fasten the bracket to the wall. Take *8*
$f_t = 60\ N/mm^2$ and $f_s = 40\ N/mm^2$ for the material of the bolts.

Q6. a) A steel shaft transmitting 20 kW at 250 rpm is supported on two bearings 700 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100 mm to the left of right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of left hand bearing and receives power from below in a vertical direction. *10*

Design a suitable diameter for the shaft, allowing a safe stress of 60 N/mm^2 in shear.

b) A cylindrical vessel meant for storing liquefied gas at a pressure of 15 N/mm^2 has an inner diameter of 260 mm. The ultimate tensile strength for the material of the vessel 350 N/mm^2. Design the wall thickness required for the vessel to sustain the above pressure. Also determine the radial and tangential stresses across the wall of the vessel at the inner, outer and middle points. *6*

c) Discuss about the different types of welded joints and their strengths. Give sketches. *4*
