# BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

## Term-End Examination 00861
### December, 2012

## BME-024 : MECHANICAL ENGINEERING DESIGN

*Time : 3 Hours*                                    *Maximum Marks : 70*

*Note :*     *Answer **any five** questions. All questions carry **equal** marks. Use of calculator and Design Data hand book is permitted. Assume missing data if any.*

1.   (a)   Specify the reasons for the followings :     4x2=8
        (i)    Why are compressive residual stresses fatigue designer's best friend ?
        (ii)   Why are square threads prefered over V-threads for power transmission ?
        (iii)  Why is selection of material for springs based on resilience ?
        (iv)   Why are levers usually tapered ?

     (b)   Select the suitable materials for the following components with justification :     4x1.5=6
        (i)    A bull gear
        (ii)   High pressure pipe joint flange
        (iii)  Coupling
        (iv)   Rivets for aeroplanes

2. (a) Explain the factors responsible for selection 7
of material for a machine component. How
are forged components superior than casted
components?

(b) A boiler shell 1200 mm in diameter is 7
subjected to steam pressure of 1.5 MPa.
Design a longitudinal joint-double chain
riveted butt joint and also calculate the
efficiency of the joint. Draw a neat sketch
of the joint and show dimensions. Assume
that plate and rivets are made of same
material with permissible stresses given
below :

Permissible tensile stress    = 80 MPa.

Permissible shearing stress   = 65 MPa.

Permissible crushing stress   = 130 MPa.

3. A shaft transmitting 120 kW is to be connected to 14
a coaxial shaft through Grey cast iron flange
coupling-protected type. The shaft runs at
1440 rpm. The keys and shafts are made up of
the same material for which permissible shearing
stress is 55 MPa, and compressive stress is 90 MPa.
The steel bolts are subjected to a shearing stress
of 30 MPa. But the permissible shearing stress in
C.I. flange is 10 MPa (only). Design and draw a
protected type flange coupling.

4. (a) Write four major applications of spring   **4**
       alongwith examples.

   (b) At the bottom of an elevator shaft a group   **10**
       of six identical springs are set in parallel to
       absorb the shock of elevator in case of failure.
       The elevator weighs 2 tons. Assuming that
       the elevator has a free fall of 1.5 m from rest,
       calculate the maximum shearing stress in
       each spring. Each spring is made of 25 mm
       diameter rod. Assume spring index of 6 and
       number of active coil ≈ 15. Take $G = 83$ GPa.
       Neglect effect of counter weights in the
       system. Assume Wahl's correction factor

$$k = \frac{4c - 1}{4c - 4} + \frac{0.615}{c}$$

       Where 'c' is the spring index.

5. A multiple disk chutch made of steel and bronze
   lined with friction lining with an expected
   co-efficient of friction 0.12; is to transmit 5 kW at
   960 rpm. The inner radius of contact is 40mm and
   outer radius of contact is 70 mm. If the average
   allowable pressure is 0.35 MPa. (max.) Determine:-

   (a) How many total disks of steel and bronze
       are represented ?                **4+4+4+2=14**

   (b) What is the average pressure at interface ?

   (c) What axial force is required ?

   (d) Actual maximum pressure at($r_i$) inner
       radius (Assume uniform wear conditions).

6. A vertical screw jack, having ISO metric square threads is supposed to lift a design load of 120kN through a height of 250 mm. The screw is made of C40 with following valves:-

Ultimate Compressive stress = 440 MPa

Ultimate shearing stress = 200 MPa

Yield stress = 340 MPa

and nut is made of GCI FG 200 ($\sigma_{u15}$ = 200 MPa) The safe bearing pressure between the screw and nut is 14 MPa. Assume a coefficient of friction 0.14 and a factor of safety of 5 for screw.

(a) Design the screw for maximum shear stress and for safe buckling.    **6**

(b) Determine the height of nut.    **4**

(c) What is the efficiency of screw jack ?    **4**

7. A pain of spur gears, with pressure angle 20° full **14** depth invalute teeth is to transmit 15kW at 750 rpm. The speed of the pinion is 1500 rpm. The gear material is cast iron and pinion is made of steel. The allowable static stress for gear and pinion are 60 MPa and 110 MPa respectively. Assume minimum number of teeth on the pinion

as 18 and velocity factor is given as $C_V = \dfrac{6}{6 + v}$

(where 'v' is pitch line velocity) and tooth form

factor (Lewis) 'y' $y = \left(0.154 - \dfrac{0.912}{\text{no. of teeth}}\right)$.

Design the gears completely on strength basis and check for dynamic load and wear load. Assume surface endurance strength of pinion=600MPa. The gears are carefully cut with an error of action 0.035mm.

8. (a) A journal bearing 95 mm long supports a load of 10 kN on a 50 mm diameter journal running at 750 rpm. The diameteral clearance is 0.07 mm. Determine the visocity of the oil, if the operating temperature of the bearing surface is to be limited to 750°C when in still air at 20°C.    7

   (b) Derive Stribeck's equation for static capacity of a single row deep groove ball bearing.    7

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