

**BITS PILANI-DUBAI, INTERNATIONAL ACADEMIC CITY, DUBAI
FIRST SEMESTER 2009-2010**

COMPREHENSIVE EXAMINATION

Course Name: Design of Machine Elements
Course No. : ME C312
Duration : 3 Hours

Max Marks: 80
Weightage: 40%
Date: 29-12-2009

- NOTE:**
- Write your ID Number on the top immediately on the receipt of this paper.
 - Required values, tables & charts are given in the paper.
 - Personal data table & charts are not allowed in the examination hall.
 - If any data is missing, assume the suitable value with proper justification.
 - Description of symbols & notations is necessary for formulae used.
 - Attempt all the questions & **maintain the order of questions in the answer script**, as they appear in question paper.

Q.1

- What are the phases in Design Process, Discuss them with a suitable flow process chart. **(Marks:5)**
- Why theories of failures are used in the Design Process? Compare the suitability of different theories on a common diagram. **(Marks:5)**

Q.2

- Describe the Miners' Rule Miners' Rule for fatigue damage with its significance. **(Marks: 2)**
- A steel plate 52 mm wide and 15 mm thick as shown in figure-2 changes in width to 40 mm over a transition radius of 5 mm. The plate is subjected to axial fluctuating load varying between 5F and 2 F. The steel plate is heat treated to have tensile strength of 920 N/mm² and yield strength of 750 N/mm². Assume notch sensitivity index of 0.9 and that the notch is ground finished. Also assume that there is no effect of size in case of plate. *Calculate the load that can be applied in the fluctuating cycle.*

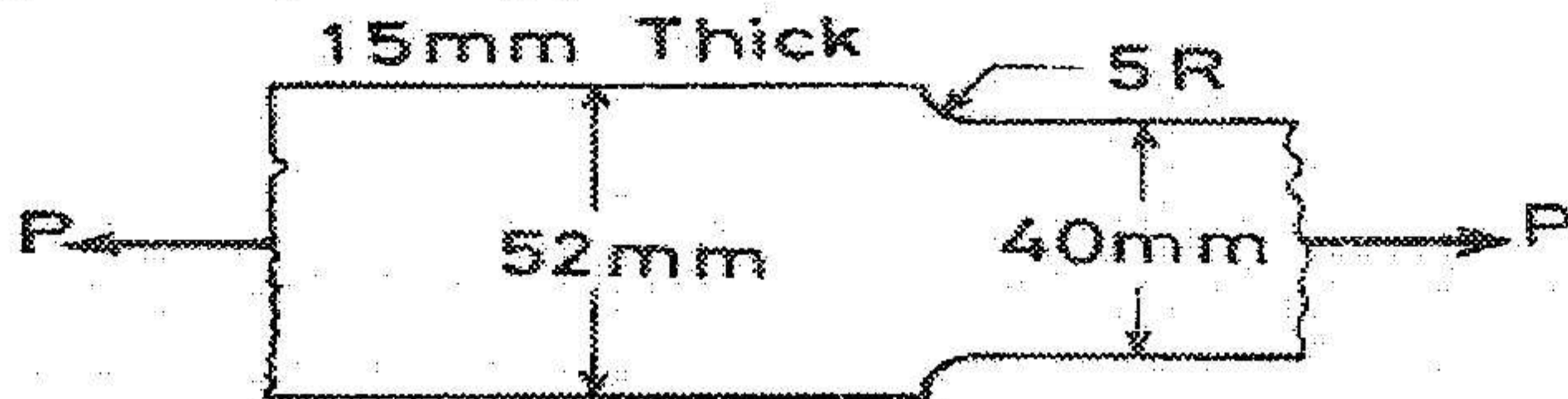


Figure-2

Assume following:

Surface Modification Factor	K_a	= 1
Size Modification factor	K_b	= 1
Load Modification factor	K_c	= $1.43[S_{ut}]^{-0.0778}$
Temperature Modification factor	K_d	= 1
Miscellaneous Effect Modification factor	K_e	= $1/K_f$
Factor of safety	n	= 1.3

(Marks:8)

Q.3

- (a) What is meant by uniform Strength of Bolts? **(Marks: 2)**
- (b) An angle of size 200 mm x 150 mm x 10 mm is required to be welded to a steel plate by a fillet weld as shown in the figure-1. If the angle is subjected to a static load of 200 KN, *determine the top and bottom weld lengths.* The allowable shear strength for static loading may be taken as 75 N/mm². **(Marks:8)**

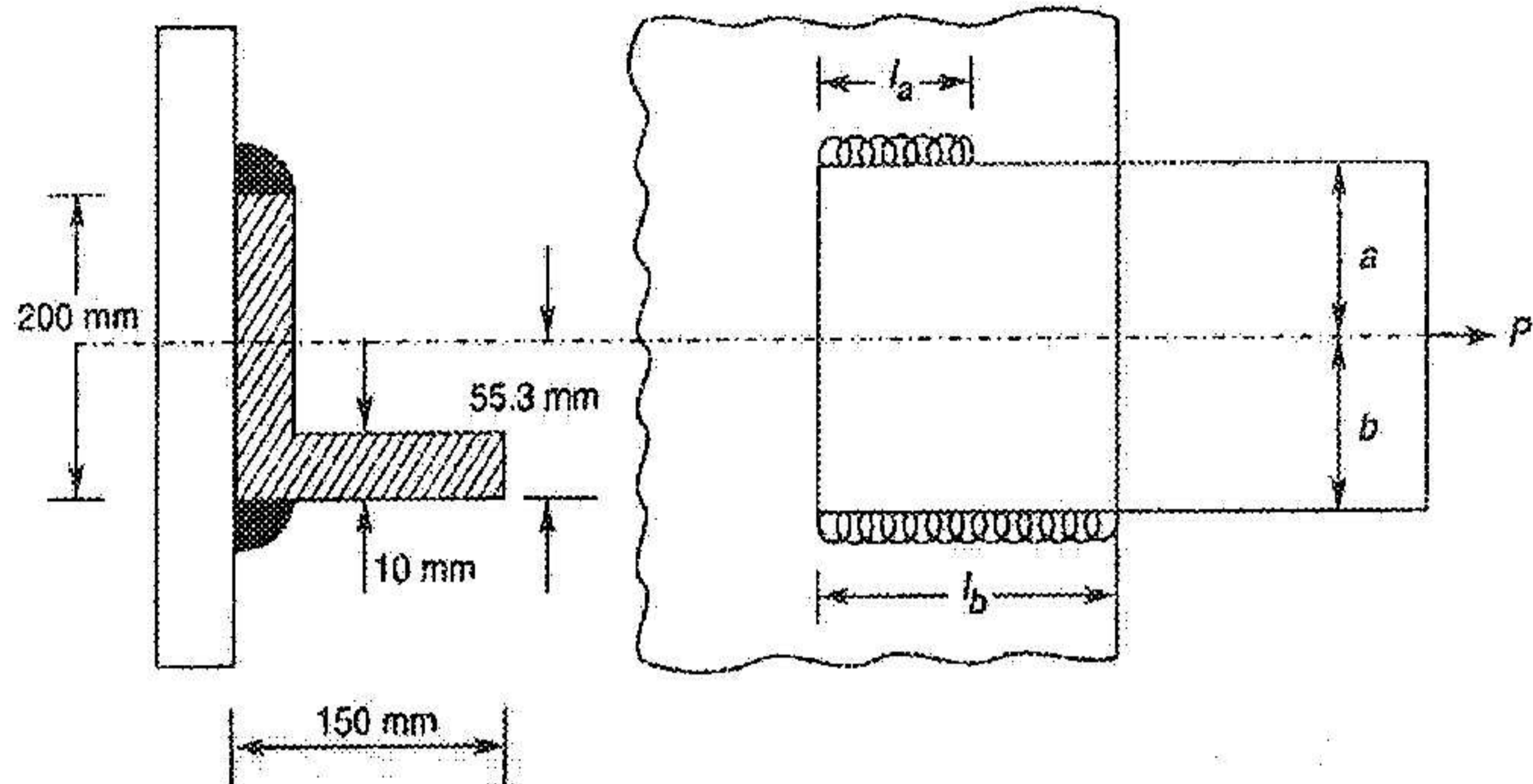


Figure-2

Q.4

- (a) Explain the Buckling in helical springs? **(Marks: 2)**
- (b) *Design & draw* a valve spring of a petrol engine for the following operating conditions:
- | | |
|---|------------|
| Length of spring when the valve is open | = 40 mm. |
| Length of spring when the valve is closed | = 50 mm. |
| Spring load when valve is open | = 400 N. |
| Spring Load when Valve is closed | = 200 N. |
| Maximum inside diameter of the spring | =28 mm. |
| Maximum permissible shearing stress | =400 MPa. |
| Modulus of rigidity | =80000 MPa |

SWG	4	5	6	7	8	9	10	11	12
Dia (mm)	5.893	5.385	4.877	4.470	4.064	3.658	3.251	2.946	2.642

Take the Wahl's K factor for spring index C

$$K = \frac{4C - 1}{4C - 4} + \frac{0.615}{C}$$

Marks: 8)

Q.5

- (a) Describe the procedure for selection of Roller bearings from manufacturer's catalogue and also elaborate the different formulae used for the same. **(Marks:5)**
- (b) Discuss the stable & unstable lubrication in journal bearings with the help of Petroff's relation. **(Marks: 5)**

Q.6

- (a) Explain the term Pressure angle for spur gears with suitable sketch. **(Marks: 2)**
- (b) A gear train transmitting 5 kW at 1440 rpm is shown in the following figure-3. The number of teeth on gears A, B, C, and D are 25, 100, 30, and 150, respectively. All gears have 5 mm module and a 20° full-depth involute profile gear tooth. Calculate the tangential and radial components of forces between gears A and B and between gears C and D. Also calculate the reactions at the bearing supports S1 and S2 due to horizontal forces. **(Marks: 8)**

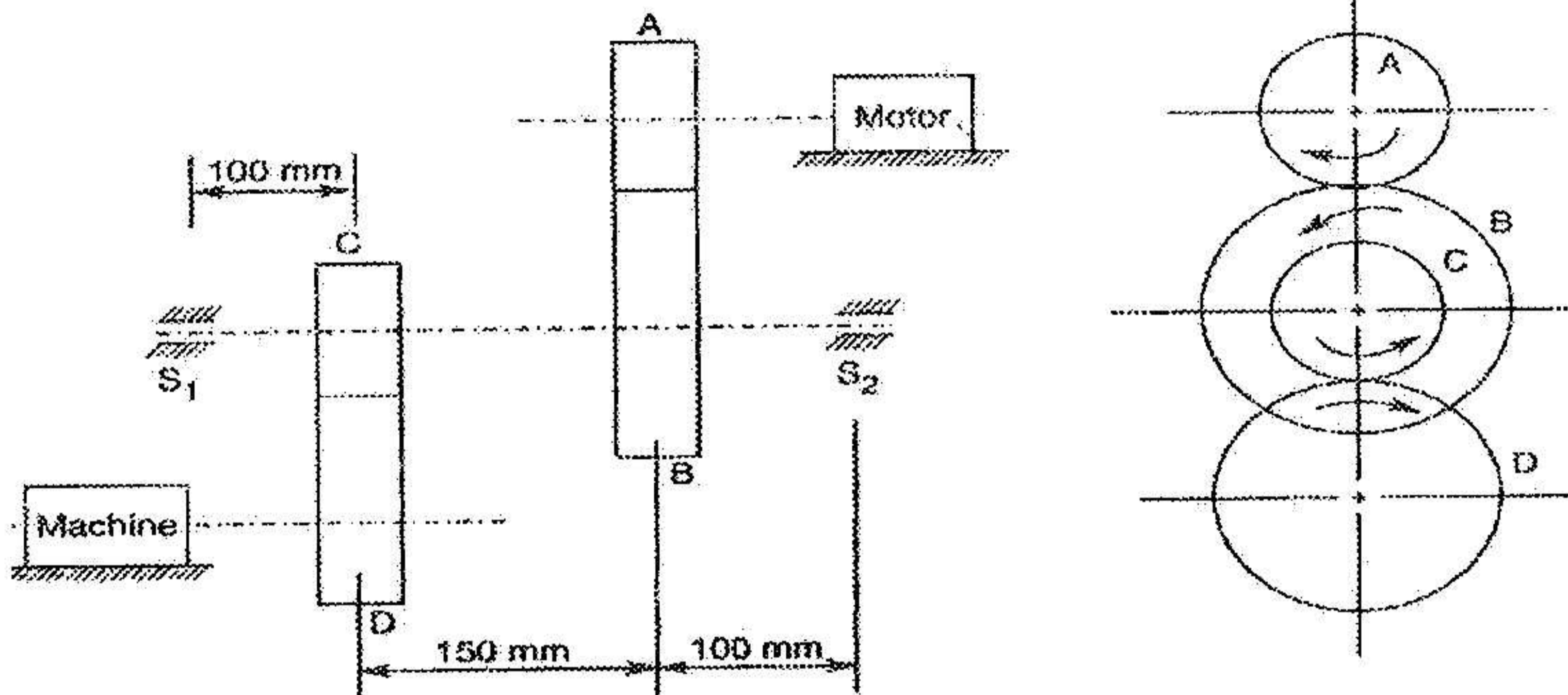


Figure-3

Q.7

- (a) What use of flywheels in the different engines or Machines. **(Marks:2)**
- (b) An internal expanding brake has the arrangement of two brake shoes which act on the internal surface of a cylindrical drum. The braking force F_1 and F_2 are applied as shown in figure-5 and each shoe pivots on its fulcrum O_1 and O_2 . The width of the brake lining is 35 mm; the intensity of pressure at any point A is $0.4 \sin\theta \text{ N/mm}^2$, where θ is measured as shown from either pivot. The coefficient of friction is 0.4. Determine the braking torque and the magnitude of the forces F_1 and F_2 .

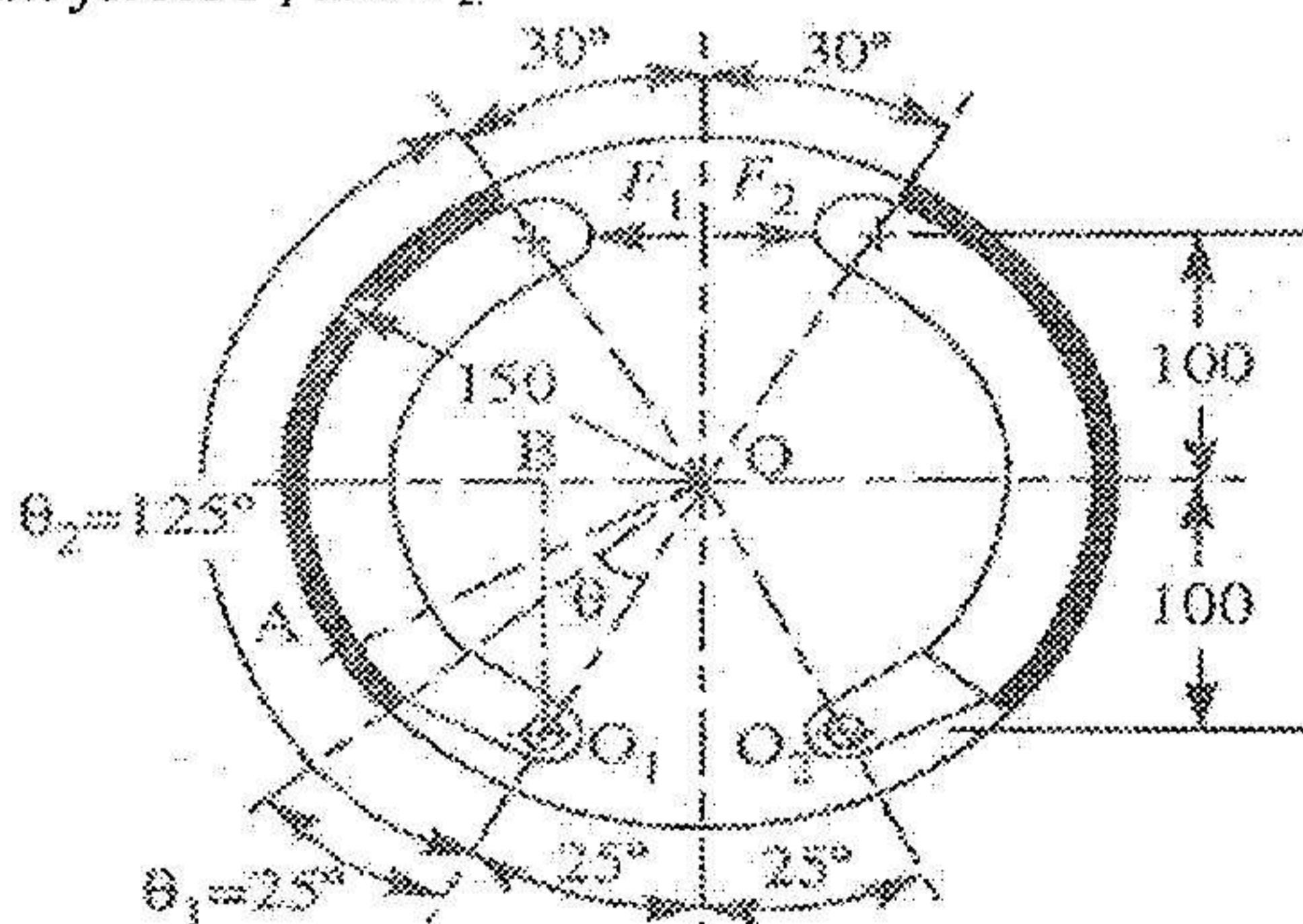


Figure-5

(Marks:8)

Q.8

- (a) What are flexible machine elements give their also give their applications & advantages.
(Marks:2)
- (b) A transmission shaft supporting a spur gear B and pulley D is shown in Fig.5. The shaft is mounted on two bearings A and C. The gear and the pulley are keyed to the shaft. The diameters of pulley and gear are 450 and 300 mm respectively. 20 kW power at 500 r.p.m. is transmitted from the pulley to the gear. P_1 and P_2 are the belt tensions in the tight and lose sides, while P_t and P_r are tangential and radial components of the gear tooth force.

(Marks: 8)

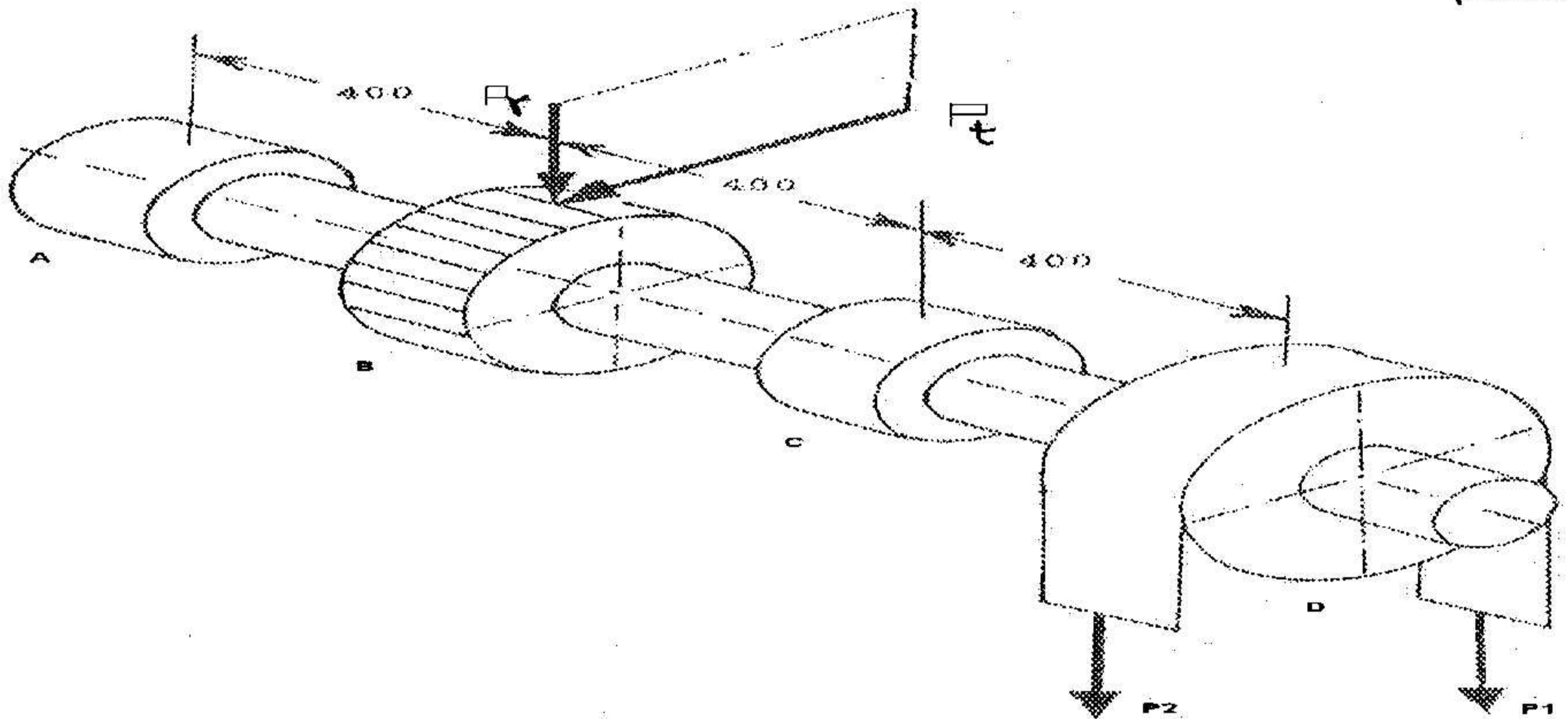


Figure-5

Assume the following

$$P_1 = 3P_2$$

$$P_r = P_t \tan(20^\circ)$$

Ultimate tensile strength of the shaft material $S_{ut} = 700 \text{ N/mm}^2$ Yield Strength of the shaft material $S_{yt} = 460 \text{ N/mm}^2$ Combined shock and fatigue factor for bending $K_m = 1.5$ Combined shock and fatigue factor for torsion $K_t = 1.5$

Design the shaft diameter for the above case.

-----END-----

Your I.D:-----

BITS, PILANI-DUBAI, INTERNATIONAL ACADEMIC CITY, DUBAI
FIRST SEMESTER 2009-2010
Open Book Test

Course Name: Design of Machine Elements *T121.2*
Course No. : ME C312
Class : IIIrd Yr. Mech.
Nature of Component: Open Book

Max Marks: 40
Weightage: 20%
Date: 06-12-2009
Duration: 50 Minutes

Instructions:

- i) Write your ID Number on the top immediately on the receipt of this paper.
- ii) If any data is missing, assume suitable value.
- iii) Draw the figures for supporting your answers & describe the symbols used.
- iv) Text Book "Mechanical Engg. Design" J.E Shigley is allowed in Examination Room.
- v) Hand written class Notes are allowed in Examination Room.
- vi) No photo copies (Books, Class Notes & Chats etc) are allowed in Examination Room
- vii) Attempt all the questions & *maintain the order of questions in the answer script, as they appear in question paper.*

Q.1

- (a) Briefly write the significance of gasket in bolted joints. **(Marks: 5)**
- (b) Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity = 84 kN/mm². Neglect the effect of stress concentration.
Draw a fully dimensioned sketch of the spring, showing details of the finish of the end coils

(Marks: 15)

Q.2.

- (a) Briefly write the advantages of roller bearing over journal bearings. **(Marks: 5)**
- (b) Design a journal bearing for a 10 MW, 1000 rpm steam turbine which is supported by two bearings. Consider the bearing to be an average industrial bearing & operating temperature for bearing oil is 60 °C. The environmental temperature is 25 °C. Use the following data:

Maximum Bearing pressure $P_{max} = 1.9 \text{ MN/m}^2$
Bearing Angle $\beta = 360^\circ$
l/d ratio = 1
Heat Transfer constant $K = 15 \text{ W/(m}^2\text{K)}$
Tensile Yield Strength $S_{yt} = 1275 \text{ N/mm}^2$ {for the Ni Cr steel Material of turbine rotor}
FOS for rotar Material = 2.6
Density for turbine oil $\rho = 890 \text{ Kg/m}^3$
Specific heat at constant pressure $C_p = 1950 \text{ J/(kg }^\circ\text{C)}$

(Marks: 15)

BEST OF LUCK

**BITS PILANI, DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
FIRST SEMESTER 2009-2010**

Closed Book Test

Course Name: Design of Machine Elements

MAX MARKS: 50

Course No. : ME C312

WEIGHTAGE: 25%

Nature of Component: Closed Book

Duration: 50 Minutes

- NOTE:**
- i) Write your ID Number on the top immediately on the receipt of this paper.
 - ii) If any data is missing, assume suitable value.
 - iii) No data table & charts are allowed in the examination hall.
 - iv) Draw the figures for supporting your answers & describe the symbols used.
 - v) Attempt all the questions & *maintain the order of questions in the answer script, as they appear in question paper.*

Q.1

(Marks: 2x5=10)

- (a) Describe the various Phases of Design Process.
- (b) List any ten Engineering design considerations.
- (c) What is Factor of Safety? Give its importance in Design process.
- (d) What is meant by endurance strength of a material?
- (e) What information do you obtained from Gerber's Parabola?

Q.2

(Marks: 10+10=20)

An Automobile I C engine cylinder head is shown in figure1 requires 10 hexagonal bolts. During its use, one bolt is subjected to a direct load of 25000 N and shear load of 15000 N. The yield strength of bolt material 990 HB steel is 200 MPa & Poisson's ratios 0.3. Take the factor of safety as 2

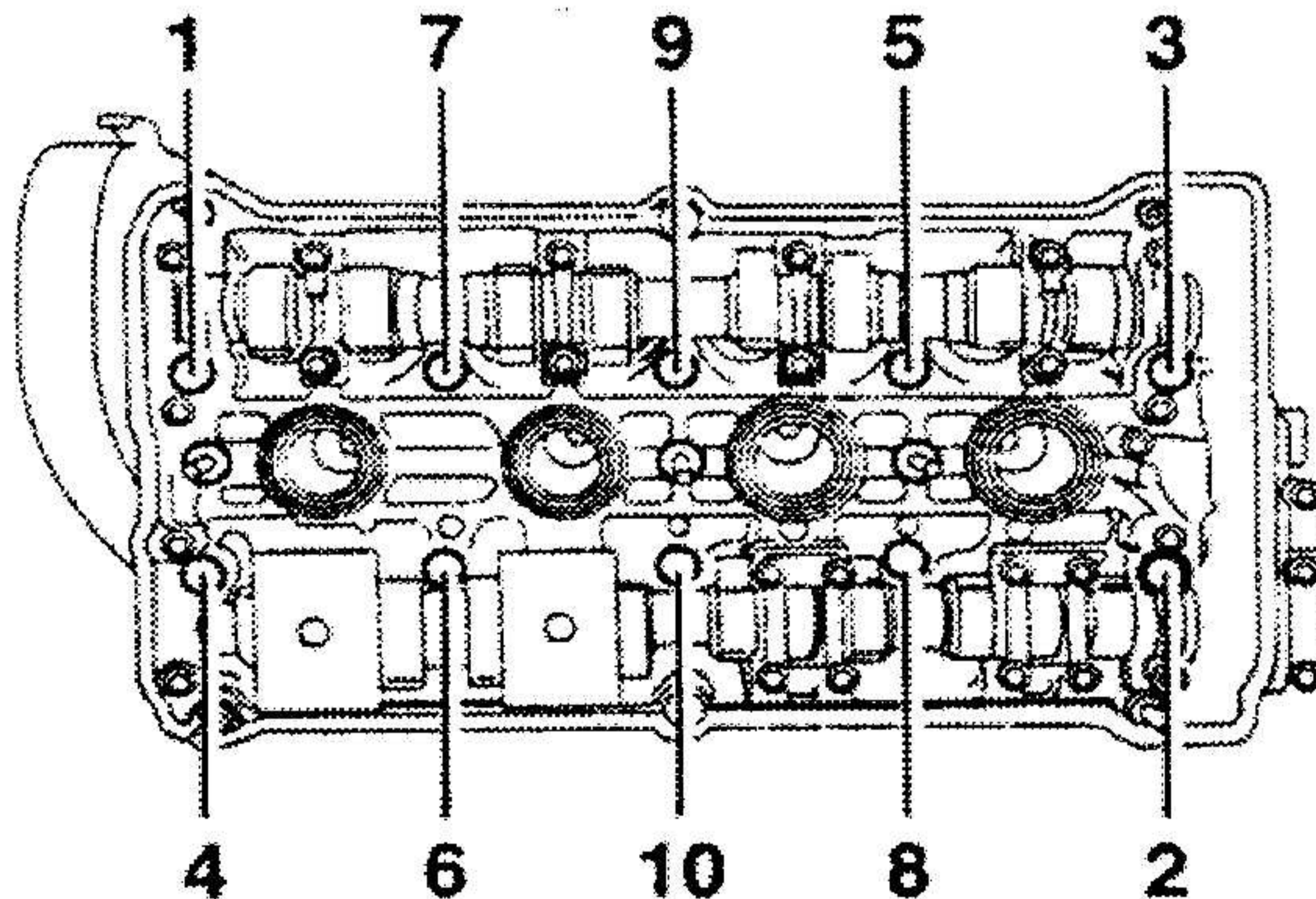


Figure-1

- (a) Design a bolt for this cylinder, according to:
- Rankin's theory of failure.
 - Tresca's theory of failure.
 - Haigh's theory of failure.

(b) As a designer which theory of failure you will chose for bolt design & why? Discuss your results graphically.

Q.3

(Marks: 5x4=20)

In a material testing laboratory a test was performed for C40 steel specimen with the help of a rotating beam type fatigue testing machine shown in figure-2. This steel specimen has mean ultimate tensile strength of 725 N/mm^2 & mean yield strength of 415 N/mm^2 .

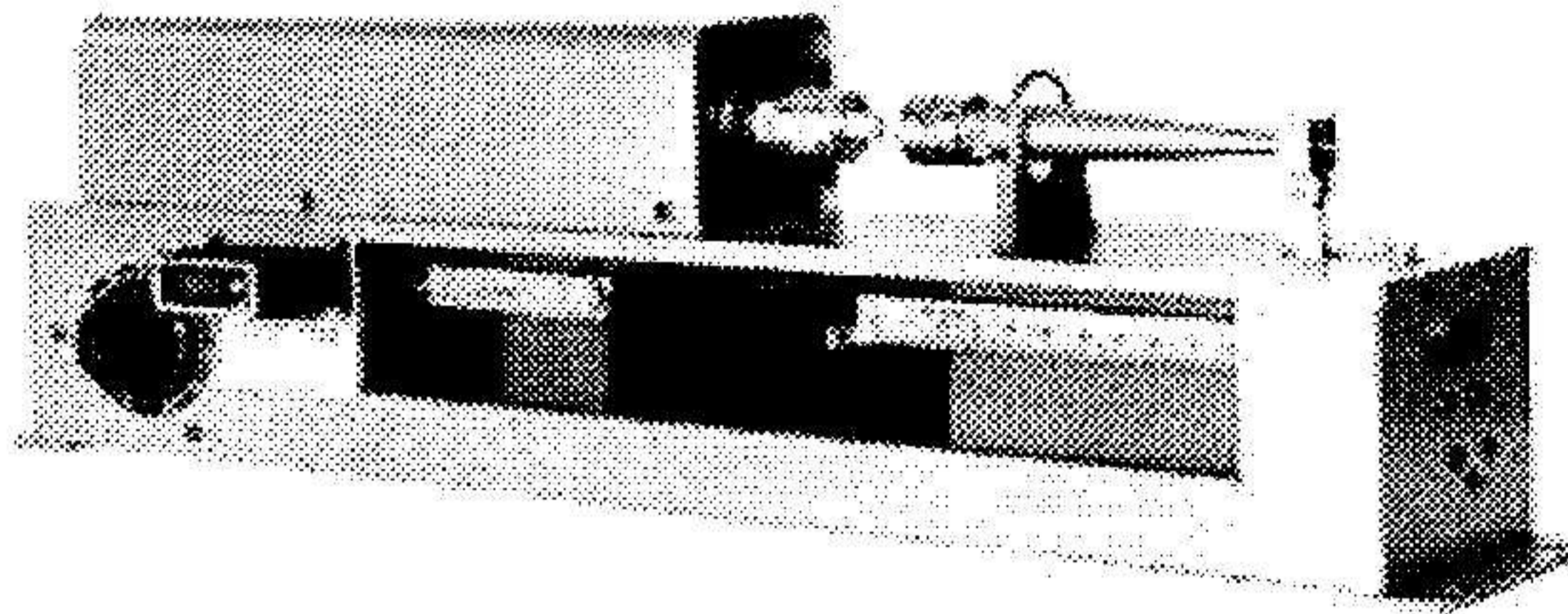


Figure-2

- Draw the standard specimen for this test.
- Calculate rotating beam endurance limit.
- Determine endurance strength for a polished rotating-beam specimen corresponding to 10^4 cycles to failure.
- Calculate expected life under completely reversed stress of 380 MPa.

---END---

BITS, PILANI – DUBAI		
FIRST SEMESTER 2009 – 2010		
Course Code: ME C312	IIIrd YEAR (Quiz-II)	Date: 11.11.09
Course Title: Design of Machine Elements		Max Marks: 16
Duration : 20 minutes		Weightage: 8%
Name: ID No: Prog:		
Instructions:		
i) Change of answer & overwriting is not permitted.		
ii) Give the answers precisely.		

Q.1. What is Lead of a screw? (Marks: 1)
Ans:

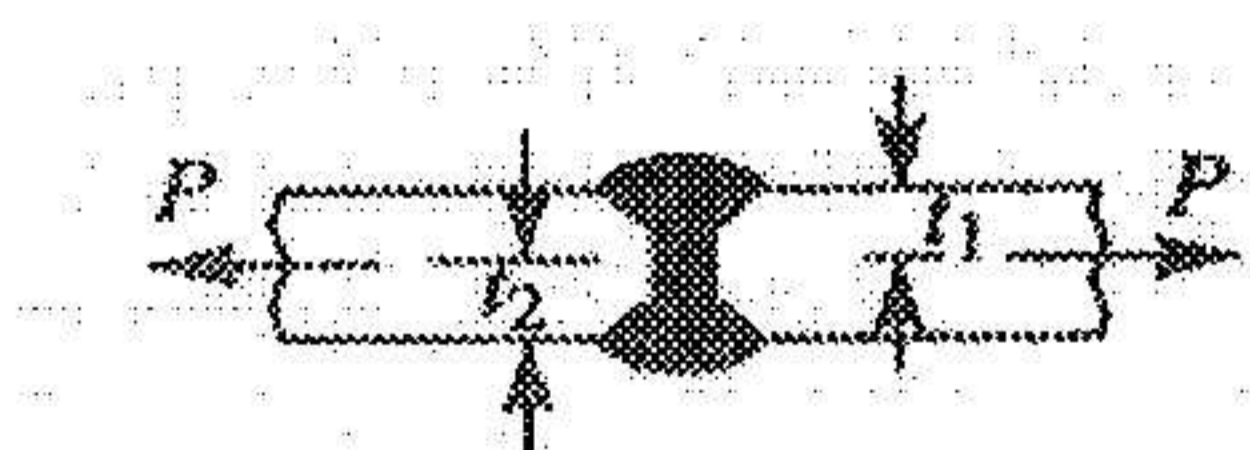
Q.2. Draw rough sketch of a set screw. (Marks: 1)
Ans:

Q.3. Write the equation for Maximum efficiency of square threads? (Marks: 1)
Ans:

Q.4. What is the self locking screw in terms of friction angle & helix angle? (Marks: 1)
Ans:

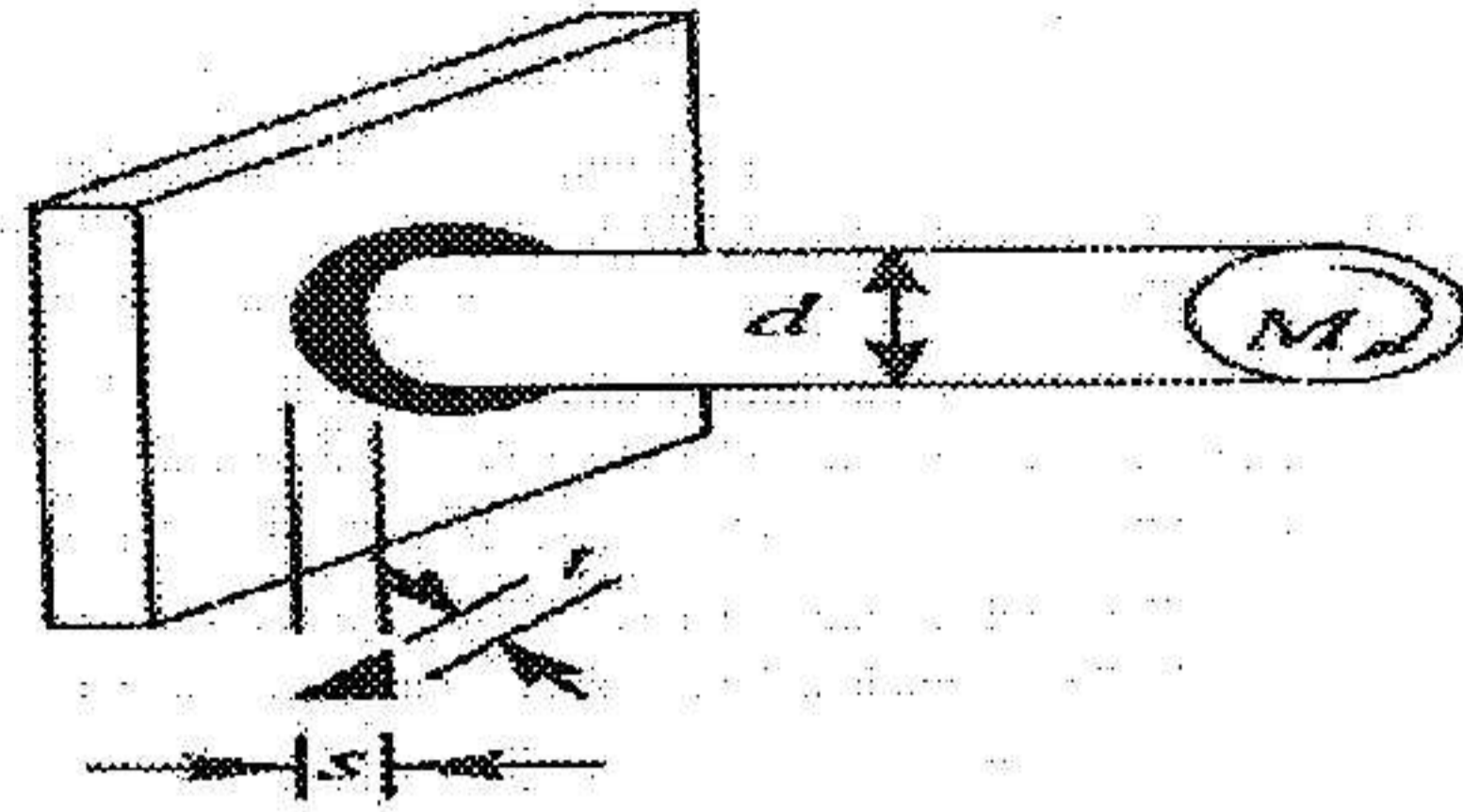
Q.5 which joints are lighter in weight & higher in joining efficiency? (Marks: 1)
Ans:

Q.6. Write the strength design equation for double V butt joint, shown in the figure. (Marks: 1)



Ans:

Q.7. Write the equation for Maximum bending stress equation for the weld throat of the following case? (Marks: 1)



Ans:

Q.8. What are the effective number of coils in the square end helical spring? (Marks: 1)
Ans:

Q.9 Draw the variation of stresses in the wire of a helical spring. (Marks: 1)
Ans:

Q.10. What is the condition for buckling helical spring? (Marks: 1)
Ans:

Q.11. Write the Petroff's equation for the journal bearing. (Marks: 1)
Ans:

Q.12. Draw the full sectional elevation of a ball bearing? (Marks: 1)
Ans:

ESM

**BITS, PILANI – DUBAI
FIRST SEMESTER 2009 – 2010**

Course Code: ME C312
Course Title: Design of Machine Elements
Duration : 20 minutes

IIIrd YEAR (Quiz-I)

Date: 28.10.09
Max Marks: 16
Weightage: 8%

Name: **ID No:** **Prog:**

Instructions:

- i) Change of answer & overwriting is not permitted.
- ii) Give the answers precisely.

Q.1 A theory of failure is necessary when a component is subjected to? (Marks: 1)
Ans:

Q.2 What is the most important design consideration is? (Marks: 1)
Ans:

Q.3 What is modulus of resilience? (Marks: 1)
Ans:

Q.4 What is the relation between E, G & K for homogenous, isotropic & elastic material? (Marks: 1)
Ans:

Q.5 What is the measure of ductility? (Marks: 1)
Ans:

Q.6 The cup & cone failure result occur in which material? (Marks: 1)
Ans:

Q.7. What is approximate value of modulus of elasticity for mild steel? (Marks: 1)
Ans:

Q.8. What is the radius of Mohr's Circle? (Marks: 1)
Ans:

Q.9 Why Molybdenum is added in steels? (Marks: 1)
Ans:

Q.10. . What is the neutral axis of a beam?

(Marks: 1)

Ans:

Q.11. what are critical temperatures in Iron-Carbon Diagram?

(Marks: 1)

Ans

Q.12 The original angle of 90 square changes to $90+\gamma$, what is the shearing strain is?

(Marks: 1)

Ans:

Q.13 Describe the state of stress at any point in the cross-section of a prismatic bar subjected to axial load P along X -axis, having cross-sectional area of the bar as A .

(Marks: 1)

Ans:

Q.14 If hole of diameter ' d ' is punched in a metal of thickness ' t ' then what force is required to punch a hole?

(Marks: 1)

Ans:

Q.15 A solid shaft transmits a torque T , the allowable shear stress is τ .what is the diameter of the shaft? (Marks: 1)

(Marks2)

Ans:

E.M.D