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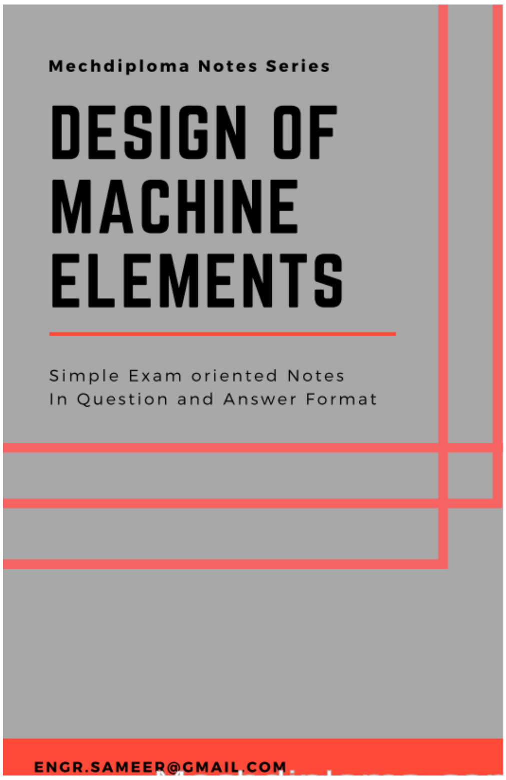
Design of Machine Elements Notes

Design of Machine Elements-diploma Engineering

Design of Machine elements-diploma engineering is prepared to meet the requirements of diploma students. The semester pattern makes it difficult to read the reference books. So students have to prepare in very short time. Notes are prepared in question and answer format. So that students get exact material for prepreation. It saves lot of time in searching various books and answer sheets..



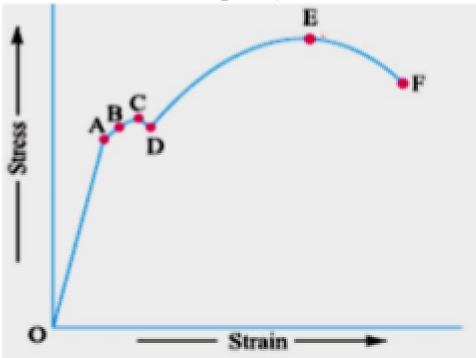
Following are the salient features of these notes

1. Simple question and answer format.
2. Answers written in most easy english language.
3. Exact answers of the asked questions, without unnecessary description.
4. Covers all points in syllabus. Also questions asked in recent exams.
5. Simple and easy to remember formulas for the numerical problems.
6. Numerical problems arranged from simpler to toughter for getting confidence in solving.
7. Machine Design notes-diploma engineering contain easy to reproduce diagrams.
8. Failure diagrams of components for easy understanding.

Screenshots from the Notes

Simple english easy to remember and reproduc in exams

Q.8. Draw Stress strain diagram for ductile and brittle materials. Name points on the diagram.(*****)



Proportional limit (A): The stress is proportional to strain. Beyond point A, the curve slightly deviates from the straight line. It is thus obvious, that Hooke's law holds good up to point A and it is known as Proportional limit.

Elastic limit (B): If the load is increase between point A and B, the body will regain its original shape when load is removed; it means body possesses elasticity up to point B, known as Elastic Limit.

Upper yield point (C): If the material is stressed beyond point B, the plastic stage will reach and the material will start yielding known as Upper Yield Point.

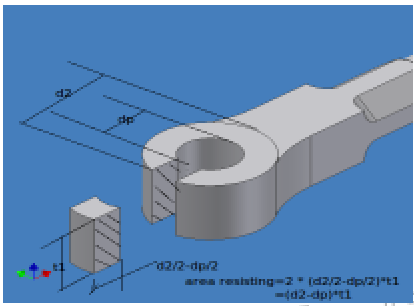
Lower yield point (D): Further addition of small load drops the stress-strain diagram to point D, as soon as the yielding start, this point 'D' is known as Lower yield point.

Ultimate stress point (E): After the end of yielding, if the load is increase beyond point 'D', there is increase in stresses up to point E and thus maximum value of stresses at point 'E' is called as Ultimate Stress point.

Breaking Stress point (F): After the specimen has reached the ultimate stress, a neck is formed, which decreases the cross-sectional area of the specimen. The stress corresponding to point F is known as Breaking stress.

Each failure of component shown in details for understanding strength equations

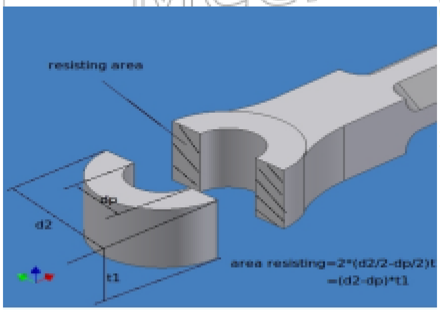
Step 4. Check stress in single eye



(1) Shear failure

$$P=(d_2-d_1)\times t\times\sigma_s$$ **Check** σ_s

If σ_s (induced)< σ_s (allowable)......................Design is safe



(2) Tensile failure

P = A x Stress

$$P=(d_2-d_1)\times t\times\sigma_t$$ **Check** σ_t

If σ_t (induced)< σ_t (allowable)..................Design is safe

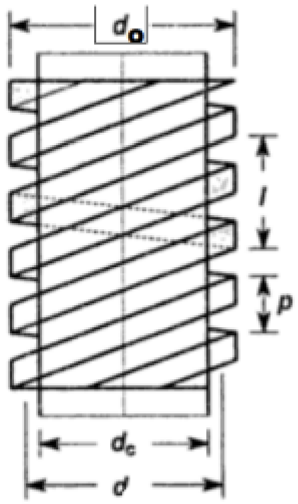
Summerized tables for remembering the formulas

Steps In short :

Part	Failure	Equation	To find
1) Rod	Tensile	$P=\frac{\pi}{4}\times d^2\times\sigma_t$	d=
2) Decide other dimensions	Emperical relations	**d1 = d** **d2 = 2d.** **d3 = 1.5 d** **t = 1.25 d** **t1 = 0.75 d** **t2 = 0.5 d**	d1,d2,d3,t,t1,t2
3) Check Pin	Double shear	$P=2\times\frac{\pi}{4}\times d_1^2\times\sigma_s$	σ_s check
4) Check single eye (Rod end)	Shear	$P=(d_2-d_1)\times t\times\sigma_s$	σ_s check
	Tensile	$P=(d_2-d_1)\times t\times\sigma_t$	σ_t check
	Crushing	$P=(d_1\times t)\times\sigma_c$	σ_c check
5) Check double eye (Fork end)	double Shear	$P=2\times(d_2-d_1)\times t_1\times\sigma_s$	check σ_s
	tensile	$P=(d_2-d_1)\times t_1\times\sigma_t$	check σ_t
	Crushing	$P=2\times(d_1\times t_1)\times\sigma_c$	check σ_c

Simplified formulas and numericals for practice

4.2 Calculation of Torque,Force and Power for SCREW



Formulas and Steps

do= Nominal diameter {Outside diameter of screw}
dc= Core diameter of screw
d= Mean Diameter of the screw
p= Pitch of the screw.

1) Mean diameter of Screw (d)

Mean diameter $d = d_o - \frac{p}{2}$,

core diameter $d_c = d_0 - p$

Thread angle (α)

$\alpha = tan^{-1}(\frac{p\, or\, 2p\, or\, 3p}{\Pi d})$

p for single start, 2p for double start 3p for triple start

3) Angle of Friction (φ)

For Square Threads.........$\phi = tan^{-1}(\mu)$

For Trapezoidal threads ...$\phi = tan^{-1}(\frac{\mu}{cos15})$

For ACME threads .... $\phi = tan^{-1}(\frac{\mu}{cos14.5})$

4) Torque Required

Torque required to raise load

$Ts = W[tan(\phi + \alpha)]\frac{d}{2}$

Torque required to Lower load

$T_s^| = W[tan(\phi - \alpha)]\frac{d}{2}$

5) Collar Friction

$Tc = \mu_c . W. (\frac{r_1 + r_2}{2})\ N-mm$ where $(\frac{r_1+r_2}{2})$ is mean radius of collar ......Uniform wear

$T_c = \mu_c . W. [\frac{2}{3}(\frac{r_1^3 - r_2^3}{r_1^2 - r_2^2})]\ N-mm$ ...Uniform Pressure

{If anything is not mentioned we assume uniform wear}

Several problems with answers for practice (Note that notes does not contains solved numericals)

NUMERICAL PROBLEMS

1] A vertical two start square threaded screw of a 100 mm mean diameter and 20 mm pitch supports a vertical load of 18 kN. The axial thrust on the screw is taken by a collar bearing of 250 mm outside diameter and 100 mm inside diameter. Find the force required at the end of a lever which is 400 mm long in order to lift and lower the load. The μ for the screw and nut is 0.15 and that for collar is 0.20.

{Ans : T raise =569150 N-mm, Force=1423 N, T lower = 3x35315 N-mm, Force=838.8 N}

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2) A vertical screw with single start square threads of 50 mm mean diameter and 12.5 mm pitch is raised against a load of 10 kN by means of a hand wheel, the boss of which is threaded to act as a nut. The axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of 60 mm. The coefficient of friction is 0.15 for the screw and 0.18 for the collar. If the tangential force applied by each hand to the wheel is 100 N, find suitable diameter of the hand wheel.

{T raise =112200 N-mm, Dia of wheel =1122 mm}

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3)The nominal diameter of a Triple threaded screw is 50mm & pitch 8mm .It is used with collar 100mm outer dia & 65mm inner dia coefficient of friction for threads as well as collars is 0.15 . Screw is used to raise of load of 15 KN calculate Using uniform wear theory i)Torque required to lift the load. ii)Torque required to lower the load. iii)Force required at radius 500mm.

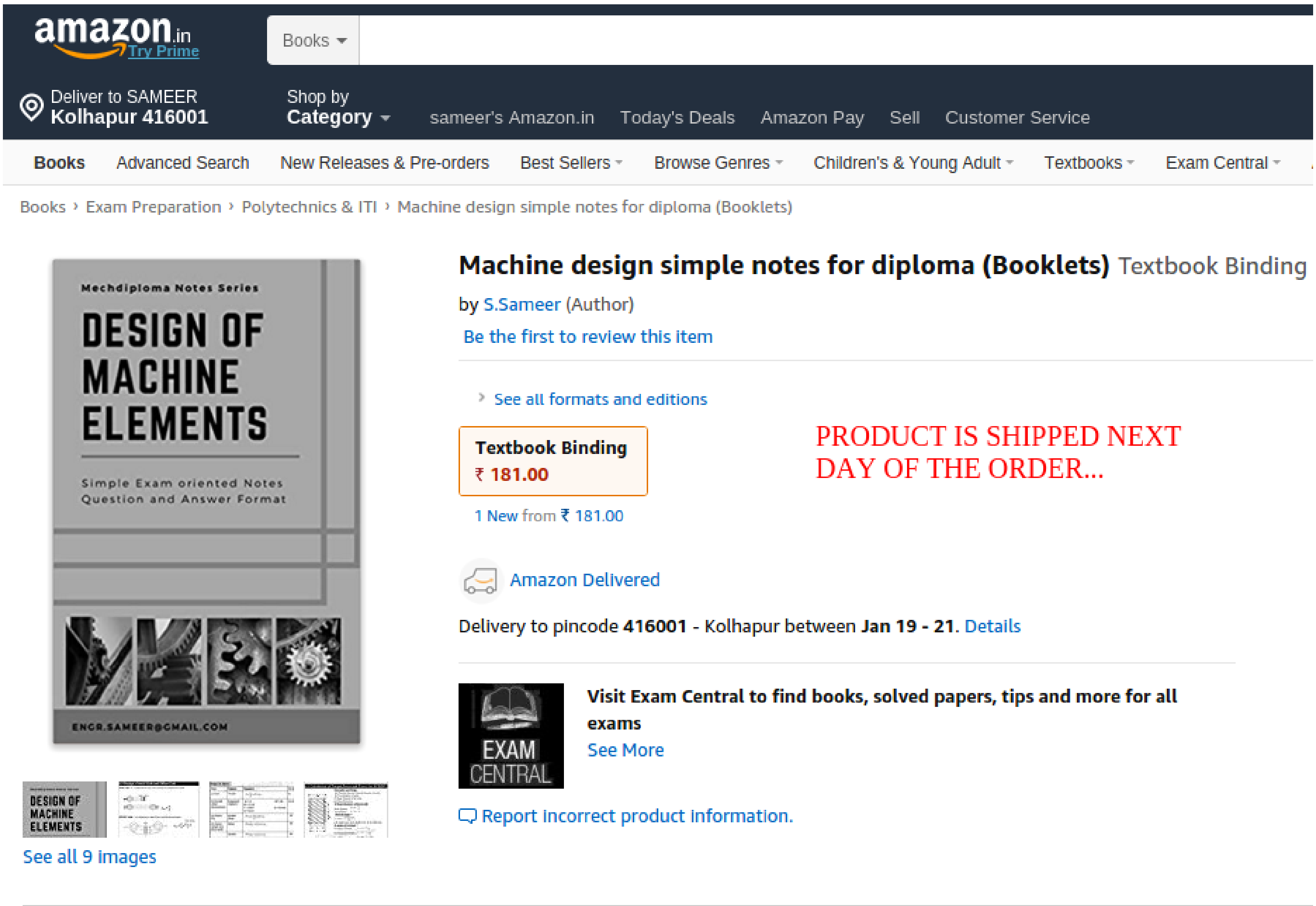
{Ans : T raise=204643.56 N-mm, T lower =87404.87 N-mm, Force to raise = 409.3 N }

4]An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm / min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at screw threads is 0.1. Estimate power of the motor.

{T raise = 211.45 $\times 10^3 N - mm$, Power=1.108 kW }

5] The cutter of a broaching machine is pulled by square threaded screw of 55 mm external diameter and 10 mm pitch. The operating nut takes the axial load of 400 N on a flat surface of 60 mm and 90 mm internal and external diameters respectively. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut when the cutting speed is 6 m/min. Also find the efficiency of the screw.

{T raise =4410 N-mm, Power=0.277 kW, efficiency 14.4%}



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