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Subject Code

- Any -

Chapter Name

- Any -

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Examination: 2017 SUMMER

Que.No	Marks	
Q 2b)(I)	8	Question: **(i) State and explain two most important reasons for adopting involute curves for a gear tooth profile** Answer: For power transmission gears, the tooth form most commonly used the involute profile as a)Involute gears can be manufactured easily: Since the rack in an involute system has straight sides and since the generating cutters usually have rack profile, these cutters can be easily manufactured. Involute gears can be produced more accurately and at a lesser cost. b) The gearing has a feature that enables smooth meshing despite the misalignment of center --
Q 5a)(i)	8	Question: **(i) Show that the efficiency of a self locking screw is less than 50%** Answer: (i) efficiency of screw η = tan α / tan(α +φ) And for self locking screws, φ ≥α or α≤ φ Efficiency ≤ tan(φ) /tan(φ +φ) ≤ tan φ/tan 2 φ ≤tan φ/ (2 tan φ/(1-tan2 φ)) ≤tan φ X (1-tan2 φ)/ (2 tan φ) ≤ ½-tan2 φ/2 From this expression efficiency of self locking screw is less than 50% --

<table>
<tr><th>Que.No</th><th>Marks</th><th></th></tr>
<tr><td>Q 5a)(ii)</td><td>8</td><td>Question:
What is self locking property of threads and where it is necessary?

Answer:
self locking property of the threads-if $\varphi > \alpha$ the torque required to lower the load will be positive, indicating that an effort is applied to lower the load. if friction angle is greater than the helix angle or coefficient of friction is greater than the tangent of helix angle applications- for very large use of screw in threaded fastener, screws in screw top container lids, vices, C-clamps and screw jacks
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<tr><td>Q 5b)(ii)</td><td>8</td><td>Question:
Explain the terms self locking and overhauling of screw.

Answer:
self locking property - torque required to lower the load, $T= W\tan(\varphi - \alpha)xd/2$ self locking property of the threads-if $\varphi > \alpha$ the torque required to lower the the load will be positive, indicating that an effort is applied to lower the load. if friction angle is greater than the helix angle or coefficient of friction is greater than the tangent of helix angle(2marks) Over hauling of screwsin the above expression, if $\varphi < \alpha$,then the torque required to lower the load will be negative. The load will start moving downward without the application of any torque, such a condition is known as over hauling of screws.
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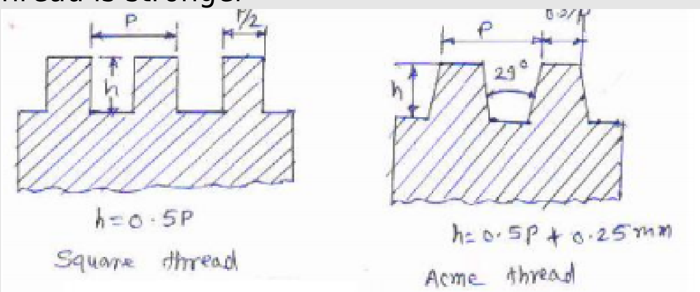
<tr><td>Q 6 a)</td><td>4</td><td>Question:
Draw profiles to square and Acme threads with full details. Which one is stronger?

Answer:
hread is stronger-


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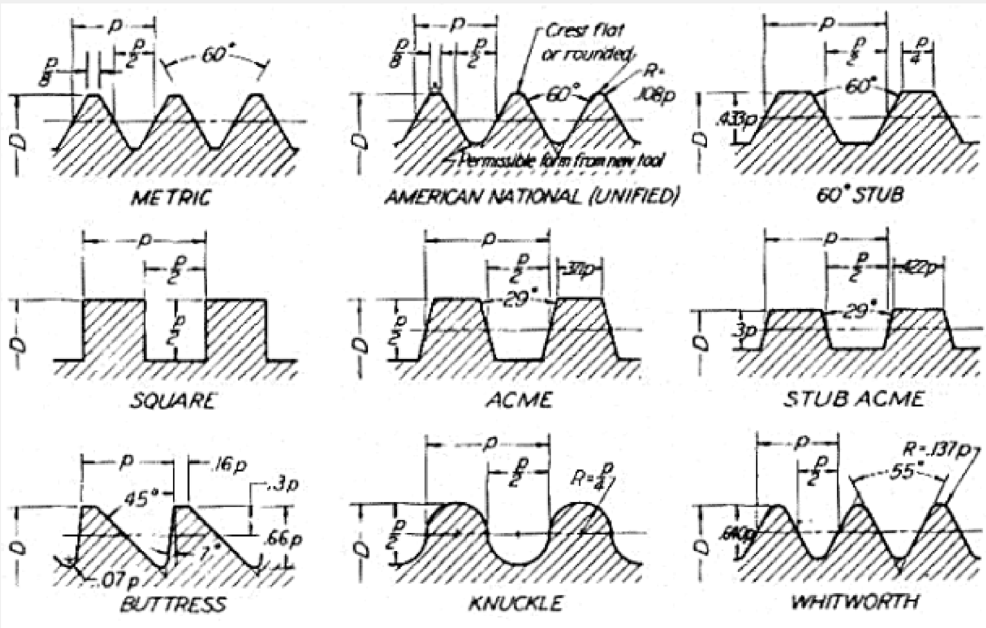
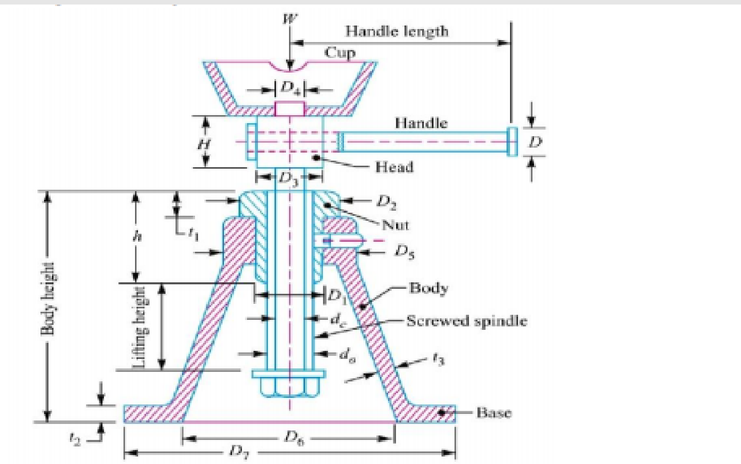
Examination: 2017 WINTER

Que.No	Marks	
Q 1 g)	2	Question: **Define following terms of spring:** Answer: (i) Spring rate: The spring rate is defined as the load required per unit deflection of the spring. It is also known as spring stiffness or spring constant. Mathematically, Spring rate, $k = W / \delta$ Where, W = Load δ = Deflection of the spring (ii) Spring index: The spring index is defined as the ratio of the mean diameter of the coil to the diameter of the wire. Mathematically, Spring index, $C = D / d$ Where, D = Mean diameter of the coil d = Diameter of the wire --
Q 1 i)	2	Question: **Draw the different thread profiles used for power screws.** Answer:  --

Que.No	Marks	
Q 4 c)	8	Question: **Design of screw jack**

Answer:



Design of Screw:

1)Consider the screw under pure compression to find diameter of screw

$$\sigma c = \frac{W}{\frac{\pi}{4} X (dc)^2}$$

As screw is subjected to twisting moment, higher value of screw is selected .

Select The dimension of d_c w.r.t pitch

Mean diameter d= do- p/2

2) Torque required to overcome the friction (T_1)

Helix angle $\alpha = tan^{-1} \frac{p}{\pi x d}$

$\emptyset = tan^{-1} \mu$

Torque required lifting the load

T1= W. tan ($\alpha + \emptyset$) $\frac{d}{2}$

As collar friction is Neglecting, T_2=0

Total Torque required to lift the load = T_1

For Checking:

Direct compressive stress in screw:

$\sigma c = \frac{W}{\frac{\pi}{4} X (dc)^2}$,

Torsional shear stress τ , $\tau = \frac{16\, T1}{\pi X (dc)^3}$

According to Maximum shear stress theory, the maximum shear stress in the screw

$\tau_{max} = 1/2\sqrt{\sigma c^2 + 4\, \tau^2}$

Permissible shear stress for a screw $\tau = \sigma c/2$

$\tau_{max} < a_{llowable}$, So screw is safe

Design of Nut:

The bearing pressure between the thread

$$Pb = \frac{W}{\frac{\pi}{4} X (do^2 - dc^2)\, n}$$, Height of Nut: H= n X P

Check: Shear stress induced in the screw thread

$\tau = \frac{W}{\pi X (dc) X t\ n}$ as t= p/2

$\tau_{calculated} < \tau_{allowable}$, So screw is safe .

Que.No	Marks	
Q 5 b)	8	Question: **Power Screw: Given Data** Answer: Do= 100 mm , W =300 KN = 300 X 10^3 N, P=12 mm , μ= μ1= 0.15 Since,Screw is double start, Lead of screw = 2 p =2 x12 =24 mm dc= do-P =100-12 =88 Mean diameter d =(do+dc)/2 =(100+88)/2 =94 mm Tan $\alpha = \frac{Lead}{\pi d} = \frac{2p}{\pi d}$, $\alpha = tan^{-1}(\frac{2p}{\pi d})$ $\alpha = tan^{-1}\frac{24}{\pi x 94}$ = 4.64° $\emptyset = tan^{-1}\mu$ $= tan^{-1} x\ 0.15$ = 8.53° Torque Required to lift the load , T1= W.tan ($\alpha + \emptyset$) $\frac{d}{2}$ T1= 300 x 10^3 x tan (4.64° $+ 8.53°)\frac{94}{2}$ = 3301.15 x 10^3 N.mm Total Torque =Tt=T1+T2 =3301.15 x 10^3 + 0 = 3301.15 x 10^3 N.mm .... **Efficiency of screw:** **n** = $\frac{tan \propto}{tan(\propto + \emptyset)}$ = $\frac{tan 4.64}{tan(4.64+8.53)}$ = **0.347 i.e 34.71 %** --

Examination: 2016 SUMMER

Que.No	Marks	
Q 1 iv)	4	Question: **Why square threads are preferred over V-thread for power transmission ?** Answer: . Square threads are preferred over V-thread for power transmission because of following points. 1) Square thread has the greatest efficiency as its profile angle is zero. 2) It produces minimum bursting pressure on the nut. 3) It has more transmission efficiency due to less friction. 4) It transmits power without any side thrust in either direction. 5) It is more smooth and noiseless operation. --

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<tr><td>Q 5 a)</td><td>8</td><td>

Question:

A screw jack is used to lift a load of 50 kN through a maximum lift of 200 mm. The material used for a screw is steel of allowable stresses in tension and compression as 100 N/mm2 and 50 N/mm2 respectively. The pitch of screw is 8 mm. The nut is made of phosphor bronze with allowable stresses as 50 N/mm2 and 45 N/mm2 in tension and crushing. The allowable shear stress for nut material is 40 N/mm2 . The allowable bearing pressure between nut and screw is not to exceed 20 N/mm2 . If the coefficient of friction between screw and nut is 0.14, design the screw and nut

Answer:

Given Data:

W =50 KN = 50 X 10^3 N, σt_{screw} =100 N/mm^2 ,σc_{screw} =50 N/mm^2

P=8 mm, σt_{nut} =50 N/mm^2 ,σc_{nut} =45 N/mm^2, τ_{nut} =40 N/mm^2

P_b= 20 N/mm^2 μ =0.14

Design of Screw:

1)Consider the screw under pure compression to find diameter of screw

$\sigma c = \frac{W}{\frac{\pi}{4} X (dc)^2}$, $50 = \frac{50 X 103}{\frac{\pi}{4} X (dc)^2}$ d_c=35.68 Say 36 mm ... **1 M**

As screw is subjected to twisting moment ,higher value of screw is selected .

The dimension of d_c= 42 mm for P=8

Mean diameter d= do- p/2 = 50-8/2 = 46 mm

2) Torque required to overcome the friction (T_1)

Helix angle $\alpha = tan^{-1}\frac{8}{\pi x 46}$ = 3.17°

$\emptyset = tan^{-1}\mu$ $=tan^{-1}x$ 0.14 = 7.97° .... **1 M**

Torque required lifting the load

T1= W. tan ($\alpha + \emptyset$) $\frac{d}{2}$

T1= 50 x 10^3 tan (3.17+7.97) $\frac{46}{2}$ = 226416.5 N.mm ....

As collar friction is Neglecting, T_2=0

Total Torque required to lift the load = T_1= 226416.5 N.mm .... **1 M**

For Checking:

Direct compressive stress in screw:

$\sigma c = \frac{W}{\frac{\pi}{4} X (dc)^2}$, $\sigma c = \frac{50 X 10^3}{\frac{\pi}{4} X (42)^2}$ σc = 36.09 N/ mm^2

Torsional shear stress τ

$\tau = \frac{16 T1}{\pi X (dc)^3}$, $\tau = \frac{16 X 226416.5}{\pi X (42)^3}$,τ = 15.56 N/ mm^2

According to Maximum shear stress theory, the maximum shear stress in the screw

τ_{max}= $1/2\sqrt{\sigma c^2 + 4\,\tau^2}$

τ_{max}= $1/2\sqrt{36.09^2 + 4\,(15.56)^2}$ = 23.83 N/mm^2

Permissible shear stress for a screw τ = $\sigma c/2$ =50/2 =25 N/mm^2

$\tau_{max} < \tau_{allowable}$. So screw is safe. ....

Design of Nut:

The bearing pressure between the thread

$Pb = \frac{W}{\frac{\pi}{4} X (do^2 - dc^2)\, n}$, $20 = \frac{50 X 10^3}{\frac{\pi}{4} X (50^2 - 42^2)\, n}$, n= 4.32 i.e = 5 threads in contacts

Height of Nut: h=n x p =5x8 =40 mm

Check: Shear stress induced in the screw thread

$\tau = \frac{W}{\pi X (dc) X t n}$ as t= p/2

$\tau = \frac{50 X 10^3}{\pi X \frac{(42) X 8}{2} X 5}$ =18.95 N/mm^2 < 40 N/mm^2

$\tau_{calculated} < \tau_{allowable}$. So screw is safe

</td></tr>
<tr><td>Q 5c)(i)</td><td>8</td><td>

Question:

Show that the efficiency of self locking screw is less than 50%

Answer:

Torque required to lower the load

T_1= P X $\frac{d}{2}$ = W. tan ($\emptyset - \alpha$) $\frac{d}{2}$................. **1 M**

If however ,Φ > α the torque required to lower the load will be positive,indicating that an effort is applied to lower the load,such a screw is known as self-locking screw.

A screw will be self-locking

1) if the friction angle is greater than helix angle or coefficient of friction is greater than tangent of helix angle i.e μ or tan Φ > tan α...

We know that the efficiency of screw,

$$ñ = \frac{\tan \Phi}{\tan (\emptyset + \alpha)}$$ .... **1 M**

Therefore, Efficiency for self-locking screws,

$$\eta \leq \frac{\tan \phi}{\tan (\phi + \phi)} \leq \frac{\tan \phi}{\tan 2\phi} \leq \frac{\tan \phi\,(1 - \tan^2 \phi)}{2 \tan \phi} \leq \frac{1}{2} - \frac{\tan^2 \phi}{2}$$ ....

From this expression we see that efficiency of self-locking screws is less than 1/2 or 50%.

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Que.No	Marks	
Q 6 b)	4	(answer below)

Question:

Explain different forms of threads with their relative advantages and applications.

Answer:

Square threads

Square threads are the most commonly used thread form for the power screws. Following table gives you various thread forms and comparisons.

Screw Form	Characteristic	Application
Sq. Thread	No side thrust Higher efficiency	Used for general purpose power transmission
Trapezoidal Threads	Stronger than square threads Easy to manufacture Wear compensation	Used for higher power transmission
ACME threads	Stronger than square threads Easy to manufacture Wear compensation	Used for higher power transmission
Buttress threads	Can bear very heavy load in one direction	Used to handle heavy forces in one direction, like in truck jack

Sq. threads Advantages and disadvantages

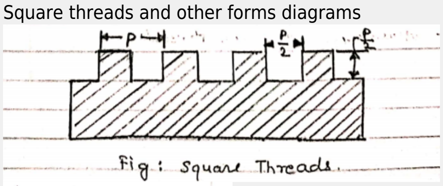
The advantages of sq. threads are as follows:

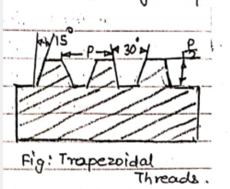
1) Efficiency of sq. threads is more than trapezoidal threads
2) There is no side thrust or radial pressure.

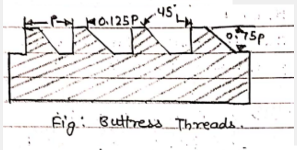
The disadvantages of sq. threads are,

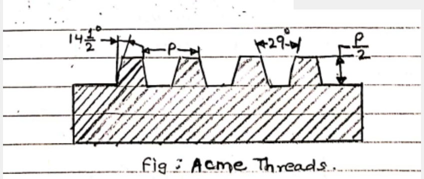
1) Sq. threads are difficult to manufacture than trapezoidal threads.
2) The wear of sq. threads can not be compensated as it can be done in trapezoidal.
3) The thread thickness at core is less than trapezoidal, hence sq. threads have less load carrying capacity.

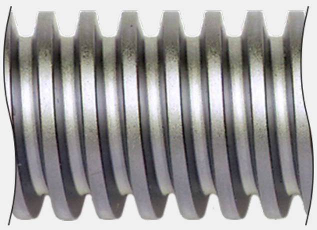
Square threads and other forms diagrams

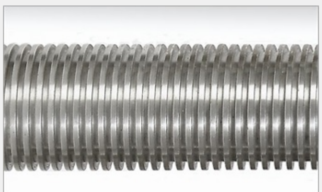


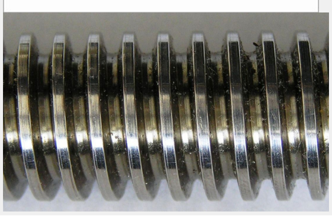




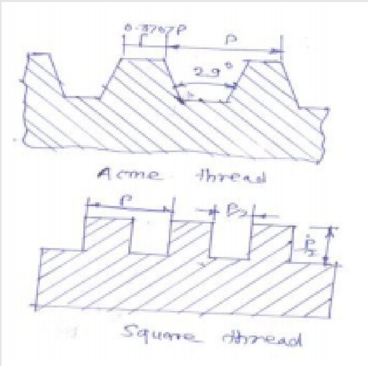




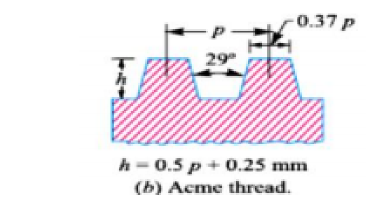
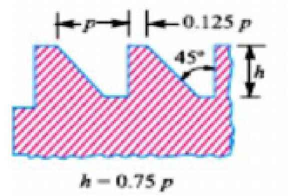




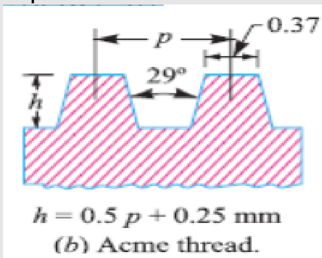
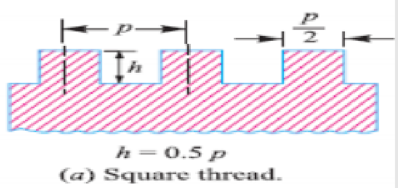
Examination: 2016 WINTER

Que.No	Marks	
Q 1a)(iv)	4	Question: **Draw neat labeled sketches of Acme and square thread profile and state its relative characteristics.** Answer:  Characteristics of Acme thread : (i)thread angle is 290 (ii) permit the use of split nut (iii)easy to manufacture (iv) max. bursting pressure on the thread Characteristics of Square thread : (i) zero profile thread angle (ii) minimum bursting pressure on the nut --

Que.No	Marks	
Q 5 a)	8	Question: **A power screw on a machine has single start square thread with a non rotating bronze nut. Axial force on the screw is 15 kN. Allowable stresses for screw material in compression and shear are 85 MPa and 37 MPa respectively. Allowable bearing pressure for the screw nut pair is 5 MPa. Find (i) Core diameter of screw (ii) Length of the nut (iii) Efficiency of power screw in coefficient of friction between screw and nut is 0.12. (iv) Shear stresses in the threads of screw and nut.** Answer: Design of power Screw: Given Data: W =15 KN =15 X 10^3 N, σ_{cnut} =85 N/mm^2, τ_{nut} =37 N/mm^2 P_b= 5 N/mm^2 μ =0.14 Design of Screw: 1) Core Diameter of screw : Consider the screw under pure compression to find diameter of screw $\sigma c = \frac{W}{\frac{\pi}{4}X(dc)^2}$, $85 = \frac{15\,x(10)^3}{\frac{\pi}{4}X(dc)^2}$ dc = 14.99 say 15 mm Do =Dc /0.84 = 15/0.84 = 17.86 Say 18 mm D = (do + dc)/2 = (15 +18) /2 = 16.5 mm P= do- dc = 18-15 = 3 mm **ii)Length of Nut :** The bearing pressure between the thread $Pb = \frac{w}{\frac{\pi}{4}X(do^2-dc^2)\,n}$, $5 = \frac{15\,x(10)^3}{\frac{\pi}{4}X(18^2-15^2)\,n}$, n= 38.60 i.e = 40 contacts Height of Nut: h=n x p =40 x 3 =120 mm Helix angle $\alpha = tan^{-1}\frac{\text{Lead}}{\pi x 16.5}$ = 3.31° $\emptyset = tan^{-1}\mu$ $=tan^{-1}x$ 0.12 = 6.84° Torque required lifting the load T_1= W. tan ($\alpha + \emptyset$) $\frac{d}{2}$ T_1= 15x 10 ^{3} tan (3.31+6.84) $\frac{16.5}{2}$ = 22159.13 N.mm As collar friction is Neglecting, T_2=0 Total Torque required to lift the load = T_1= 22159.13 N.mm III) Efficiency of power screw : $\tilde{n} = \frac{W.\tan(\alpha)\frac{d}{2}}{T}$ $=\frac{(15x10^3 tan\,(3.31)16.5/2)}{22159.13}$ = 0.323 = 32 % IV)Shear stresses in threads of screw & nut : Shear stress induced in the screw thread $\tau = \frac{W}{\pi X(dc)Xtn}$ as t= p /2 $\tau = \frac{50\,X\,10^3}{\pi X(15)X1.5\;X\,40}$ =5.30 N/mm^2 Shear stress induced in the Nut thread $\tau = \frac{W}{\pi X(do)Xtn}$ as t = p /2 $\tau = \frac{50\,X\,10^3}{\pi X(18)X1.5\;X\,40}$ =4.42 N/mm^2 --

Que.No	Marks	
Q 5c)(ii)	8	Question: **State two engineering applications of each of Acme and Buttress thread profiles with neat sketches.** Answer: Engg. Application of ACME Thread profiles : 1)screw cutting lathes,2) brass valves,3) cocks and 4) bench vices.  Buttress Thread profiles 1) light jack screws 2) vices  --

Examination: 2015 WINTER

Que.No	Marks	
Q 1a)(iv)	4	Question: **State four different thread profiles used in power transmission. Draw neat sketches of any two of them.** Answer: Following are the three types of screw threads mostly used for power screws: 1. Square thread. 2. Acme threads 3.trapezoidal thread. 3. Buttress thread   --

Que.No	Marks	
Q 5 a)	8	Question: **A vertical double start square threaded screw of 120 mm mean diameter and 24 mm pitch supports a vertical load of 20 kN. The axial thrust in screw is taken by collar bearings of 300 mm outside and 150 mm inside diameter. Find the force required at the end of the lever which is 400 mm long in order to lift and lower the load. The coefficient of friction for screw and nut is 0.18 and for collar bearing it is 0.25.** Answer: W =20 KN = 20 X 10^3 N P=24 mm d=120 mm D1=150 mm R1= 75 mm D2= 300 mm R2= 150 mm Tan Ø= μ =0.18, $\mu c = 0.25$ Since,Screw is double start, Lead of screw = 2 p =2 x24 =48 mm Tan $\alpha = \frac{Lead}{\pi d} = \frac{2p}{\pi d}$, $\alpha = tan^{-1}\frac{2p}{\pi d}$ $\alpha = tan^{-1}\frac{48}{\pi x 120}$ = 7.25° $\emptyset = tan^{-1}\mu$ $= tan^{-1} x\ 0.18$ = 10.20° Torque Required to lift the load T1= W.tan ($\alpha + \emptyset$) $\frac{d}{2}$ T1= 20 x 10 3tan ($7.25 + 10.20$) $\frac{120}{2}$ = 377.27 N.m Torque required in overcoming frictional resistance = Te Assuming Uniform Wear condition Te = $\mu c .W.R$ Mean radius R=$\frac{R1+R2}{2} = \frac{75+150}{2} = 112.5\ mm$ Te=0.25 x 20 x 103 x 112.5 =562.5 N.m Total Torque =Tt=T1+Te =377.27 + 562.5 = 940 N.m Force required at the end of lever Tt= P1 x l 940 x 103 =P1 x 400 P1= 2350mm Torque Required to lower the load T1= W.tan ($\emptyset - \alpha$) $\frac{d}{2}$ = 20 x 103 x tan (10.203 -7.25) x 120/2 =61.90 N-m .... Total Torque = T_2 + Te = 61.90 +562.5 =624.40 N.m Force required at the end of the lever to lower the load P_2 = Tt/L = 624.40 X 10^3 /400 = 1561 N. --

Que.No	Marks	
Q 5c)(ii)	8	Question: **Explain the terms self locking and overhauling of screw.** Answer: $T = P \times \frac{d}{2} = W \tan(\phi - \alpha)\frac{d}{2}$ If however , $\phi > \alpha$, the torque required to lower the load will be positive,indicating that an effort is applied to lower the load,such a screw is known as self locking screw. A screw will be self locking 1) if the friction angle is greater than helix angle or coefficient of friction is greater than tangent of helix angle $i.e.\ \mu$ or $\tan\phi > \tan\alpha$. 2) if the frequency is less than 50 % i.e $\eta < 50\%$ **(Correct Ans: 03 M)** a screw will be self locking if the friction angle is greater than helix angle or coefficient of friction is greater than tangent of helix angle .μ or $\tan\Phi$ >or = $\tan\alpha$. We know that the efficiency of screw, $\eta = \frac{\tan\phi}{\tan(\alpha + \phi)}$ Therefore, Efficiency for self locking screws, $\eta \leq \frac{\tan\phi}{\tan(\phi+\phi)} \leq \frac{\tan\phi}{\tan 2\phi} \leq \frac{\tan\phi(1-\tan^2\phi)}{2\tan\phi} \leq \frac{1}{2} - \frac{\tan^2\phi}{2}$ From this expression we see that efficiency of self locking screws is less than ½ or 50%. If the efficiency is more than 50%, then the screw is said to be overhauling. --