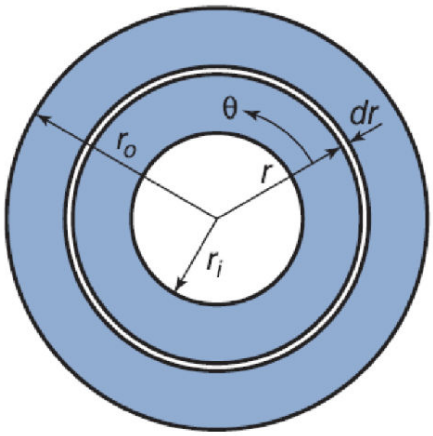
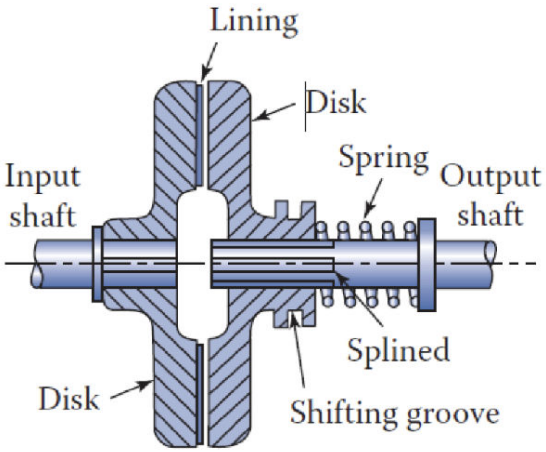
Question 1

A disk clutch has a single pair of friction surfaces of 250mm outside diameter and 150mm inside diameter. Determine the maximum pressure and torque capacity using the assumption of

- Uniform wear
- Uniform pressure

Given the coefficient of friction is 0.3 and the actuating force is 6 kN.






```
% Uniform wear

% P_w = 2 * pi * p_max * r_i * (r_o - r_i)


% write down what is known
r_i = 150/1000/2;      %[m]
r_o = 250/1000/2;      %[m]
P_w = 6000/1000;       %[N]
P_p = 6000/1000;       %[N]
mu = 0.3;              %[]

% calculating maximum pressure
p_max = P_w / (2 * pi * r_i * (r_o - r_i))     %[kPa]
```

```
p_max = 254.6479
```

```
% Calculating torque

p_max = p_max * 1000;        %[Pa]
T_w = pi * mu * r_i * p_max * (r_o^2 - r_i^2)
```

```
T_w = 180
```

```
% uniform pressure

% calculating maximum pressure
p_max = P_p / (pi * (r_o^2 - r_i^2))   %[kPa]
```

```
p_max = 190.9859
```

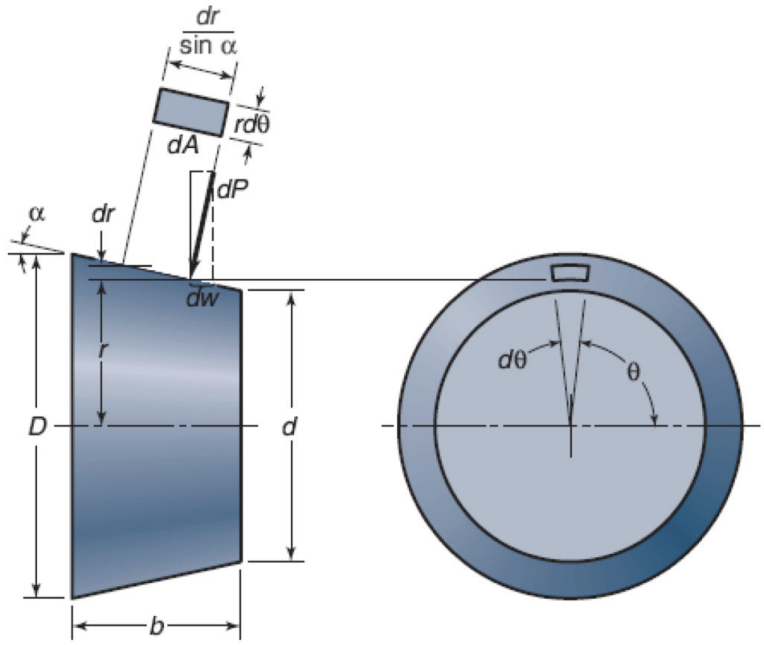
```
% calculating torque

p_max = p_max * 1000;        %[Pa]
T_p =  (2 * pi * mu * p_max) / 3 * (r_o^3 - r_i^3)  %[Nm]
```

```
T_p = 183.7500
```

Question 2

A cone clutch has D = 330mm, d = 306 mm and b = 60mm. The friction coefficient is 0.26 and the torque transmitted is 200 Nm. Determine the minimum actuating force by using the uniform pressure and uniform wear models.




```
% write down what is known

D = 330/1000;     %[m]
d = 306/1000;     %[m]
b = 60/1000;      %[m]
mu = 0.26;        %[]
T = 200;         %[Nm]
```

```
% Assuming uniform wear

alpha = atand((D - d) / (2 * b));        %[deg]
W = (4 * T * sind(alpha)) / (mu * (D + d))      %[N]
```

```
W = 948.7960
```

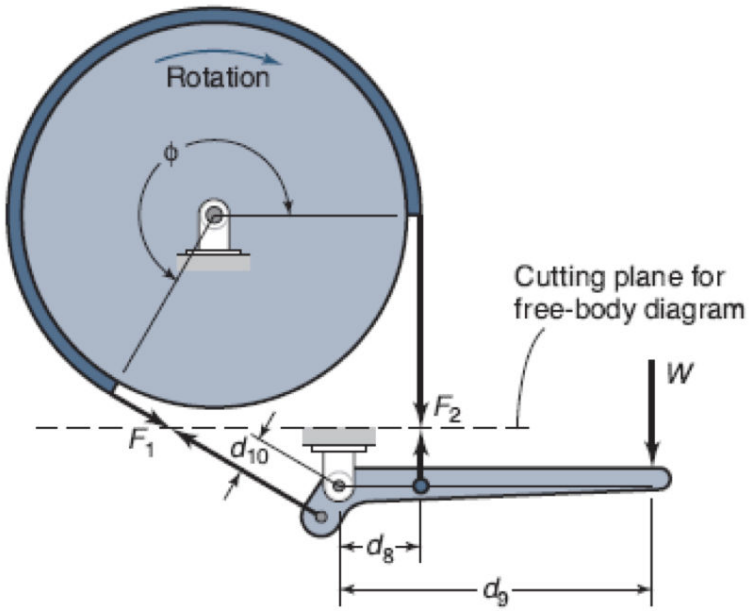
```
% Assuming uniform pressure

W = (3 * T * sind(alpha) * (D^2 - d^2)) / (mu * (D^3 - d^3))  %[N]
```

```
W = 948.3459
```

Question 3

The band brake shown in the below figure has $r = 100\text{mm}$, $b = 25\text{mm}$, $d_9 = 225\text{mm}$, $d_8 = 50\text{mm}$, $d_{10} = 12\text{mm}$, wrapping angle $\phi = 270^\circ$, friction coefficient 0.2 and $p_{\max} = 500\text{kPa}$. Determine the braking torque, actuating force.




```
% write down what is known

b = 25/1000;          %[m]
p_max = 500000;       %[Pa]
r = 100/1000;         %[m]
mu = 0.2;             %[]
phi = 270;            %[deg]
d_8 = 50/1000;        %[m]
```

```
d_9 = 225/1000;      %[m]
d_10 = 12/1000;      %[m]

% Pin
%
% p_max = F_1 / (b * r)

F_1 = p_max * b * r;
```

Force $F_2 = F_1 e^{-\mu \phi \pi / 180}$

```
% F_1 / F_2 = exp(-(mu * phi * pi) / 180)

F_2 = F_1 * exp(-(mu * phi * pi) / 180)  %[N]
```

```
F_2 = 487.0764
```

```
% Taking moments about the hinge

% -d_9 * W + d_8 * F_2 - d_10 * F_1 = 0 so that;

W = (d_8 * F_2 - d_10 * F_1) / d_9
```

```
W = 41.5725
```

Question 4

Given an electric motor of power 500W and rated speed 3000 rpm. Select a brake for it with the safety factor of 2.

Refer to;

https://www.stearnsbrakes.com/products/motor-brakes

https://vn.misumi-ec.com/vona2/maker/misumi/

https://www.maxongroup.com/maxon/view/content/index

Solution

Since $P = T\omega$

```
% write down what is known

P = 500;    %[W]
n = 3000;    %[rpm]


% since P = T * omega
```

```
T = P / (n / 60 * 2 * pi)        % [Nm]
```

```
T = 1.5915
```

```
% with a safety factor of 2

T = 2 * T  %[Nm]
```

```
T = 3.1831
```

Some possible solutions

AAB 320 Series

Details	Data
Size	1.2 - 2.8
Torque (lb-in)	3 - 50
Nm	0.34 - 5.6
Enclosure	Open
UL Recognized	Insulation System File E125303

Brake AB 60 S

Mass inertia	1339 gcm²
Max. speed	8800 rpm
Nominal voltage smoothed	24 V
holding torque	5000 mNm