Program for design of shaft, Problem Number 1.

Problem Statement :A shaft is required to transmit 1MW power at 220 rpm. The twist of shaft must not exceed more than 10 on a length of 15diameter. Determine the diameter of the shaft and shear stress induced. Take G = 80 kN/mm2 .

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```
clc;
clear all;
```

Solution:

Given Data:

P = 1 = 1 × 10^3

= 220

Theta = 1 degree (Initalized as theta)

L = 15

= 80/ = 80 × 10^3 /

```
P = 1000
```

```
P = 1000
```

```
n = 220-10
```

```
n = 210
```

```
L = 15;
G = 80*10^3
```

```
G = 80000
```

```
theta = 1
```

```
theta = 1
```

```
no = 100
```

```
no = 100
```

```
fin_T =  zeros(no,1);
fin_n =  zeros(no,1);
```

Using Eqn. 3.1,

$$\tau = \frac{16T}{\pi d^3} = \frac{16 \times 43.41 \times 10^6}{\pi \times 180^3}$$
$$\therefore \tau = 37.9\ N/mm^2$$

```
[T] = Eqn_3_3_a(P,n)
```

```
T = 4.5476e+07
```

Using Eqn. 3.2,

$$\theta = \frac{584TL}{Gd^4} \Rightarrow 1 = \frac{584 \times 43.41 \times 10^6 \times 15d}{80 \times 10^3 \times d^4}$$
$$\therefore d = 168.14\ mm$$

```
z = Eqn_3_2(T,G,L,theta)
```

```
Select the following:
1.The angular Deformation
2.The diameter
z = 170.7652
```

```
d = z
```

```
d = 170.7652
```

Using Eqn. 3.1,

$$\tau = \frac{16T}{\pi d^3} = \frac{16 \times 43.41 \times 10^6}{\pi \times 180^3}$$
$$\therefore \tau = 37.9\ N/mm^2$$

Adopting standard diameter for the shaft, using *Table 3.5(a),*

$$d = 180\ mm$$

```
d = Table_3_5_a(d);
```

```
Standard size of the shaft (mm) using table 3.5(a) is :
d = 180
```

```
disp('Shear Stress (N/mm^2) induced on the shaft is : ')
```

```
Shear Stress (N/mm^2) induced on the shaft is :
```

```
Tu = Eqn_3_1(T,d);
```

To find the following trends:

1.Power vs rpm

2.Torque vs rpm

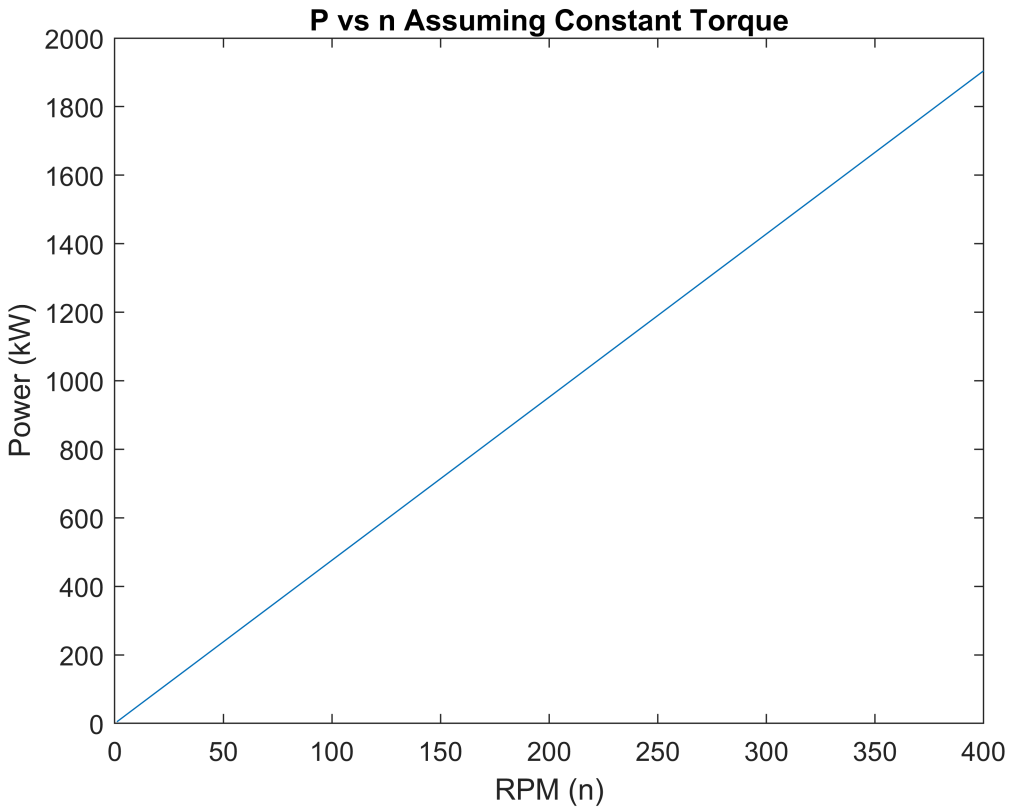
3.Diameter vs rpm

Intializing the 4 parameter arrays.

```
theta = 1;
n_array = 1:400;
P_array = n_array.*(T/(9.55*(10^6)));
T_array = n_array.^(-1).*(9.55*(10^6)*P);
d_array = ((T_array.*(584*L))./(G*theta)).^(1/3);
```

Trend of P vs N

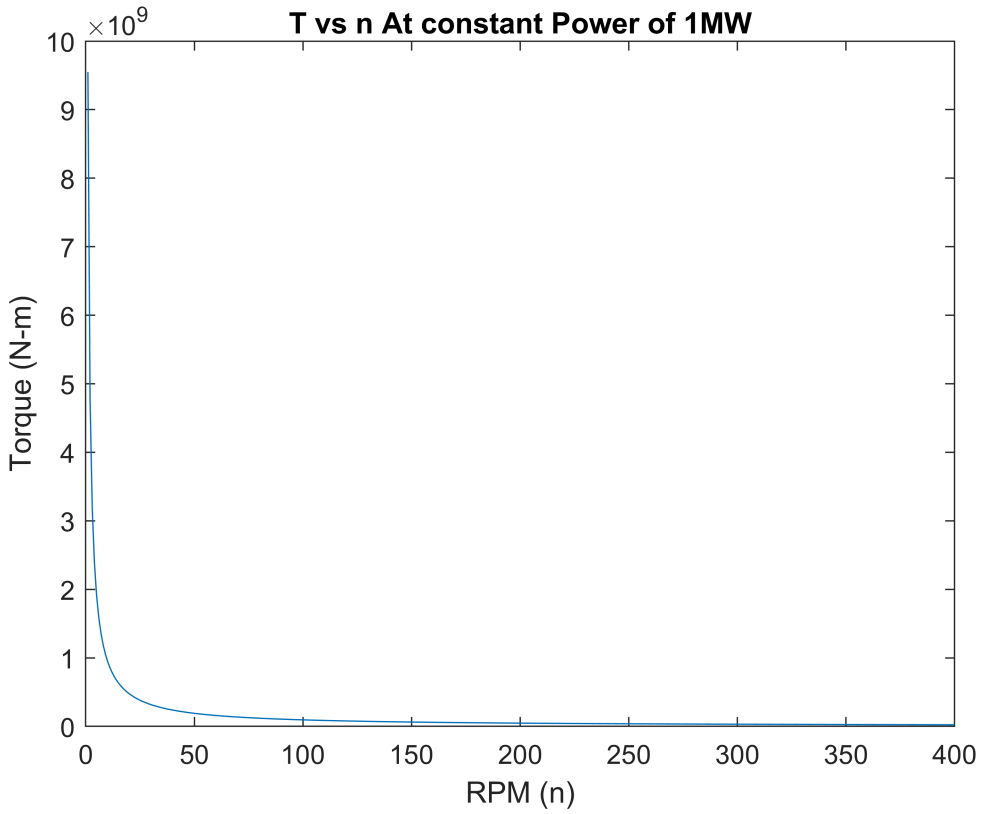
```
plot(n_array,P_array)
xlabel('RPM (n)')
ylabel('Power (kW)')
title('P vs n Assuming Constant Torque')
```



Plot Trend of T vs N

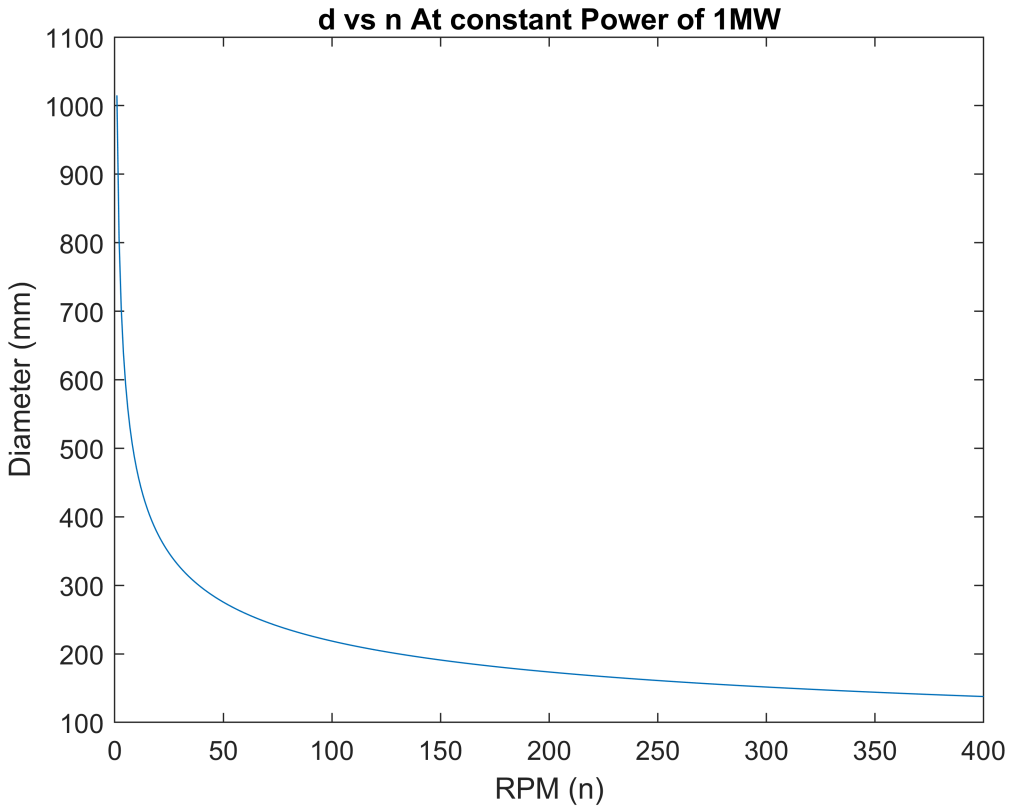
```
plot(n_array,T_array)
xlabel('RPM (n)')
```

```
ylabel('Torque (N-m)')
title('T vs n At constant Power of 1MW')
```



Plot Trend of d vs N

```
plot(n_array,d_array)
xlabel('RPM (n)')
ylabel('Diameter (mm)')
title('d vs n At constant Power of 1MW')
```


d vs n At constant Power of 1MW
Diameter (mm)
RPM (n)
1100
1000
900
800
700
600
500
400
300
200
100
0
50
100
150
200
250
300
350
400