

Scilab Textbook Companion for  
Machine Design  
by U. C. Jindal<sup>1</sup>

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July 31, 2019

<sup>1</sup>Funded by a grant from the National Mission on Education through ICT, <http://spoken-tutorial.org/NMEICT-Intro>. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website <http://scilab.in>

# Book Description

**Title:** Machine Design

**Author:** U. C. Jindal

**Publisher:** Dorling Kindersley (India)

**Edition:** 1

**Year:** 2010

**ISBN:** 978-81-317-1659-5

Scilab numbering policy used in this document and the relation to the above book.

**Exa** Example (Solved example)

**Eqn** Equation (Particular equation of the above book)

**AP** Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

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# Chapter 3

## MECHANICS OF SOLIDS

Scilab code Exa 3.1 MS1

```
1 // sum 3-1
2 clc;
3 clear;
4 d=10;
5 l=1500;
6 m=12;
7 h=50;
8 E=210*103;
9 sigut=450;
10 A=%pi*d2/4;
11 W=m*9.81;
12 sigi=W/A*(1+sqrt(1+(2*E*A*h)/(W*l)));
13 deli=sigi*l/E;
14 siggradual=W/A;
15 sigsudden=2*siggradual;
16
17 // printing data in scilab o/p window
18 printf(" sigi is %f N/mm2      ",sigi);
19 printf(" \n deli is %f mm      ",deli);
20 printf(" \n siggradual is %f N/mm2      ",
        siggradual);
```

```
21
22 // The difference in the answer of sigi and
    siggradual is due to round-off errors.
```

---

### Scilab code Exa 3.2 MS2

```
1 // sum 3-2
2 clc;
3 clear;
4 d=5;
5 A=%pi*d^2/4;
6 l=100*10^3;
7 W=600;
8 E=210*10^3;
9 w=0.0784*10^-3;
10 del1=W*l/(A*E);
11 del2=w*l^2/(2*E);
12 del=del1+del2;
13
14 // printing data in scilab o/p window
15 printf("del is %f mm      ",del);
```

---

### Scilab code Exa 3.3 MS3

```
1 // sum 3-3
2 clc;
3 clear;
4 m=25;
5 v=3;
6 E=210*10^3;
7 KE=0.5*m*v^2;
8 d=30;
9 L=2000;
```

```

10 A=%pi*d^2/4;
11 U=A*L/(2*E);
12 del=4*10^-5*A;
13 W=A*del;
14 sigi=sqrt(KE*10^3/(W+U));
15
16 // printing data in scilab o/p window
17 printf("del is %f N/mm^2      ",sigi);

```

---

#### Scilab code Exa 3.4 MS4

```

1 // sum 3-4
2 clc;
3 clear;
4 P=40*10^3;
5 A=60*18;
6 sig=P/A;
7 r1=12;
8 b1=60;
9 SCF1=1.7;
10 sigmax1=sig*SCF1;
11 r2=24;
12 b2=60;
13 SCF2=1.5;
14 sigmax2=sig*SCF2;
15
16 // printing data in scilab o/p window
17 printf("sigmax1 is %f N/mm^2      ",sigmax1);
18 printf("\n sigmax2 is %f N/mm^2      ",sigmax2);

```

---

#### Scilab code Exa 3.5 MS5

```

1 // sum 3-5

```

```

2  clc;
3  clear;
4  p=2.4;
5  //Let axial movement of nut be La
6  La=p*45/360;
7  d=20;
8  D=30;
9  L=500;
10 d1=18;
11 As=%pi*d1^2/4;
12 Ac=%pi*(D^2-d^2)/4;
13 sigt=120/(3.543);
14 sigb=1.543*sigt;
15
16 // printing data in scilab o/p window
17 printf("sigt is %f N/mm^2      ",sigt);
18 printf("\\n sigb is %f N/mm^2      ",sigb);

```

---

### Scilab code Exa 3.6 MS6

```

1 // sum 3-6
2 clc;
3 clear;
4 delT=100;
5 ab=18*10^-6;
6 aa=23*10^-6;
7 delta=(360*ab*delT)+(450*aa*delT);
8 lc=delta-0.6;
9 Ea=70*10^3;
10 Eb=105*10^3;
11 Aa=1600;
12 Ab=1300;
13 P=lc/((360/(Ab*Eb))+(450/(Aa*Ea)));
14 P=P*10^-3;
15 //Let the change in length be delL

```



```

16 delL=(aa*450*delT)-(P*10^3*450/(Aa*Ea));
17
18 // printing data in scilab o/p window
19 printf("P is %f kN      ",P);
20 printf("\n delL is %f mm      ",delL);
21
22 // The difference in the answer of delL is due to
    round-off errors.

```

---

### Scilab code Exa 3.7 MS7

```

1 // sum 3-7
2 clc;
3 clear;
4 a=23*10^-6;
5 E=70*10^3;
6 l=750;
7 sig=35;
8 delT=((sig*l/E)+0.8)/(l*a);
9
10 // printing data in scilab o/p window
11 printf("delT is %f degC      ",delT);

```

---

### Scilab code Exa 3.8 MS8

```

1 // sum 3-8
2 clc;
3 clear;
4 OA=60;
5 AB=30;
6 OC=-20;
7 CD=-30;
8 theta=30;

```

```

 9  angBEK=2*theta;
10  OM=14;
11  KM=49.5;
12  p1=70;
13  p2=-30;
14  angBEH=-37;
15  angBEI=143;
16  theta1=angBEH/2;
17  theta2=angBEI/2;
18  Tmax=50;
19  angBEL=53;
20  angBEN=233;
21  theta3=angBEL/2;
22  theta4=angBEN/2;
23  // printing data in scilab o/p window
24  printf("Stress on plane AB is %f MPa      ",OM);
25  printf("\n Stress on plane AB is %f MPa      ",KM);
26  printf("\n Principal stress p1 is %f MPa      ",p1)
    ;
27  printf("\n Principal stress p2 is %f MPa      ",p2)
    ;
28  printf("\n Principal angle theta1 is %f deg      ",
    theta1);
29  printf("\n Principal angle theta2 is %f deg      ",
    theta2);
30  printf("\n Maximum shear stress is %f MPa      ",
    Tmax);
31  printf("\n Direction of plane theta3 is %f deg
    ",theta3);
32  printf("\n Direction of plane theta4 is %f deg
    ",theta4);
33
34  //The answers in the book are written in form of
    degrees and minutes.

```

---

### Scilab code Exa 3.9 MS9

```
1 // sum 3-9
2 clc;
3 clear;
4 E=200*10^3;
5 v=0.29;
6 E1=720*10^-6;
7 E2=560*10^-6;
8 p1=121.76;
9 p2=-76.69;
10
11 // printing data in scilab o/p window
12 printf("p1 is %f MN/mm^2      ",p1);
13 printf("\n p2 is %f MN/mm^2      ",p2);
```

---

### Scilab code Exa 3.10 MS10

```
1 // sum 3-10
2 clc;
3 clear;
4 G=38*10^3;
5 d=10;
6 P=5*10^3;
7 A=%pi*d^2/4;
8 sig=P/A;
9 delld=0.0002;
10 //Let the lateral strain be E1
11 E1=delld/d;
12 v=2*delld*G/(sig-(2*delld*G));
13 E=2*G*(1+v)*10^-3;
14
15 // printing data in scilab o/p window
16 printf("v is %0.4 f      ",v);
17 printf("\n E is %0.3 f kN/mm^2      ",E);
```

---

**Scilab code Exa 3.11 MS11**

```
1 // sum 3-11
2 clc;
3 clear;
4 D=1500;
5 p=1.2;
6 sigt=100;
7 sigc=p*D/2;
8 siga=p*D/4;
9 P=sigc*2*10^3;
10 n=0.75;
11 t=sigc/(n*sigt);
12
13 // printing data in scilab o/p window
14 printf("t is %0.1f mm ",t);
```

---

**Scilab code Exa 3.12 MS12**

```
1 // sum 3-12
2 clc;
3 clear;
4 D=50;
5 t=1.25;
6 d=0.5;
7 n=1/d;
8 p=1.5;
9 siga=p*D/(4*t);
10 sigc=20.27;
11 sigw=sigc/0.31416;
12
```

```
13 // printing data in scilab o/p window
14 printf("sigw is %0.2f N/mm^2      ",sigw);
```

---

### Scilab code Exa 3.13 MS13

```
1 // sum 3-13
2 clc;
3 clear;
4 R1=50;
5 p=75;
6 pmax=125;
7 R2=sqrt((pmax+p)*R1^2/(pmax-p));
8 t=R2-R1;
9
10 // printing data in scilab o/p window
11 printf("t is %0.1f mm      ",t);
```

---

### Scilab code Exa 3.14 MS14

```
1 // sum 3-14
2 clc;
3 clear;
4 R1=40;
5 R2=60;
6 B=50;
7 E=210*10^3;
8 e=41*10^-6;
9 sig=2*R1^2/(R2^2-R1^2);
10 p=E*e/sig;
11 Fr=p*2*%pi*R1*B;
12 u=0.2;
13 Fa=u*Fr*10^-3;
14
```

```
15 // printing data in scilab o/p window
16 printf("Fa is %0.2 f kN      ",Fa);
```

---

### Scilab code Exa 3.15 MS15

```
1 // sum 3-15
2 clc;
3 clear;
4 a1=10*1.5;
5 x1=15-0.75;
6 a2=1.5*(15-1.5);
7 x2=(15-1.5)/2;
8 y1=((a1*x1)+(a2*x2))/(a1+a2);
9 y2=a1-y1;
10 Ixx=(10*1.5^3)/12+(10*1.5*(5.06-1.5/2)^2)
      +(1.5*13.5^3/12)+(1.5*13.5*(9.94-6.75)^2);
11 Z1=Ixx/y1;
12 Z2=Ixx/y2;
13 L=3;
14 sigc=50;
15 W=sigc*Z1/L*10^-3;
16
17 // printing data in scilab o/p window
18 printf("W is %0.3 f kN      ",W);
```

---

### Scilab code Exa 3.16 MS16

```
1 // sum 3-16
2 clc;
3 clear;
4 D=22;
5 d=20;
6 r=1;
```

```

7 K=2.2;
8 sigmax=130;
9 sigmax=sigmax/K;
10 Z=%pi*d^3/32;
11 M=sigmax*Z*10^-3;
12
13 // printing data in scilab o/p window
14 printf("M is %0.3 f Nm      ",M);

```

---

#### Scilab code Exa 3.17 MS17

```

1 // sum 3-17
2 clc;
3 clear;
4 A=(12*2)+(12*2)+(30-4);
5 B=sqrt(A/2);
6 D=2*B;
7 B1=12;
8 D1=30;
9 d=26;
10 b=1;
11 Z1=((B1*D1^3)-((B1-b)*d^3))/(B1*D1/2);
12 Zr=B*D^2/6;
13 //Let the ratio of both the sections be x
14 x=Z1/Zr;
15 M=30*10^6;
16 sigmax=M/(Z1*10^3);
17
18 // printing data in scilab o/p window
19 printf("Z1/Zr is %0.2 f      ",x);
20 printf("\n sigmax is %0.2 f N/mm^2      ",sigmax);

```

---

#### Scilab code Exa 3.18 MS18

```

1 // sum 3-18
2 clc;
3 clear;
4 //Tmax=F/(I*b)*[B*t(d/2+t/2)+(b*d*d/8)];
5 //T1=F/(I*b)*[B*t*(d+t)/2];
6 //Tmean=T1+2/3*(Tmax-T1);
7 //T=Tmax-Tmean;
8 //T=F*d^2/(24*I);
9 disp("Difference between maximum and mean shear
      stresses in the web is ,T=F*d^2/(24*I)");

```

---

#### Scilab code Exa 3.19 MS19

```

1 // sum 3-19
2 clc;
3 clear;
4 x1=((13*3*1.5)+(2*15*8))/(39+30);
5 x2=13-x1;
6 A=30+39;
7 E=2*10^7;
8 Iyy=995.66;
9 e=54.32;
10 x=x2-3;
11 sigb=e*x/Iyy;
12 sigd=1/69;
13 sigr=sigd+sigb;
14 //Let the strain be E1
15 E1=800*10^-6;
16 P=E1*E/sigr;
17 P=P*10^-3;
18
19 // printing data in scilab o/p window
20 printf("P is %0.2 f kN      ",P);

```

---



### Scilab code Exa 3.20 MS20

```
1 // sum 3-20
2 clc;
3 clear;
4 H=20;
5 D=5;
6 d=3;
7 rho=21;
8 sigd=rho*H;
9 p=2;
10 A=D*H;
11 P=p*A;
12 M=P*H/2;
13 Z=%pi*(D^4-d^4)/(32*D);
14 sigb=M/Z;
15 sigmax=420+sigb;
16 sigmin=420-sigb;
17
18 // printing data in scilab o/p window
19 printf("sigmax is %0.2f kN/m^2      ",sigmax);
20 printf("\n sigmin is %0.2f kN/m^2      ",sigmin);
```

---

### Scilab code Exa 3.21 MS21

```
1 // sum 3-21
2 clc;
3 clear;
4 D=30;
5 R=15;
6 T=0.56*10^6;
7 G=82*10^3;
```

```

8 J=%pi*R^4/2;
9 T1=T*R/J;
10 l=1000;
11 theta=T*l/(G*J)*180/%pi;
12 r=10;
13 Tr=T1*r/R;
14
15 // printing data in scilab o/p window
16 printf("T1 is %0.2f N/mm^2      ",T1);
17 printf("\n theta is %0.2f deg      ",theta);
18 printf("\n Tr is %0.2f N/mm^2      ",Tr);

```

---

#### Scilab code Exa 3.22 MS22

```

1 // sum 3-22
2 clc;
3 clear;
4 T=8*10^3;
5 d=80;
6 D=110;
7 l=2000;
8 Gst=80*10^3;
9 Gcop=Gst/2;
10 Js=%pi*d^4/32;
11 Jc=%pi*(D^4-d^4)/32;
12 //Ts=0.777*Tc
13 Tc=T/1.777*10^3;
14 Ts=0.777*Tc;
15 Ts1=Ts/Js*d/2;
16 Tc1=Tc/Jc*D/2;
17 //Let t1 be Angular twist per unit length
18 t1=Ts*10^3/(Js*Gst)*180/%pi;
19 // Let the maximum stress developed when the Torque
    is acting in the centre of the shaft be Ts2 & Tc2
    resp. for steel and copper

```

```

20 Ts2=Ts1/2;
21 Tc2=Tc1/2;
22
23 // printing data in scilab o/p window
24 printf("Ts1 is %0.3 f N/mm^2      ",Ts1);
25 printf("\n Tc1 is %0.1 f N/mm^2      ",Tc1);
26 printf("\n theta/length is %0.3 f deg/m      ",t1);
27 printf("\n Ts2 is %0.3 f N/mm^2      ",Ts2);
28 printf("\n Tc2 is %0.2 f N/mm^2      ",Tc2);

```

---

### Scilab code Exa 3.23 MS23

```

1 // sum 3-23
2 clc;
3 clear;
4 D=100;
5 d=75;
6 r=6;
7 K=1.45;
8 P=20*746;
9 N=400;
10 w=2*%pi*N/60;
11 T=P/w;
12 Ts=16*T*10^3/(%pi*d^3);
13 Tmax=K*Ts;
14
15 // printing data in scilab o/p window
16 printf("Tmax is %0.3 f MPa      ",Tmax);

```

---

### Scilab code Exa 3.24 MS24

```

1 // sum 3-24
2 clc;

```

```

3 clear;
4 G=84*10^3;
5 T=28*10^3;
6 l=1000;
7 theta=%pi/180;
8 J=T*l/(G*theta);
9 d=(J*32/%pi)^(1/4);
10
11 // printing data in scilab o/p window
12 printf("d is %0.1 f mm      ",d);

```

---

#### Scilab code Exa 3.25 MS25

```

1 // sum 3-25
2 clc;
3 clear;
4 P=2*10^6;
5 N=200;
6 w=2*%pi*N/60;
7 Tm=P/w;
8 W=5*10^3*9.81;
9 l=1800;
10 Mmax=W*l/4;
11 Tmax=1.8*Tm*10^3;
12 Me=(Mmax+sqrt(Mmax^2+Tmax^2))/2;
13 Te=sqrt(Mmax^2+Tmax^2);
14 sig=60;
15 Ts=40;
16 d1=(32*Me/(%pi*sig))^(1/3);
17 d2=(16*Te/(%pi*Ts))^(1/3);
18
19 // printing data in scilab o/p window
20 printf("d is %0.1 f mm      ",d2);

```

---

### Scilab code Exa 3.26 MS26

```
1 // sum 3-26
2 clc;
3 clear;
4 Q=4*10^3;
5 P=8*10^3;
6 sig=P;
7 T=Q;
8 p1=(sig/2+sqrt((sig/2)^2+T^2));
9 p2=(sig/2-sqrt((sig/2)^2+T^2));
10 sigyp=285;
11 FOS=3;
12 siga=sigyp/3;
13 A1=p1/siga;
14 d1=sqrt(4*A1/%pi);
15 A2=(p1-p2)*2/(siga*2);
16 d2=sqrt(4*A2/%pi);
17 v=0.3;
18 A3=sqrt(p1^2+p2^2-(2*v*p1*p2))/siga;
19 d3=sqrt(4*A3/%pi);
20
21 // printing data in scilab o/p window
22 printf("d1 is %0.2 f mm      ",d1);
23 printf("\n d2 is %0.1 f mm      ",d2);
24 printf("\n d3 is %0.2 f mm      ",d3);
```

---

### Scilab code Exa 3.27 MS27

```
1 // sum 3-27
2 clc;
3 clear;
```

```

4 sigx=-105;
5 Txy=105;
6 sigy=270;
7 p1=(sigx/2+sqrt((sigx/2)^2+Txy^2));
8 p2=(sigx/2-sqrt((sigx/2)^2+Txy^2));
9 p3=0;
10 Tmax=(p1-p2)/2;
11 siga=sigy/2;
12 if (Tmax<=siga) then
13     printf("The component is safe")
14 end
15
16 // printing data in scilab o/p window
17 printf("\n Tmax is %0.1 f MPa      ",Tmax);

```

---

#### Scilab code Exa 3.28 MS28

```

1 // sum 3-28
2 clc;
3 clear;
4 rho=0.0078*9.81*10^-6;
5 sigc=150;
6 g=9.81;
7 V=sqrt(sigc*g/rho)*10^-3;
8 R=1;
9 w=V/R;
10 N=w*60/(2*%pi);
11
12 // printing data in scilab o/p window
13 printf("N is %0.3 f rpm      ",N);

```

---

#### Scilab code Exa 3.29 MS29

```

1 // sum 3-29
2 clc;
3 clear;
4 R1=50;
5 R2=200;
6 N=6*10^3;
7 w=2*%pi*N/60;
8 v=0.28;
9 rho=7800*10^-9;
10 g=9810;
11 k1=(3+v)/8;
12 k2=(1+(3*v))/8;
13 W=rho*9.81;
14 x=k1*w^2*W*(R1^2+R2^2)/g;
15 y=k1*w^2*W*(R1*R2)^2/g;
16 y1=k1*w^2*W/g;
17 z=k2*w^2*W/g;
18 r=sqrt(R1*R2);
19 sigrmax=x-(y/r^2)-(r^2*y1);
20 r=50:200
21 n=length(r);
22 for i=1:n
23     sigr(i)=x-(y/r(i)^2)-(r(i)^2*y1)
24 end
25
26 for j=1:n
27     sigc(j)=x+(y/r(j)^2)-(r(j)^2*z)
28 end
29
30 plot (r,sigr);
31 plot (r,sigc);
32 xtitle('','r mm');
33 ylabel('stress N/mm^2');
34 xgrid(2);
35
36 // printing data in scilab o/p window
37 printf("sigrmax is %0.1f MPa ",sigrmax);

```

---

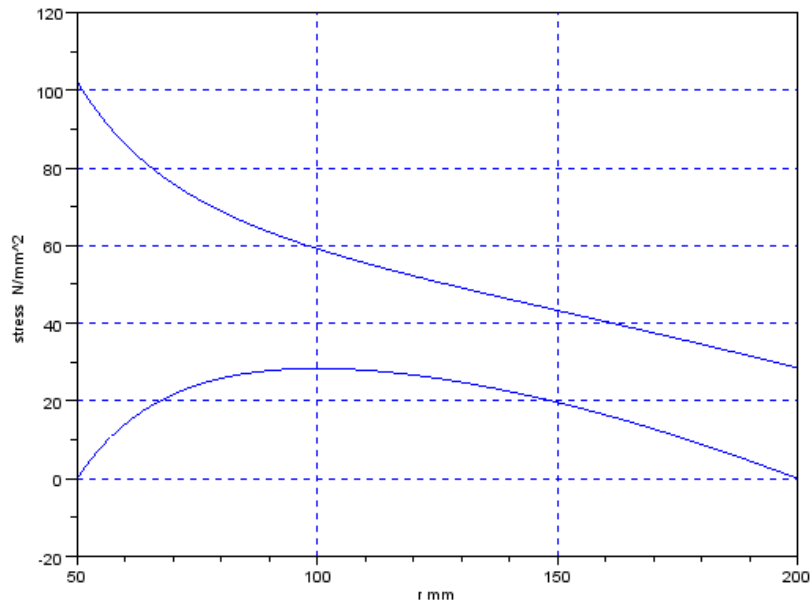


Figure 3.1: MS29

**Scilab code Exa 3.30 MS30**

```

1 // sum 3-30
2 clc;
3 clear;
4 r=500;
5 to=15;
6 N=3500;
7 w=2*%pi*N/60;
8 sig=80;

```



```

9 w1=0.07644*10^-3;
10 g=9810;
11 a=w1*w^2*r^2/(2*sig*g);
12 t=to*exp(-a);
13
14 // printing data in scilab o/p window
15 printf("t is %0.3f mm ",t);

```

---

### Scilab code Exa 3.31 MS31

```

1 // sum 3-31
2 clc;
3 clear;
4 M=60*10^3;
5 y1=((5*1*2.5)+(6*1*5.5))/(5+6);
6 y2=6-y1;
7 R=12;
8 R1=R-y2;
9 R1=10.136
10 R2=11.136;
11 R3=R1+6;
12 B=6;
13 b=1;
14 A=(B*b)+((B-1)*b);
15 //Let x= h^2/R^2
16 x=R/A*((B*log(R2/R1))+(b*log(R3/R2)))-1;
17 x=1/x;
18 //Let Maximum compressive stress at B be sigB
19 sigB=M/(A*R)*(1+(x*y1/(R+y1)))*10^-2;
20 //Let Maximum tensile stress at A be sigA
21 sigA=M/(A*R)*((y2*x/(R-y2))-1)*10^-2;
22 // printing data in scilab o/p window
23 printf("sigB is %0.1f MPa ",sigB);
24 printf("\n sigA is %0.0f MPa ",sigA);
25

```

26 //The answer to  $R^2/h^2$  is calculated incorrectly  
in the book.

---

### Scilab code Exa 3.32 MS32

```
1 // sum 3-32
2 clc;
3 clear;
4 R1=24;
5 R2=30;
6 R3=50;
7 R4=54;
8 F=200;
9 y1=((16*4*2)+(2*20*14*4)+(24*6*27))/((16*4)+(2*20*4)
    +(24*6));
10 y2=30-y1;
11 R=24+y2;
12 A=(24*6)+(2*4*20)+(4*16);
13 //Let x= h^2/R^2
14 x=R/A*((24*log(R2/R1))+(2*4*log(R3/R2))+(16*log(R4/
    R3)))-1;
15 x=1/x;
16 M=F*(60+R);
17 sigd=F/A;
18 //Let bending stress at a be sigA
19 sigA=M/(A*R)*((y2*x/(R-y2))-1);
20 //Let bending stress at b be sigB
21 sigB=M/(A*R)*(1+(x*y1/(R+y1)));
22 //Let resultant at a be Ra
23 Ra=(sigA+sigd)*10;
24 //Let resultant at b be Rb
25 Rb=(sigB-sigd)*10;
26 // printing data in scilab o/p window
27 printf("Ra is %0.2f N/mm^2      ",Ra);
28 printf("\n Rb is %0.2f N/mm^2      ",Rb);
```

29

30 //The difference in the answers are due to rounding-  
off of values.

---

### Scilab code Exa 3.33 MS33

```
1 // sum 3-33
2 clc;
3 clear;
4 F=50;
5 B1=4;
6 B2=8;
7 D=12;
8 y1=D/3*(B1+(2*B2))/(B1+B2);
9 y2=12-y1;
10 R=6+y2;
11 A=(B1+B2)/2*D;
12 //Let x= h^2/R^2
13 a=(B1+((B2-B1)*(y1+R)/D))*log((R+y1)/(R-y2))
14 x=R/(A)*(a -(B2-B1));
15 x=x-1;
16 x=1/x;
17 KG=y2+8;
18 M=F*KG;
19 sigd=F/A;
20 //Let bending stress at a be sigA
21 sigA=M/(A*R)*(1+(x*y1/(R+y1)));
22 //Let bending stress at b be sigB
23 sigB=M/(A*R)*((y2*x/(R-y2))-1);
24 sigA=(sigA-sigd)*10;
25 sigB=(sigB+sigd)*10;
26 // printing data in scilab o/p window
27 printf("sigA is %0.2f MPa      ",sigA);
28 printf("\n sigB is %0.2f MPa      ",sigB);
29
```

30 //The difference in the answers are due to  
rounding-off of values.

---

# Chapter 4

## MANUFACTURING CONSIDERATIONS

Scilab code Exa 4.1 MF1

```
1 // sum 4-1
2 clc;
3 clear;
4 d=70;
5 dmin=50;
6 dmax=80;
7 D=sqrt(dmin*dmax);
8 D=63;
9 i=0.458*(D^(1/3))+(0.001*D);
10
11 //standard tolerance for H8 is ST1
12 ST1=25*i;
13 ST1=ST1*10^-3;
14 //standard tolerance of shaft for grade g7 is ST2
15 ST2=16*i;
16 ST2=ST2*10^-3;
17 es=-(2.5*(D^0.333));
18 es=es*10^-3;
19 ei=es-ST2;
```

```

20 //Lower limit for hole is LLH
21 //Upper limit for hole is ULH
22 //Upper limit for shaft is ULS
23 //Lower limit for shaft is LLS
24 LLH=d;
25 ULH=LLH+ST1;
26 ULS=LLH+es;
27 LLS=ULS-ST2;
28 //Maximum clearance is Cmax
29 //minimum clearance is Cmin
30 Cmax=ULH-LLS;
31 Cmin=LLH-ULS;
32
33 // printing data in scilab o/p window
34 printf("LLH is %0.1f mm ",LLH);
35 printf("\n ULH is %0.3f mm ",ULH);
36 printf("\n ULS is %0.2f mm ",ULS);
37 printf("\n LLS is %0.2f mm ",LLS);
38 printf("\n Cmax is %0.3f mm ",Cmax);
39 printf("\n Cmin is %0.3f mm ",Cmin);

```

---

#### Scilab code Exa 4.2 MF2

```

1 // sum 4-2
2 clc;
3 clear;
4 d=25;
5 //Lower limit for hole is LLH
6 //Upper limit for hole is ULH
7 //Upper limit for shaft is ULS
8 //Lower limit for shaft is LLS
9 ULH=d+0.021;
10 LLH=d+0;
11 ULS=d+0.041;
12 LLS=d+0.028;

```

```

13 //Maximum interference is Cmax
14 //minimum interference is Cmin
15 Cmax=ULS-LLH;
16 Cmin=LLS-ULH;
17
18 // printing data in scilab o/p window
19 printf("Cmax is %0.3f mm ",Cmax);
20 printf("\n Cmin is %0.3f mm ",Cmin);

```

---

### Scilab code Exa 4.3 MF3

```

1 // sum 4-3
2 clc;
3 clear;
4 d=50;
5 Es=0.039;
6 Ei=0;
7 es=-9*10^-3;
8 ei=-34*10^-3;
9 //Shaft dia is D
10 D=d+es;
11 //Lower limit for hole is LLH
12 //Upper limit for hole is ULH
13 //Upper limit for shaft is ULS
14 //Lower limit for shaft is LLS
15 ULH=d+Es;
16 LLH=d+Ei;
17 ULS=d+es;
18 LLS=d+ei;
19 //Maximum interference is Cmax
20 //minimum interference is Cmin
21 Cmax=ULH-LLS;
22 Cmin=LLH-ULS;
23
24 // printing data in scilab o/p window

```

```

25     printf("ULH is %0.3 f mm ",ULH);
26     printf("\n LLH is %0.3 f mm ",LLH);
27     printf("\n ULS is %0.3 f mm ",ULS);
28     printf("\n LLS is %0.3 f mm ",LLS);
29     printf("\n Cmax is %0.3 f mm ",Cmax);
30     printf("\n Cmin is %0.3 f mm ",Cmin);
31     disp('Therefore , H8g7 is easy running fit ');

```

---

#### Scilab code Exa 4.4 MF4

```

1 // sum 4-3
2 clc;
3 clear;
4 d=30;
5 Es=0.025;
6 Ei=0;
7 es=11*10^-3;
8 ei=-5*10^-3;
9 //Shaft dia is D
10 D=d+es;
11 //Lower limit for hole is LLH
12 //Upper limit for hole is ULH
13 //Upper limit for shaft is ULS
14 //Lower limit for shaft is LLS
15 ULH=d+Es;
16 LLH=d+Ei;
17 ULS=d+es;
18 LLS=d+ei;
19 //Maximum interference is Cmax
20 //minimum interference is Cmin
21 Cmax=ULH-LLS;
22 Cmin=ULS-LLH;;
23
24 // printing data in scilab o/p window
25     printf("ULH is %0.3 f mm ",ULH);

```



```
26     printf("\n LLH is %0.3 f mm ",LLH);
27     printf("\n ULS is %0.3 f mm ",ULS);
28     printf("\n LLS is %0.3 f mm ",LLS);
29     printf("\n Cmax is %0.3 f mm ",Cmax);
30     printf("\n Cmin is %0.3 f mm ",Cmin);
```

---

# Chapter 5

## INTRODUCTION TO PRESSURE VESSELS

Scilab code Exa 5.1 IPV5 1

```
1 // sum 5-1
2 clc;
3 clear;
4 p=2;
5 Rm=220;
6 //tensile hoop or circumferential stress= sigt
7 sigr=-2;
8 //sigt=(p*Rm)/t;
9 Sa=230/2;
10 //t1=thickness according to maximum principal stress
    theory
11 //t2=thickness according to maximum shear stress
    theory
12 t1=(p*Rm)/Sa;
13 t2=(p*Rm)/(Sa+sigr);
14
15 // printing data in scilab o/p window
16 printf("t1 is %0.2f mm ",t1);
17 printf("\n t2 is %0.3f mm ",t2);
```

---

Scilab code Exa 5.2 IPV5 2

```
1 // sum 5-2
2 clc;
3 clear;
4 //Elastic limit=sige
5 sige=310;
6 //inside diameter=di
7 di=300;
8 p=1.8;
9 FOS=2;
10 //design stress=sigd;
11 sigd=sige/2;
12 c=0.162;
13 d=380;
14 //cover plate thickness=t;
15 t=d*sqrt(c*p/sigd);
16 t=17;
17 M=di*p*t/4;
18
19 z=(1/6)*1*t^2;
20 //bending stress=sigb;
21 sigb=M/z;
22
23 // printing data in scilab o/p window
24 printf("t is %0.1fmm ",t);
25 printf("\n M is %0.1fmm ",M);
26 printf("\n sigb is %0.1fmm ",sigb);
27 if (sigb<=sigd) then
28     disp ('sigb is below allowable sigd.')
29 end
```

---

### Scilab code Exa 5.3 IPV5 3

```
1 // sum 5-3
2 clc;
3 clear;
4 sige=220;
5 v=0.29;
6 Ri=175;
7 FOS=3;
8 Sa=sige/3;
9 p=10;
10 //t1=thickness according to maximum principal stress
    theory
11 //t2=thickness according to maximum shear stress
    theory
12 x=Sa+(p*(1-(2*v)));
13 y=Sa-(p*(1+v));
14 t1=(sqrt(x/y)-1)*Ri;
15 t1=24;
16 //t1=((sqrt((Sa+(p*(1-(2*v)))))/(Sa-(p*(1+v))))-1)*
    Ri;
17 t2=Ri*((sqrt(Sa/(Sa-(2*p))))-1);
18
19 // printing data in scilab o/p window
20 printf("t1 is %0.1fmm ",t1);
21 printf("\n t2 is %0.3fmm ",t2);
22
23 //The answer to t2 is not calculated in the book.
```

---

### Scilab code Exa 5.4 IPV5 4

```
1 // sum 5-4
2 clc;
3 clear;
4 p=16;
```

```

5 Ri=250;
6 //Yield strength =sigy;
7 sigy=330;
8 v=0.3;
9 FOS=3;
10 Sa=sigy/3;
11 t=Ri*((sqrt(Sa/(Sa-(2*p))))-1);
12 t=50;
13 // printing data in scilab o/p window
14 printf("t is %0.1fmm ",t);

```

---

#### Scilab code Exa 5.5 IPV5 5

```

1 // sum 5-5
2 clc;
3 clear;
4 d=15;
5 Eg=480;
6 t=3;
7 //flange thickness=ft;
8 ft=12;
9 A=%pi*d^2/4;
10 l=d+t+(ft/2);
11 E=210;
12 kb=A*E/l;
13 //effective area of gasket=Ag;
14 Ag=%pi*(((ft+t+d)^2)-(d^2))/4;
15 kg=Ag*Eg/t;
16 // printing data in scilab o/p window
17 printf("kb is %0.3f N/mm ",kb);
18 kb=kb*10^-3;
19 kg=kg*10^-3;
20 if (kb<=kg) then
21     printf("\n The combines stiffness of bolt and
           gasket is %0.3f kN/mm",kg)

```

```
22 end
23
24 //The difference in the value of kb is due to
    rounding-off the value of A
```

---

# Chapter 6

## LEVERS

Scilab code Exa 6.1 L1

```
1 // sum 6-1
2 clc;
3 clear;
4 del=10;
5 k=500;
6 W=k*del;
7 //Let load arm be l1
8 l1=200;
9 //Let effort arm be l2
10 l2=500;
11 P=W*l1/l2;
12 Ro=sqrt(W^2+P^2);
13 Ta=40;
14 d=sqrt(Ro*4/(2*pi*Ta));
15 d=10;
16 pb=10;
17 d1=sqrt(Ro/(pb*1.5));
18 d1=20;
19 l=1.5*d;
20 t=10;
21 T=Ro*4/(2*pi*d1^2);
```

```

22 M=(Ro/2*(1/2+t/3))-(Ro/2*1/4);
23 sigb=32*M/(%pi*d1^3);
24 sigmax=(sigb/2)+sqrt((sigb/2)^2+T^2);
25 P=Ro/(1*d1);
26 D=2*d1;
27
28 // printing data in scilab o/p window
29 printf("d1 is %0.1f mm      ",d1);
30 printf("\n D is %0.1f mm      ",D);

```

---

### Scilab code Exa 6.2 L2

```

1 // sum 6-2
2 clc;
3 clear;
4 d1=80;
5 p=0.981;
6 Ta=40;
7 siga=80;
8 pa=15;
9 W=%pi*(d1^2)*p/4;
10 P=W/8;
11 Ws=W-P;
12 d=sqrt(W*4/(%pi*2*Ta));
13 l=1.5*d;
14 D=2*d;
15 T=W/(2*%pi*pa^2/4);
16 M1=P*(700-87.5-(D/2));
17 h=50;
18 b=h/4;
19 Z=b*h^2/6;
20 sigb=M1/Z;
21 pmax=80;
22 T=2465.6/h^2;
23 pmax=(sigb/2)+sqrt((sigb/2)^2+T^2);

```



```

24
25 // printing data in scilab o/p window
26 printf("h is %0.2f mm      ",h);
27 printf("\n pmax is %0.2f MPa      ",pmax);
28
29 //The difference in the value of pmax is due to
    rounding-off the digits.

```

---

### Scilab code Exa 6.3 L3

```

1 // sum 6-3
2 clc;
3 clear;
4 P=((4*360)+(2*360))/900;
5 Fv=4-2;
6 Fh=P;
7 Fr=sqrt(Fv^2+Fh^2);
8 P1=4*0.36/0.9;
9 Rf=sqrt(4^2+1.6^2);
10 d=sqrt(Rf*10^3/(15*1.25));
11 d=16;
12 l=1.25*d;
13 T=Rf*10^3*4/(2*pi*d^2);
14 D=2*d;
15 M1=Rf*10^3*(360-(D/2));
16 pa=15;
17 h=80;
18 b=h/4;
19 Z=b*h^2/6;
20 sigb=M1/Z;
21 T=4310/(b*h);
22 pmax=(sigb/2)+sqrt((sigb/2)^2+T^2);
23
24 // printing data in scilab o/p window
25 printf("P is %0.1f KN      ",P);

```

```
26     printf("\n pmax is %0.2 f MPa      ", pmax);
```

---

#### Scilab code Exa 6.4 L4

```
1 // sum 6-4
2 clc;
3 clear;
4 l=360;
5 P=400;
6 Mh=2*P*l/3;
7 sigb=50;
8 l1=60;
9 d=(Mh*32/(%pi*l1))^(1/3);
10 d=30;
11 L=420;
12 siga=60;
13 H=20;
14 B=H/3;
15 Mx=P*(L-H/2);
16 Tx=2*P*l/3;
17 sigb1=Mx*18/H^3;
18 Td=P/(B*H);
19 Tr=17.17*Tx/H^4;
20 T=Tr+Td;
21 sigmax=(sigb1/2)+sqrt((sigb1/2)^2+T^2);
22 Tmax=sqrt((sigb1/2)^2+T^2);
23 T=P*L;
24 M=P*(l1+(2/3*l));
25 Te=sqrt(T^2+M^2);
26 Ta=40;
27 D=(Te*16/(%pi*Ta))^(1/3);
28 D=30; //Rounding off to nearest whole number
29
30 // printing data in scilab o/p window
31 printf("d is %0.1 f mm      ", d);
```

```
32     printf("\n D is %0.1f mm      ",D);
```

---

### Scilab code Exa 6.5 L5

```
1 // sum 6-5
2 clc;
3 clear;
4 l2=300;
5 l=450;
6 P=400;
7 Mx=2*P*l2/3;
8 siga=80;
9 dh=(Mx*32/(%pi*siga))^(1/3);
10 dh=22;
11 L=(2*l2/3)+l;
12 T=P*L;
13 Ta=40;
14 d=(T*16/(%pi*Ta))^(1/3);
15 d=35;
16 d1=1.6*d;
17 Th=T*16*d1/(%pi*(d1^4-d^4));
18 l1=1.5*d;
19 My=P*(L-(d1/2));
20 B=dh;
21 H=sqrt(3.66*75);
22 H=30;
23 Mz=P*l1/2;
24 Te=sqrt(T^2+Mz^2);
25 d2=(Te*16/(%pi*Ta))^(1/3);
26 d2=32;
27 b=d/4;
28 b=9; //Rounding off to nearest whole number
29 t=d/6;
30 t=6; //Rounding off to nearest whole number
31
```

```

32 // printing data in scilab o/p window
33 printf("d is %0.1f mm      ",d);
34 printf("\n dh is %0.1f mm      ",dh);
35 printf("\n d1 is %0.1f mm      ",d1);
36 printf("\n l1 is %0.1f mm      ",l1);
37 printf("\n d2 is %0.1f mm      ",d2);
38 printf("\n b  is %0.1f mm      ",b);
39 printf("\n t  is %0.1f mm      ",t);

```

---

### Scilab code Exa 6.6 L6

```

1 // sum 6-6
2 clc;
3 clear;
4 L=450;
5 P=700;
6 T=P*L;
7 Ta=50;
8 d=(T*16/(%pi*Ta))^(1/3);
9 d=32;
10 d1=1.6*d;
11 d1=52; //Rounding off to nearest whole number
12 l1=1.25*d;
13 My=P*(L-d1/2);
14 sigb=65;
15 H=(My*18/sigb)^(1/3);
16 H=45;
17 B=H/3;
18 T1=P/(B*H);
19 sigmax=(sigb/2)+sqrt((sigb/2)^2+T^2);
20 Mx=P*l1/2;
21 Te=sqrt((T)^2+(Mx^2));
22 d2=(Te*16/(%pi*Ta))^(1/3);
23 d2=d2+6;
24 d2=38; //Rounding off to nearest whole number

```

```
25
26 // printing data in scilab o/p window
27 printf("d is %0.1f mm      ",d);
28 printf("\n d1 is %0.1f mm      ",d1);
29 printf("\n l1 is %0.1f mm      ",l1);
30 printf("\n B  is %0.1f mm      ",B);
31 printf("\n H  is %0.1f mm      ",H);
32 printf("\n d2 is %0.1f mm      ",d2);
```

---

# Chapter 7

## STRUTS AND COLUMNS

Scilab code Exa 7.1 SC1

```
1 // sum 7-1
2 clc;
3 clear;
4 sigc=550;
5 FOS=4;
6 sigw=sigc/FOS;
7 l=4000;
8 le=l/2;
9 A=%pi*(1-0.7^2)/4;
10 K=(1+0.7^2)/16;
11 Pr=800*10^3;
12 a=1/1600;
13 D=130; //Rounding off to nearest whole number
14 d=D*0.7;
15
16 // printing data in scilab o/p window
17 printf("D is %0.1f mm      ",D);
18 printf("\n d is %0.1f mm      ",d);
```

---

### Scilab code Exa 7.2 SC2

```
1 // sum 7-2
2 clc;
3 clear;
4 l=500;
5 E=70*10^3;
6 P=20*10^3;
7 FOS=2;
8 d=P*2*12*4*l^2/((%pi)^2*E);
9 d=(sqrt(8)*d)^0.25;
10 b=d/sqrt(8);
11
12 // printing data in scilab o/p window
13 printf("d is %0.2f mm      ",d);
14 printf("\n b is %0.2f mm      ",b);
```

---

### Scilab code Exa 7.3 SC3

```
1 // sum 7-3
2 clc;
3 clear;
4 Ixx=(2*1696.6)+115.4;
5 Iyy=1696.6+(2*115.4)+(2*25.27*10.27^2);
6 A=3*25.27;
7 Kmin=sqrt(Ixx/75.81);
8 L=600;
9 k=L/Kmin;
10 sigc=110;
11 c=1/200;
12 sigw=sigc*(1-(c*k));
13 Pw=sigw*A;
14 a=1/7500;
15 sigc1=320;
16 Pr=(sigc1*A)/(1+(a*(L/Kmin)^2));
```

```
17 FOS=Pr/Pw;
18
19 // printing data in scilab o/p window
20 printf("FOS is %0.2 f      ",FOS);
```

---

#### Scilab code Exa 7.4 SC4

```
1 // sum 7-4
2 clc;
3 clear;
4 Iyy=193.4+(2*1.2*1.5^3/12);
5 E=200*10^3;
6 l=500;
7 Pe=(%pi^2)*E*Iyy*10^5/(l^2);
8 A=35.53+(2*1.2*15);
9 sige=Pe/7530;
10 k=sqrt(Iyy/A);
11 xc=75;
12 sig=80;
13 sigo=20.875;
14 A=A*100;
15 P=sigo*A;
16 P=P*10^-3;
17
18 // printing data in scilab o/p window
19 printf("P is %0.1 f kN      ",P);
20
21 //The difference in the value of P is due to
    rounding-off the digits.
```

---

#### Scilab code Exa 7.5 SC5

```
1 // sum 7-5
```



```

2  clc;
3  clear;
4  sigc=330;
5  a=1/7500;
6  t=4;
7  A=14.5*t^2;
8  l=300;
9  Kx=sqrt(1.4626*t^2);
10 Pr=sigc*A/(1+(a*(l/Kx)^2));
11 FOS=2;
12 P=Pr/FOS*10^-3;
13
14  // printing data in scilab o/p window
15  printf("P is %0.4 f KN      ",P);

```

---

### Scilab code Exa 7.6 SC6

```

1  // sum 7-6
2  clc;
3  clear;
4  P=1500;
5  FOS=2;
6  Pd=FOS*P;
7  l=280;
8  E=207*10^3;
9  I=Pd*l^2/(%pi^2*E);
10 D=(64*I/(%pi*(1-0.8^4)))^(1/4);
11 D=8;
12 d=6.4;
13
14  // printing data in scilab o/p window
15  printf("D is %0.1 f mm      ",D);
16  printf("\\n d is %0.1 f mm      ",d);

```

---

### Scilab code Exa 7.7 SC7

```
1 // sum 7-7
2 clc;
3 clear;
4 D=500;
5 p=0.3;
6 E=208*10^3;
7 sigc=320;
8 a=1/7500;
9 l=2000;
10 le=1/2;
11 W=%pi*D^2*p/4;
12 FOS=4;
13 Wd=W*FOS;
14 I=Wd*l^2/(%pi^2*E);
15 d=(64*I/%pi)^(1/4);
16 A=%pi*d^2/4;
17 k=d/4;
18 d=45; //Rounding off to nearest whole number
19
20 // printing data in scilab o/p window
21 printf("d is %0.1f mm      ",d);
```

---

# Chapter 8

## SPRINGS

Scilab code Exa 8.1 S8 1

```
1 // sum 8-1
2 clc;
3 clear;
4 d=5;
5 D=30;
6 G=84*(10^3);
7 Na=15;
8 //Axial Load W
9 W=300;
10 //Spring index C
11 C=30/5;
12 //Shear stress Augmentation factor Ks
13 Ks=((2*C)+1)/(2*C);
14 //Wahl's factor Kw
15 Kw=((4*C)-1)/((4*C)-4)+(0.615/C);
16 //Curvature correction factor Kc
17 Kc=Kw/Ks;
18 //Spring stiffness k
19 k=(G*(d^4))/(8*(D^3)*Na);
20 //Axial deflection delta
21 delta=W/k;
```

```

22
23 // printing data in scilab o/p window
24 printf("Ks is %0.4f ",Ks);
25 printf("\n Kw is %0.4f ",Kw);
26 printf("\n Kc is %0.3f ",Kc);
27 printf("\n The Spring Stiffness is %0.1f N/mm",k);
28 printf("\n The Axial deflection is %0.3f mm",delta);

```

---

### Scilab code Exa 8.2 S8 2

```

1 // sum 8-2
2 clc;
3 clear;
4 W=196.2;
5 lenthofscale=50;
6 k=196.2/50;
7 C=8;
8 Ks=(1+(0.5/C));
9
10 // Let us choose oil tempered wire 0.6-0.7 %C. Refer
    to Table 8-4 for constants A and m, relating
    strength wire
11 //diameter.
12 G=77.2*(10^3);
13 A=1855;
14 m=0.187;
15 // equating Tmax=0.5*sig(ut).
16 // Ks*(8*W*D/(pi*(d^3)))=0.5*A/(d^2)
17 d1=(Ks*(8*W*C/(%pi*A*0.5)));
18 d=d1^(1/1.813);
19 D=C*d;
20 Na=G*(d^4)/(8*(D^3)*k);
21 //Solid length = SL
22 SL=(Na-1)*d
23

```

```

24
25 // printing data in scilab o/p window
26 printf(" wire diameter is %0.3f mm ",d);
27 printf("\n mean diameter is %0.3f mm ",D);
28 printf("\n Number of acting coils are %0.3f ",Na);
29
30 //The difference in the values of d,D and Na is due
    to rounding-off the digits.

```

---

### Scilab code Exa 8.3 S8 3

```

1 // sum 8-3
2 clc;
3 clear;
4 d=1.626;
5 A=2211;
6 m=0.145;
7 rm=3;
8 ri=(rm-(d/2));
9 sigma=A/(d^m);
10 W=(sigma*pi*(d^3)*ri)/(32*(rm^2));
11
12 // printing data in scilab o/p window
13 printf(" Ultimate tensile Strength is %0.1f MPa ",
    sigma);
14 printf("\n Force at which the spring hook fails is
    %0.1f N ",W);
15
16 //The difference in the values of sigma and W is due
    to rounding-off the digits.

```

---

### Scilab code Exa 8.4 S8 4

```

1 // sum 8-4
2 clc;
3 clear;
4 Do=25;
5 // mean coil diameter D=25-d
6 W=150;
7 T=800;
8 G=81000;
9 // Substituting values in equation  $T=8*W*D/(\pi*d^3)$ 
10 // therefore , the equation becomes  $d^3 + 0.477*d = 11.936$ 
11 //consider d=2.2mm, (d can be taken between 2.2-2.3
    mm)
12 d=2.337; //(nearest available wire gauge)
13 C=9.5;
14 D=22.2;
15 Do=D+d;
16 Ks=1+(0.5/C);
17 Tmax=Ks*8*W*D/( $\pi*d^3$ );
18 // check for safety - Tmax<T;
19 Lo=100;
20 Ls=40;
21 //Lo=Ls+delta+0.15*delta
22 delta=(Lo-Ls)/1.15;
23 delta=50;
24 k=150/50;
25 Na=( $G*d^4$ )/( $8*(D^3)*k$ );
26
27 N=Na+2;
28 Ls=N*d;
29 Lo=Ls+(1.15*delta);
30
31 // printing data in scilab o/p window
32 printf("d is %0.3fmm ",d);
33 printf(" \n D is %0.2f mm",D);
34 printf(" \n Ls is %0.2f mm",Ls);
35 printf(" \n Lo is %0.2f mm",Lo);

```

```
36     if (Do<=25)
37         disp ('The diameter is within space constraints'
38             );
38     end
```

---

#### Scilab code Exa 8.5 S8 5

```
1 // sum 8-5A
2 clc;
3 clear;
4 Di=15;
5 Do=20;
6 d=2.3;
7 D=17.5;
8 C=D/d;
9 Ks=1+(0.5/C);
10 Wmax=100;
11 Tmax=Ks*8*Wmax*D/(%pi*(d^3));
12 G=81000;
13 delmax=67.7/2.366;
14 k=100/28;
15 Na=G*(d^4)/(8*k*(D^3));
16 Ls=Na+1; //(for plain ends)
17 delmax=28;
18 //TL= total working length
19 TL=Ls+delmax+(0.15*delmax);
20
21 // printing data in scilab o/p window
22 printf("d is %0.1fmm ",d);
23 printf("\n C is %0.1f ",C);
24 printf("\n Na is %0.1f ",Na);
```

---

#### Scilab code Exa 8.6 S8 6

```

1 // sum 8-6
2 clc;
3 clear;
4 // 18 SWG=1.219MM in dia
5 d=1.219;
6 E=198.6*10^3;
7 G=80.7*10^3;
8 m=0.19;
9 A=1783;
10 sig=A/(d^m);
11 Tys=(0.4*sig);
12 Do=12.5;
13 D=Do-d;
14 C=D/d;
15 Ks=((2*C)+1)/(2*C);
16 W=(Tys*%pi*(d^3))/(8*D*Ks);
17 Nt=13.5;
18 Na=Nt-2;
19 del=(8*W*(D^3)*Na)/(G*(d^4));
20 Ls=(Nt-1)*d;
21 Lo=Ls+del+(0.15*del);
22
23 // printing data in scilab o/p window
24 printf("Tys is %0.1f MPa ",Tys);
25 printf("\n W is %0.1f N ",W);
26 printf("\n del is %0.3f mm ",del);
27 printf("\n Ls is %0.4f mm ",Ls);
28 printf("\n Lo is %0.2f mm ",Lo);
29
30 //Answers in the book for Torsional yeild strength
    have been rounded-off to the nearest whole
    number.

```

---

Scilab code Exa 8.7 S8 7



```

1 // sum 8-7
2 clc;
3 clear;
4 d=1.016;
5 A=2211;
6 m=0.145;
7 G=81000;
8 Nt=16;
9 Na=16-2;
10 sig=A/(d^m);
11 Tys=0.45*sig;
12 Do=12.6;
13 D=Do-d;
14 C=D/d;
15 Ks=1+(0.5/C);
16 W=(Tys*pi*(d^3))/(8*D*Ks);
17 k=(G*(d^4))/(8*(D^3)*Na);
18 del=W/k;
19 Ls=(Nt-1)*d;
20 Lo=Ls+(1.15*del);
21
22
23 // printing data in scilab o/p window
24 printf("Tys is %0.1f MPa ",Tys);
25 printf("\n Do is %0.1f N ",Do);
26 printf("\n W is %0.1f N ",W);
27 printf("\n k is %0.3f N ",k);
28 printf("\n del is %0.2f mm ",del);
29 printf("\n Ls is %0.2f mm ",Ls);
30 printf("\n Lo is %0.3f mm ",Lo);
31
32 if ((Lo/D)>=5.26)
33     disp('The spring will fail under buckling');
34 end
35
36 //Values after the decimal point has not been
    considered for answer of Torsional yeild strength
    in the book, whereas answers for deflection and

```

free-length is different as entire value of variables is taken for calculation in the code.

---

### Scilab code Exa 8.8 S8 8

```
1 // sum 8-8
2 clc;
3 clear;
4 d=2;
5 Do=20;
6 D=Do-d;
7 C=D/d;
8 Na=9;
9 //Material hard drawn spring steel
10 A=1783;
11 m=0.19;
12 G=81000;
13 sig=A/(d^m);
14 Tys=0.45*sig
15 Kf=1.5;
16 Ta=Tys/Kf;
17 Ks=1+(0.5/C);
18 W=(Ta*pi*(d^3))/(8*D*Ks);
19 k=(G*(d^4))/(8*(D^3)*Na);
20 del=W/k;
21 Lo=((Na+1)*d)+(1.15*del);
22 p=(Lo-d)/Na;
23
24 // printing data in scilab o/p window
25 printf("k is %0.3f N/mm ",k);
26 printf("\n W is %0.1f N ",W);
27 printf("\n Lo is %0.3f mm ",Lo);
28 printf("\n p is %0.3f mm ",p);
29
30
```

```

31     if ((Lo)>=47.34)
32         disp ('The spring will fail under buckling');
33     end
34
35 //The answer for value of spring rate 'k' is
    misprinted in the book. Due to this all
    subsequent values of del,Lo,p is calucated
    incorrectly in the book.

```

---

#### Scilab code Exa 8.9 S8 9

```

1 // sum 8-9
2 clc;
3 clear;
4 // for music wire
5 d1=11.5;
6 A=2211;
7 d=1.5;
8 m=0.145;
9 sigut=A/(d^m);
10 sigy=0.78*sigut;
11 Do=16;
12 E=2*(10^5);
13 Nb=4.25;
14 D=Do-d;
15 C=D/d;
16 Ki=((4*(C^2))-C-1)/(4*C*(C-1));
17 Mmax=(sigy*%pi*(d^3))/(32*Ki);
18 kc=((d^4)*E)/(10.8*D*Nb);
19 theta3=Mmax/kc';
20 l1=20;
21 l2=20;
22 Ne=(l1+l2)/(3*%pi*D);
23 Na=Nb+Ne;
24 k=((d^4)*E)/(10.8*Na*D);

```

```

25 thetat=Mmax/k';
26 ke=(3*pi*(d^4)*E)/(10.8*(l1+l2));
27 // angdisp=theta1+theta2=Mmax/ke;
28 angdisp=Mmax/ke;
29 //D1 is final coil diameter
30 D1=(Nb*D)/(Nb+theta3);
31 //IRC=Initial radial clearance
32 IRC=((D-d)-d1)/2;
33 //FRC=Final radial clearance
34 FRC=((D1-d)-d1)/2;
35
36
37 // printing data in scilab o/p window
38 printf("Maximum Torque is %0.2f Nmm",Mmax);
39 printf("\n theta3 is %0.3f turns ",theta3);
40 printf("\n Ne is %0.3f turns ",Ne);
41 printf("\n ke is %0.1f N/mm ",ke);
42 printf("\n theta1+theta2 is %0.4f turns ",angdisp);
43 printf("\n D1 is %0.2f mm ",D1);
44 printf("\n IRC is %0.2f mm ",IRC);
45 printf("\n FRC is %0.2f mm ",FRC);

```

---

#### Scilab code Exa 8.10 S8 10

```

1 // sum 8-10
2 clc;
3 clear;
4 A=1783;
5 m=0.190;
6 d=1.5;
7 D=15;
8 M=300;
9 E=20800;
10 k=30;
11 //sigult= ultimate strength of the material

```

```

12 // sigy= yield strength of the material
13 sigult=A/(d^m);
14 sigy=0.7*sigult;
15 //siga= allowable yield strength of the material
16 siga=sigy/2;
17 C=D/d;
18 Ki=(4*(C^2)-C-1)/(4*C*(C-1));
19 Z=%pi*(d^3)/32;
20 //sigb=bending strength of the material;
21 sigb=Ki*M/Z;
22 while (sigb>=siga)
23     d=d+0.15;
24     D=15;
25     C=D/d;
26     sigult=A/(d^m);
27 sigy=0.7*sigult;
28 siga=sigy/2;
29 Ki=(4*(C^2)-C-1)/(4*C*(C-1));
30 Z=%pi*(d^3)/32;
31 sigb=Ki*M/Z;
32 end
33 d=2; // rounding off the value of the diameter.
34 D;
35 Na=(d^4)*E/(64*D*k);
36
37 // printing data in scilab o/p window
38 printf("d is %0.1f mm ",d);
39 printf("\n D is %0.1f mm ",D);
40 printf("\n Na is %0.2f mm ",Na);

```

---

### Scilab code Exa 8.11 S8 11

```

1 // sum 8-11
2 clc;
3 clear;

```

```

4 L=1180;
5 W=40*(10^3);
6 Nf=2;
7 Ng=8;
8 E=207*(10^3);
9 //sigut is ultimate strength
10 sigut=1400;
11 FOS=2;
12 //sigma= allowable yield strength of the material
13 sigma=1400/2;
14 //sigbf=bending strength in full length
15 sigbf=700;
16 b=75;
17 t=((4.5*W*L)/(((3*Nf)+(2*Ng))*sigbf))^(0.5);
18 t=14;
19 I=(Nf*b*(t^3))/12;
20 Wf=(3*Nf*W)/((3*Nf)+(2*Ng));
21 del=(Wf*(L^3))/(48*E*I);
22
23
24 // printing data in scilab o/p window
25 printf("t is %0.0f mm ",t);
26 printf("\n Wf is %0.0f N ",Wf);
27 printf("\n I is %0.0f mm^4 ",I);
28 printf("\n del is %0.1f mm ",del);

```

---

#### Scilab code Exa 8.12 S8 12A

```

1 // sum 8-12A
2 clc;
3 clear;
4 W=80000;
5 sigbfr=500;
6 L=1100;
7 Nf=3;

```

```

8 Ng=10;
9 N=Nf+Ng;
10 t=((1.5*W*L)/(N*6*sigbfr))^(1/3);
11 t=15;
12 b=6*t;
13 E=207*10^3;
14 deli=(W*(L^3))/(8*E*N*b*(t^3));
15 Wi=(W*Nf*Ng)/(N*((3*Nf)+(2*Ng)));
16
17
18 // printing data in scilab o/p window
19 printf("t is %0.1f mm ",t);
20 printf("\n deli is %0.1f mm ",deli);
21 printf("\n Wi is %0.0f N ",Wi);

```

---

### Scilab code Exa 8.13 S8 13

```

1 // sum 8-13
2 clc;
3 clear;
4 //ultimate strength=sigut
5 sigut=1500;
6 C=7;
7 d=3;
8 D=C*d;
9 Ks=1+(0.5/C);
10 Kw=((4*C)-1)/((4*C)-4)+(0.615/C);
11 Pmax=120;
12 Pmin=40;
13 Pm=80;
14 Tm=(Ks*8*Pm*D)/(pi*(d^3));
15 Ta=(Kw*8*Pmin*D)/(pi*(d^3));
16 Tse=0.22*sigut;
17 Tys=0.45*sigut;
18 x=(Tys-(0.5*Tse))/(0.5*Tse);

```

```

19 y=((x)*Ta)+Tm;
20 FOS=(Tys/y);
21
22 // printing data in scilab o/p window
23 printf("Tm is %0.2 f MPa ",Tm);
24 printf("\n Ta is %0.1 f MPa ",Ta);
25 printf("\n FOS is %0.3 f ",FOS);

```

---

#### Scilab code Exa 8.14 S8 14

```

1 // sum 8-14
2 clc;
3 clear;
4 Tse=360;
5 Tys=660;
6 d=25;
7 P=0.03;
8 m=40;
9 Pmin=((%pi*(d^2)*P)/4)+(m*9.81/1000);
10 k=6;
11 // Additional load= Padd=k*further compression in
    spring
12 Padd=k*10;
13 Pmax=Padd+Pmin;
14 Pm=(Pmax+Pmin)/2;
15 Pa=(Pmax-Pmin)/2;
16 d=2;
17 D=12;
18 C=6;
19 Ks=1+(0.5/C);
20 Ks=1.083;
21 Kw(((4*C)-1)/((4*C)-4))+ (0.615/C);
22 Ta=(Kw*8*Pa*D)/(%pi*(d^3));
23 Tm=(Ks*8*Pm*D)/(%pi*(d^3));
24 x=(Tys-(0.5*Tse))/(0.5*Tse);

```



```
25 y=((x)*Ta)+Tm;
26 FOS=(Tys/y);
27
28 // printing data in scilab o/p window
29 printf("Tm is %0.2 f MPa ",Tm);
30 printf("\n Ta is %0.3 f MPa ",Ta);
31 printf("\n FOS is %0.2 f ",FOS);
```

---

# Chapter 9

## THREADED FASTENERS

Scilab code Exa 9.1 TF1

```
1 // sum 9-1
2 clc;
3 clear;
4 p1=2;
5 d=16;
6 dt1=d-(0.93825*p1);
7 At1=%pi*dt1^2/4;
8 p2=1.5;
9 d=16;
10 dt2=d-(0.93825*p2);
11 At2=%pi*dt2^2/4;
12
13 // printing data in scilab o/p window
14 printf(" At1 is %0.1 f mm^2      ",At1);
15 printf(" \n At2 is %0.1 f mm^2      ",At2);
```

---

Scilab code Exa 9.2 TF2

```

1 // sum 9-2
2 clc;
3 clear;
4 W=20*10^3;
5 n=4;
6 //Let the load on each bolt be W1
7 W1=W/n;
8 At=W1/80;
9
10 // printing data in scilab o/p window
11 printf("At is %0.1f mm^2      ",At);

```

---

#### Scilab code Exa 9.3 TF3

```

1 // sum 9-3
2 clc;
3 clear;
4 d=18;
5 p=2.5;
6 dr=d-(1.2268*p);
7 dm=(d+dr)/2;
8 alpha=atan(p/(%pi*dm));
9 theta=%pi*30/180;
10 u1=0.15;
11 u2=0.13;
12 x=(tan(alpha)+(u1/cos(theta)))/(1-(tan(alpha)*u1/cos
    (theta)));
13 K=dm*x/(2*d)+(0.625*u2);
14
15 // printing data in scilab o/p window
16 printf("K is %0.5f      ",K);

```

---

#### Scilab code Exa 9.4 TF4

```

1 // sum 9-4
2 clc;
3 clear;
4 d=20;
5 t=4;
6 Lg=84;
7 Ad=%pi*d^2/4;
8 Eb=205*10^3;
9 Ed=105*10^3;
10 kb=Ad*Eb/Lg;
11 lg=80;
12 x=5*(lg+(0.5*d))/(lg+(2.5*d));
13 kp=%pi*Ed*d/(2*log(x));
14 At=245;
15 sigb=105;
16 Pe=20*10^3;
17 Pb=Pe*kb/(kb+kp);
18 sigad=Pb/At;
19 finalst=sigb+sigad;
20
21 // printing data in scilab o/p window
22 printf(" final stress is %0.2f N/mm^2      ",
        finalst);

```

---

### Scilab code Exa 9.5 TF5

```

1 // sum 9-5
2 clc;
3 clear;
4 Eb=207*10^3;
5 Ec=105*10^3;
6 sigp=650;
7 At=115;
8 Pi=0.75*sigp*At;
9 F=sigp*At;

```

```

10 //Let the additional load Fadd
11 Padd=F-Pi;
12 d=14;
13 Ad=%pi*d^2/4;
14 Lg=63;
15 kb=Ad*Eb/Lg;
16 lg=60;
17 x=5*(lg+(0.5*d))/(lg+(2.5*d));
18 km=%pi*Ec*d/(2*log(x));
19 C=kb/(kb+km);
20 Pe=Padd/C;
21 K=0.2;
22 Ti=Pi*K*d*10^-3;
23
24 // printing data in scilab o/p window
25 printf("Ti is %0.2f Nm      ",Ti);

```

---

### Scilab code Exa 9.6 TF6

```

1 // sum 9-6
2 clc;
3 clear;
4 d=20;
5 sigp=600;
6 At=245;
7 Pi=120*10^3;
8 Pe=30*10^3;
9 C=0.35;
10 Pb=C*Pe;
11 P=Pi+Pb;
12 sigi=Pi/At;
13 sigf=P/At;
14 K=0.18;
15 T=K*d*Pi*10^-3;
16 E1=sigi/sigp;

```

```

17 E2=sigf/sigp;
18
19 // printing data in scilab o/p window
20 printf(" sigi is %0.1f MPa      ",sigi);
21 printf("\n sigi is %0.2f MPa      ",sigf);
22 printf("\n T is %0.0f Nm          ",T);
23 printf("\n E1 is %0.3f           ",E1);
24 printf("\n E2 is %0.3f           ",E2);
25
26 //Value upto tenthth place is considered in the
    book for value of final stress in bolt, 'sigf'

```

---

#### Scilab code Exa 9.7 TF7

```

1 // sum 9-7
2 // The sum sequence is numbered incorrectly in the
    book, from this sum onwards.
3 clc;
4 clear;
5 p=2;
6 d=16;
7 dt=d-(0.938*p);
8 At=%pi*dt^2/4;
9 r=60*sqrt(2);
10 Td=1/(4*At);
11 Ta=120;
12 T=8.722*10^-3;
13 P=Ta/T*10^-3;
14
15 // printing data in scilab o/p window
16 printf("P is %0.3f kN          ",P);
17
18 //Value upto hundredth place is considered in the
    book for value of permissible load, 'P'

```

---

### Scilab code Exa 9.8 TF8

```
1 // sum 9-8
2 clc;
3 clear;
4 sigyp=460;
5 FOS=2;
6 Ts=0.577*sigyp/FOS;
7 At=245;
8 r=100;
9 P=Ts*At/1.453*10^-3;
10 // Open prob9p8.txt file
11 fid = mopen('prob9p8.txt', "w");
12 // error message
13 if (fid == -1)
14     error('cannot open file for writing');
15 end
16
17 fprintf(fid, "Problem 9.8 Solution: \nThe
    eccentric load is %f N          ",P);
18
19 fclose(fid);
20 // printing data in scilab o/p window
21 printf("P is %0.3f kN          ",P);
22
23 //Value of thousandth place of eccentric load, 'P'
    is misprinted in the book.
```

---

### Scilab code Exa 9.9 TF9

```
1 // sum 9-9
2 clc;
```

```

3 clear;
4 P=4*10^3;
5 e=200;
6 l1=150;
7 l2=550;
8 sigyp=420;
9 FOS=3;
10 siga=sigyp/3;
11 M=P*e;
12 At=12.5;
13 At=14.2;
14
15 // printing data in scilab o/p window
16 printf("At is %0.1f mm^2      ",At);

```

---

#### Scilab code Exa 9.10 TF10

```

1 // sum 9-10
2 clc;
3 clear;
4 Pi=10*10^3;
5 sigyp=420;
6 FOS=2;
7 sige=sigyp/FOS;
8 K1=0.85;
9 K2=0.74;
10 K4=0.868;
11 SCF=2.4;
12 K3=1/SCF;
13 sige=sige*K1*K2*K3*K4;
14 Pe=10*10^3/3;
15 Pmax=Pi+Pe;
16 Pmin=Pi;
17 Pa=(Pmax-Pmin)/2;
18 Pm=(Pmax+Pmin)/2;

```



```

19 theta=atan(Pa/Pm);
20 siga=21.132;
21 At=Pa/siga;
22 At=84.2;
23
24 // printing data in scilab o/p window
25 printf("At is %0.1f mm^2      ",At);
26 disp('M12 coarse-pitch bolt with 1.75 mm pitch is
      used ');

```

---

#### Scilab code Exa 9.11 TF11

```

1 // sum 9-11
2 clc;
3 clear;
4 Pi=15;
5 Pmax=15+3.75;
6 Pmin=15+1.25;
7 Pa=(Pmax-Pmin)/2;
8 Pm=(Pmax+Pmin)/2;
9 K1=0.85;
10 K2=0.7;
11 K4=0.897;
12 SCF=2.4;
13 K3=1/SCF;
14 siga=900/4*K1*K2*K3*K4;
15 siga=28.115;
16 At=Pa*10^3/siga;
17 At=58;
18
19 // printing data in scilab o/p window
20 printf("At is %0.0f mm^2      ",At);

```

---

# Chapter 10

## PIPES AND PIPE JOINTS

Scilab code Exa 10.1 PPJ1

```
1 // sum 10-1
2 clc;
3 clear;
4 sigta=140/2;
5 nt=0.75;
6 //Let the flow rate be Q
7 Q=0.25;
8 v=1.2;
9 D=1.13*sqrt(Q/v);
10 D=520;
11 p=0.7;
12 C=9;
13 t=(p*D)/(2*sigta*nt)+C;
14
15 // printing data in scilab o/p window
16 printf(" t is %0.1f mm ",t);
```

---

Scilab code Exa 10.2 PPJ2

```

1 // sum 10-2
2 clc;
3 clear;
4 p=3*8;
5 sigta=60;
6 d=150;
7 t=d/2*sqrt(((sigta+p)/(sigta-p))-1);
8 t=75*sqrt((84/36)-1);
9 t=40;
10 do=d+(2*t);
11 D=d+(2*t)+20;
12 w=10;
13 Ds=d+(2*w);
14 P=%pi*(Ds^2)*8/4;
15 sigp=310;
16 FOS=4;
17 sigb=77.5;
18 At=P/(sigb*2);
19 At=1300;
20 D=250;
21 db=45;
22 b=D;
23 a=1.8*b;
24 CD=D+(2*db*1.2);
25 sigp=310;
26 Pr=0.75*sigp*At;
27 Pr=Pr*10^-3;
28 t=40;
29 D1=d+(2*t)+20;
30 D2=D1+(4.6*31);
31 CD=D2-((3*t)+20);
32
33 // printing data in scilab o/p window
34 printf("Pr is %0.2 f kN      ",Pr);
35 printf("\n D1 is %0.0 f mm      ",D1);
36 printf("\n D2 is %0.1 f mm      ",D2);
37 printf("\n CD is %0.1 f mm      ",CD);

```

---

### Scilab code Exa 10.3 PPJ3

```
1 // sum 10-3
2 clc;
3 clear;
4 p=14;
5 d=50;
6 sigyp=270;
7 FOS=3;
8 sigta=sigyp/FOS;
9 pt=2*p;
10 t=d/2*sqrt(((sigta+pt)/(sigta-pt))-1);
11 t=10;
12 D1=d+(2*t);
13 Ds=D1+20;
14 P=%pi*(Ds^2)*p/4;
15 sigba=380/4;
16 At=P/(4*sigba);
17 At=245;
18 db=20;
19 Dd=70+(2*20)+5;
20 R=db+2.5;
21 B=(Dd/sqrt(2))+(2*(db+2.5));
22 B=127;
23 Y=Dd/(2*sqrt(2));
24 Rm=34.12;
25 M=(P*Y/2)+(P*Rm/%pi);
26 sigfa=250/5;
27 b=127/70;
28 Z=b/6;
29 tf=sqrt(M/(sigfa*Z));
30 tf=44;
31
32 // printing data in scilab o/p window
```

```

33 printf("d is %0.0f mm      ",d);
34 printf("\n t is %0.0f mm      ",t);
35 printf("\n B is %0.0f mm      ",B);
36 printf("\n R is %0.1f mm      ",R);
37 printf("\n Y is %0.2f mm      ",Y);
38 printf("\n tf is %0.0f mm      ",tf);

```

---

#### Scilab code Exa 10.4 PPJ4

```

1 // sum 10-4
2 clc;
3 clear;
4 p=1.25;
5 D=200;
6 nt=0.75;
7 C=9;
8 sigta=20;
9 t=(p*D)/(2*sigta*nt)+C;
10 t=18;
11 D1=D+(2*t);
12 dr=D1+10;
13 sigp=310;
14 sigba=sigp/4;
15 db=16;
16 Db=dr+32+5;
17 Do=Db+(2*db);
18 P=%pi*(251+db)^2*1.25/4;
19 n=6;
20 Y=(Db-dr)/2;
21 M=P/n*Y;
22 Z=dr*tand(30)/6;
23 tf=sqrt(M/(sigta*Z));
24 tf=22;
25 Deff=dr+db+5;
26

```

```
27 // printing data in scilab o/p window
28 printf("D is %0.0f mm      ",D);
29 printf("\n t is %0.0f mm      ",t);
30 printf("\n Y is %0.1f mm      ",Y);
31 printf("\n tf is %0.0f mm      ",tf);
32 printf("\n Deff is %0.0f mm      ",Deff);
```

---

# Chapter 11

## RIVETED JOINTS

Scilab code Exa 11.1 RJ1

```
1 // sum 11-1
2 clc;
3 clear;
4 t=20;
5 p=100;
6 d=25;
7 sigt=40;
8 P=(p-d)*t*sigt;
9 Ts=(4*P)/(%pi*d^2);
10 sigb=P/(d*t);
11
12 // printing data in scilab o/p window
13 printf("P is %0.0f N      ",P);
14 printf("\n Ts is %0.2f MPa      ",Ts);
15 printf("\n sigb is %0.0f MPa      ",sigb);
```

---

Scilab code Exa 11.2 RJ2

```

1 // sum 11-2
2 clc;
3 clear;
4 t=22;
5 t1=5*t/8;
6 d=30;
7 p=100;
8 sigt=75;
9 P=(p-d)*t*sigt;
10 Ts=(2*P)/(pi*d^2);
11 sigb=P/(d*t);
12 P=P*10^-3
13 // printing data in scilab o/p window
14 printf("P is %0.1f kN      ",P);
15 printf("\n Ts is %0.1f MPa      ",Ts);
16 printf("\n sigb is %0.0f N/mm^2      ",sigb);

```

---

### Scilab code Exa 11.3 RJ3

```

1 //sum 11-3
2 clc;
3 clear;
4 t=15;
5 t1=5*t/8;
6 d=25;
7 n=2;
8 Ta=80;
9 sigta=100;
10 sigba=120;
11 Ps=n*1.875*pi*d^2*Ta/4;
12 Pb=n*d*t*sigba;
13 p=Pb/(t*Ta)+d;
14 Pp=p*t*Ta;
15 n=Pb/Pp;
16

```



```

17
18 // printing data in scilab o/p window
19 printf("p is %0.0f mm      ",p);
20 printf("\n n is %0.2f      ",n);

```

---

#### Scilab code Exa 11.4 RJ4

```

1 // sum 11-4
2 clc;
3 clear;
4 b=200;
5 t=16;
6 d=6*sqrt(t);
7 sigta=80;
8 Ta=60;
9 sigba=100;
10 Pt=(b-d)*t*sigta;
11 Ps=1.875*%pi*d^2*Ta/4;
12 Pb=d*t*sigba;
13 n1=Pt/Pb;
14 n1=6;
15 Pt2=((b-(2*d))*t*sigta)+Pb;
16 Pt3=((b-(3*d))*t*sigta)+(3*Pb);
17 Pp=b*t*sigta;
18 n2=Pt/Pp;
19 n2=n2*100;
20
21 // printing data in scilab o/p window
22 printf("d is %0.0f mm      ",d);
23 printf("\n n1 is %0.0f      ",n1);
24 printf("\n Pt is %0.0f N      ",Pt);
25 printf("\n Pt2 is %0.0f N      ",Pt2);
26 printf("\n Pt3 is %0.0f N      ",Pt3);
27 printf("\n n2 is %0.0f      ",n2);
28

```

29 //Answer to strength of rivet in bearing 'Pb' is  
calculated incorrectly in the book, hence Pt2,  
Pt3 is calculated subsequently incorrect.

---

#### Scilab code Exa 11.5 RJ5

```
1 // sum 11-5
2 clc;
3 clear;
4 a=50;
5 b=75;
6 P=36*10^3;
7 d=24;
8 Ta=60;
9 n=9;
10 A=%pi*d^2/4;
11 Td=P/(n*A);
12 theta=atan(b/a);
13 Ts=54.64;
14 r2=90.184;
15 e=A*29575.7/P;
16
17 // printing data in scilab o/p window
18 printf(" e is %0.1 f mm ",e);
```

---

#### Scilab code Exa 11.6 RJ6

```
1 // sum 11-6
2 clc;
3 clear;
4 P=12*10^3;
5 Tmax=100;
6 n=6;
```

```

7 e=50+50+(5/2);
8 T=P*e;
9 Td=P/n;
10 ra=125;
11 k=T/((2*125^2)+(2*75^2)+(2*25^2));
12 Tr=(k*ra)+Td;
13 A=Tr/Tmax;
14 d=sqrt(A*4/%pi);
15 d=12;
16
17 // printing data in scilab o/p window
18 printf(" d is %0.0f mm      ",d);

```

---

#### Scilab code Exa 11.7 RJ7

```

1 // sum 11-7
2 clc;
3 clear;
4 t=15;
5 d=6*sqrt(t);
6 d=24;
7 sigta=75;
8 sigba=105;
9 Ta=60;
10 n=4;
11 Pt=n*%pi*d^2*Ta/4;
12 x=d*t*sigta;
13 y=2*t*sigta;
14 p=(Pt+x)/y;
15 p=60;
16 C=4.17;
17 pmax=(C*t)+41.28;
18 Pt1=(y*p)-x;
19 Ps=n*%pi*d^2*Ta/4;
20 Pb=n*d*t*sigba;

```

```

21 S=2*p*t*sigta;
22 n=Pt1/S;
23 n=n*100;
24
25 // printing data in scilab o/p window
26 printf(" n is %0.0f      ",n);

```

---

### Scilab code Exa 11.8 RJ8

```

1 // sum 11-8
2 clc;
3 clear;
4 D=1500;
5 p=2;
6 nt=0.75;
7 sigut=420;
8 FOS=5;
9 sigta=sigut/FOS;
10 t=p*D/(2*sigta*nt);
11 t=24;
12 d=6*sqrt(t);
13 d=30;
14 Ta=330/5;
15 sigba=640/5;
16 Ps=2*1.875*%pi*(d^2)*Ta/4;
17 p=(Ps/(t*sigta))+d;
18 p=117;
19 t1=5*t/8;
20 Pt=(p-d)*t*sigta;
21 Pp=p*t*sigta;
22 Pb=2*d*t*sigba;
23 n=Ps/Pb;
24 n=n*100;
25
26 // printing data in scilab o/p window

```

```
27     printf(" n is %0.0f      ",n);
```

---

### Scilab code Exa 11.9 RJ9

```
1 // sum 11-9
2 clc;
3 clear;
4 D=1200;
5 p=2.5;
6 sigba=110;
7 Pa=%pi*D^2*p/4;
8 nt=0.8;
9 sigta=80;
10 t=p*D/(2*sigta*nt);
11 t=24;
12 d=6*sqrt(t);
13 d=30;
14 Ta=55;
15 Ps=%pi*(d^2)*Ta/4;
16 Np=Pa/Ps;
17 Np=74;
18 nr=Np/2;
19 p=%pi*(D+t)/nr;
20 pb=2*d;
21 m=1.5*d;
22 Pt=(p-d)*t*sigta;
23 Ps=2*Ps;
24 Pb=2*d*t*sigba;
25 Pp=p*t*sigta;
26 n=Ps/Pp;
27 n=n*100;
28
29 // printing data in scilab o/p window
30     printf(" n is %0.0f      ",n);
```

---

# Chapter 12

## WELDED JOINTS

Scilab code Exa 12.1 WJ1

```
1 // sum 12-1
2 clc;
3 clear;
4 h=8;
5 F=100*10^3;
6 t=0.707*h;
7 A=4*60*t;
8 T=F/A;
9
10 // printing data in scilab o/p window
11 printf("T is %0.1f MPa      ",T);
```

---

Scilab code Exa 12.2 WJ2

```
1 // sum 12-2
2 clc;
3 clear;
4 FOS=3;
```

```
5 Ta=95/FOS;
6 P=350*10^3;
7 h=12.5;
8 t=0.707*h;
9 l=P/(2*t*Ta);
10
11 // printing data in scilab o/p window
12 printf("l is %0.0f mm      ",l);
```

---

### Scilab code Exa 12.3 WJ3

```
1 // sum 12-3
2 clc;
3 clear;
4 h=12;
5 t=0.707*h;
6 l=60;
7 Ta=80;
8 P=2*l*t*Ta;
9 P=P*10^-3;
10
11 // printing data in scilab o/p window
12 printf("P is %0.3f kN      ",P);
```

---

### Scilab code Exa 12.4 WJ4

```
1 // sum 12-4
2 clc;
3 clear;
4 P=6*10^3;
5 e=150+(100/2);
6 T=P*e;
7 A=200;
```

```

8 Td=P/A;
9 r=sqrt(2*50^2);
10 Ixx=2*(100*50^2);
11 Iyy=2*100^3/12;
12 IG=Ixx+Iyy;
13 Ts=r*T/IG;
14 Tmax=sqrt((Ts*sind(45))^2+(Td+(Ts*cosd(45)))^2);
15 Ta=80;
16 t=Tmax/Ta;
17 h=sqrt(2)*t;
18 h=3;
19 // printing data in scilab o/p window
20 printf("h is %0.0f mm      ",h);

```

---

#### Scilab code Exa 12.5 WJ5

```

1 // sum 12-5
2 clc;
3 clear;
4 h=10;
5 t=10/sqrt(2);
6 Ta=80;
7 x=((50*25)+(50*0))/(50+50);
8 y=x;
9 ra=sqrt(x^2+37.5^2);
10 Ixx=(7.07*50^3/12)+(50*7.07*(12.5^2))
    +(50*7.07*12.5^2);
11 IG=2*Ixx;
12 e=100+(50-12.5);
13 Tr=16.09*10^-3;
14 P=Ta/Tr;
15 P=P*10^-3;
16
17 // printing data in scilab o/p window
18 printf("P is %0.3f KN      ",P);

```



---

### Scilab code Exa 12.6 WJ6

```
1 // sum 12-6
2 clc;
3 clear;
4 P=16*10^3;
5 l=300;
6 r=50;
7 M=P*l;
8 A=2*%pi*r;
9 Ixx=%pi*r^3;
10 sigb=M*r/Ixx;
11 Td=P/A;
12 Tmax=sqrt((sigb/2)^2+(Td^2));
13 Ta=90;
14 t=Tmax/Ta;
15 h=sqrt(2)*t;
16 h=5;
17 // printing data in scilab o/p window
18 printf("h is %0.0f mm      ",h);
```

---

### Scilab code Exa 12.7 WJ7

```
1 // sum 12-7
2 clc;
3 clear;
4 sigut=415;
5 sige=sigut/3;
6 Ka=0.5;
7 Kb=0.85;
8 Kc=0.897;
```

```

9 SCF=1.5;
10 Kd=1/SCF;
11 FOS=2;
12 sige1=sige*Ka*Kb*Kc*Kd/FOS;
13 Pa=50*10^3;
14 h=10;
15 t=0.707*h;
16 l=Pa/(2*sige1*t);
17
18 // printing data in scilab o/p window
19 printf("l is %0.0f mm      ",l);

```

---

#### Scilab code Exa 12.8 WJ8

```

1 // sum 12-8
2 clc;
3 clear;
4 l=300;
5 P=30*10^3;
6 T=P/(2*l);
7 Ta=124;
8 t1=T/Ta;
9 h1=sqrt(2)*t1;
10 M=P*l;
11 Ixx=2*100*110^2;
12 sigb=M/Ixx*110;
13 //Let the allowable bending stress is Tab
14 Tab=200;
15 t2=sigb/Tab;
16 h2=t2/0.707;
17 h2=3;
18
19 // printing data in scilab o/p window
20 printf("h is %0.0f mm      ",h2);

```

---

### Scilab code Exa 12.9 WJ9

```
1 // sum 12-9
2 clc;
3 clear;
4 Ta=60;
5 l1=60;
6 l2=40;
7 P1=Ta*0.707*l1;
8 P2=Ta*0.707*l2;
9 P=80*10^3;
10 h=P/(P1+P2);
11 h=20;
12 a=(P2*100)/(P1+P2);
13
14 // printing data in scilab o/p window
15 printf("h is %0.0f mm      ",h);
16 printf("\n a is %0.0f mm      ",a);
```

---

### Scilab code Exa 12.10 WJ10

```
1 // sum 12-10
2 clc;
3 clear;
4 P=300*10^3;
5 l=500;
6 A=2*l;
7 Td=P/A;
8 T=(350-250)*P;
9 IG=(l^3*2/12)+(1*2*5^2);
10 r=sqrt(250^2+5^2);
11 Ts=T*r/IG;
```

```
12 Ts=Ts+Td;
13 Ta=110;
14 t=Ts/Ta;
15 h=t/0.707;
16 h=9;
17
18 // printing data in scilab o/p window
19 printf("h is %0.0f mm      ",h);
```

---

#### Scilab code Exa 12.11 WJ11

```
1 // sum 12-11
2 clc;
3 clear;
4 t=30;
5 sigut=417;
6 sige=sigut/2;
7 Ka=0.5;
8 Kb=0.85;
9 Kc=0.897;
10 SCF=1.2;
11 Kd=1/SCF;
12 FOS=1.5;
13 sigel=sige*Ka*Kb*Kc*Kd/FOS;
14 Pa=60*10^3;
15 l=Pa/(sigel*t);
16
17 // printing data in scilab o/p window
18 printf("l is %0.1f mm      ",l);
```

---

# Chapter 13

## COTTER AND KNUCKLE JOINTS

Scilab code Exa 13.1 CKJ1

```
1 //sum 13-1
2 clc;
3 clear;
4 F=25*10^3;
5 sigat=50;
6 Ta=40;
7 pa=80;
8 d=sqrt((4*F)/(pi*sigat));
9 d=26;
10 t=d/4;
11 t=7;
12 d1=1.2*d;
13 d1=32;
14 pc=F/(d1*t);
15 t=10;
16 c=0.75*d;
17 c=20;
18 d2=44;
19 tw=(d2-d1)/2;
```

```

20 b=F/(2*t*Ta);
21 b=34;
22 a=0.5*d;
23 d3=(F/(pa*t))+d1;
24 d3=64;
25 e=F/(Ta*(d3-d1));
26 d4=sqrt((F*4/(%pi*pa))+d1^2);
27 d4=40;
28 f=0.5*d;
29 sigbc=3*F*d3/(t*b^2*4);
30
31 // printing data in scilab o/p window
32 printf(" d is %0.0f mm      ",d);
33 printf("\n d1 is %0.0f mm      ",d1);
34 printf("\n d2 is %0.0f mm      ",d2);
35 printf("\n d3 is %0.0f mm      ",d3);
36 printf("\n d4 is %0.0f mm      ",d4);
37 printf("\n sigbc is %0.1f MPa      ",sigbc);

```

---

### Scilab code Exa 13.2 CKJ2

```

1 // sum 13-2
2 clc;
3 clear;
4 P=40*10^3;
5 sigut=490;
6 FOS=4;
7 sigts=sigut/FOS;
8 sigcs=1.4*sigts;
9 sigs=0.8*sigts;
10 d=sqrt((4*P)/(%pi*sigs));
11 d=21;
12 sigcc=1.4*330/4;
13 Tc=0.8*330/4;
14 t=d/3;

```

```

15 b=P/(2*t*Tc);
16 b=31;
17 t=10;
18 d1=28;
19 d2=40;
20 c=d/2;
21 c=15;
22 a=P/(2*(d2-d1)*98);
23 a=20;
24 L=(2*a)+(2*b)+(2*c)+(2*3);
25
26 // printing data in scilab o/p window
27 printf("d is %0.0f mm      ",d);
28 printf("\n d1 is %0.0f mm      ",d1);
29 printf("\n t is %0.0f mm      ",t);
30 printf("\n b is %0.0f mm      ",b);
31 printf("\n d2 is %0.0f mm      ",d2);
32 printf("\n L is %0.0f mm      ",L);

```

---

### Scilab code Exa 13.3 CKJ3

```

1 // sum 13-3
2 clc;
3 clear;
4 P=40*10^3;
5 sigt=60;
6 sigc=125;
7 T=45;
8 a=sqrt(P*3/(2*sigt));
9 a=33;
10 t=a/3;
11 b=P/(4.5*t*T);
12 b=20;
13 b1=1.25*b;
14 t1=P*3/(4*a*sigt);

```

```

15 t1=16;
16 l2=P/(2*2*T*t1);
17 l2=14;
18 l1=P/(2*a*T);
19 l1=14;
20 l3=(0.6*a);
21 l3=20;
22 l4=11;
23 sigcr=P/(t*a);
24 sigcr1=P/(2*t1*t);
25
26 // printing data in scilab o/p window
27 printf(" a is %0.0 f mm      ",a);
28 printf("\n t is %0.0 f mm      ",t);
29 printf("\n t1 is %0.0 f mm      ",t1);
30 printf("\n b is %0.0 f mm      ",b);
31 printf("\n b1 is %0.0 f mm      ",b1);
32 printf("\n l1 is %0.0 f mm      ",l1);
33 printf("\n l2 is %0.0 f mm      ",l2);
34 printf("\n l3 is %0.0 f mm      ",l3);
35 printf("\n l4 is %0.0 f mm      ",l4);
36 printf("\n sigcr is %0.1 f MPa    ",sigcr);
37 printf("\n sigcr1 is %0.1 f MPa    ",sigcr1);

```

---

#### Scilab code Exa 13.4 CKJ4

```

1 // sum 13-4
2 clc;
3 clear;
4 P=50*10^3;
5 sigp=380;
6 FOS=4;
7 sigca=80;
8 Ta=50;
9 sigta=sigp/FOS;

```



```

10 At=P/sigta;
11 d=30;
12 d1=1.5*d;
13 t=P/(sigca*d1);
14 t=14;
15 A=(%pi*(d1^2)/4)-(d1*t);
16 //let tearing stress be sigt
17 sigt=P/A;
18 b=P/(2*t*Ta);
19 b=36;
20
21 // printing data in scilab o/p window
22 printf("d is %0.0f mm      ",d);
23 printf("\n sigt is %0.1f MPa      ",sigt);
24 printf("\n b is %0.0f mm      ",b);
25
26 //The answer to tearing stress in bolt 'sigt' is
    calculated incorrectly in the book.

```

---

# Chapter 14

## KEYS AND COUPLINGS

Scilab code Exa 14.1 KC1

```
1 // sum 14-1
2 clc;
3 clear;
4 d=40;
5 r=d/2;
6 P=6*10^3;
7 N=350;
8 sigyt=380;
9 A=%pi*12^2/2;
10 theta=%pi-(2*atan(4/12));
11 alpha=180-(theta*%pi/180);
12 l=2*12*cosd(19.5);
13 A1=l*4/2;
14 Abcd=(A*141/180)-A1;
15 A2=A-Abcd;
16 A3=8*l;
17 w=2*%pi*N/60;
18 T=P/w;
19 Pt=T*10^3/r;
20 sigb=Pt/A2;
21 //Let shear stress developed in key Tk
```

```

22 Tk=Pt/A3;
23 FOS1=sigyt/sigb;
24 FOS2=0.577*sigyt/Tk;
25
26 // printing data in scilab o/p window
27 printf("FOS1 is %0.3 f      ",FOS1);
28 printf("\n FOS2 is %0.2 f      ",FOS2);

```

---

### Scilab code Exa 14.2 KC2

```

1 // sum 14-2
2 clc;
3 clear;
4 n=12;
5 phi=360*%pi/(180*12*2);
6 R1=45/2;
7 R2=50/2;
8 l=60;
9 Rm=(R1+R2)/2;
10 p=6.5;
11 Pn=(R2-R1)*l*p;
12 T=Pn*Rm;
13 T=T*n;
14 N=400;
15 w=2*%pi*N/60;
16 P=T*w;
17 A=(%pi*R1*l)/n;
18 Ts=Pn/A;
19 Ah=(%pi*R2*l)/n;
20 Th=Pn/Ah;
21
22 // printing data in scilab o/p window
23 printf("Ts is %0.2 f N/mm^2      ",Ts);
24 printf("\n Th is %0.2 f N/mm^2      ",Th);

```

---

### Scilab code Exa 14.3 KC3

```
1 // sum 14-3
2 clc;
3 clear;
4 N=360;
5 w=2*%pi*N/60;
6 sigyt=380;
7 r=25;
8 P=40*10^3;
9 FOS=3;
10 T=P/w;
11 Pt=T*10^3/(2*r);
12 siga=380/3;
13 Ta=0.577*380/3;
14 l1=Pt/(sqrt(2)*12*Ta);
15 l2=Pt*sqrt(2)/(sig*12);
16
17 // printing data in scilab o/p window
18 printf("l1 is %0.0 f mm      ",l1);
19 printf("\n l2 is %0.2 f mm      ",l2);
```

---

### Scilab code Exa 14.4 KC4

```
1 // sum 14-4
2 clc;
3 clear;
4 N=300;
5 w=2*%pi*N/60;
6 P=12*10^3;
7 Ks=1.25;
8 Pd=P*Ks;
```

```

 9 T=Pd/w;
10 Tas=50;
11 d=16*T*10^3/(%pi*Tas);
12 d=d^(1/3);
13 d=40;
14 Ts=10;
15 d1=(2*d)+13;
16 x=(d1^4-d^4)/d1;
17 //Let the shear stress in the key be Tsh
18 Tsh=T*10^3*16/(%pi*x);
19 l=3.5*d;
20 Ft=T*2*10^3/d;
21 l1=70;
22 sigak=50;
23 b=Ft/(l1*sigak);
24 t=2*Ft/(100*l1);
25
26 // printing data in scilab o/p window
27 printf("d is %0.0f mm      ",d);
28 printf("\n Tsh is %0.2f MPa      ",Tsh);
29 printf("\n b is %0.0f mm      ",b);
30 printf("\n t is %0.0f mm      ",t);

```

---

#### Scilab code Exa 14.5 KC5

```

1 // sum 14-5
2 clc;
3 clear;
4 P=36*10^3;
5 N=200;
6 w=2*%pi*N/60;
7 T=P/w;
8 Tas=45;
9 d=16*T*10^3/(%pi*Tas);
10 d=d^(1/3);

```

```

11 d=60;
12 d1=(2*d)+13;
13 l=3.5*d;
14 Ftk=T*2/d;
15 lk=l/2;
16 Tak=40;
17 sigack=90;
18 b=Ftk*10^3/(lk*Tak);
19 t=2*Ftk*10^3/(sigack*lk);
20 n=4;
21 sigatb=60;
22 u=0.25;
23 dr=16*T*10^3/(u*pi^2*sigatb*n*d);
24 dr=sqrt(dr);
25
26 // printing data in scilab o/p window
27 printf("d is %0.0f mm      ",d);
28 printf("\n b is %0.1f mm      ",b);
29 printf("\n t is %0.0f mm      ",t);
30 printf("\n dr is %0.3f mm      ",dr);

```

---

#### Scilab code Exa 14.6 KC6

```

1 // sum 14-5
2 clc;
3 clear;
4 P=16*10^3;
5 N=1000;
6 w=2*pi*N/60;
7 T=P/w;
8 Ks=1.4;
9 Td=T*Ks;
10 Tas=40;
11 d=16*T*10^3/(pi*Tas);
12 d=d^(1/3);

```

```

13 d=32;
14 d1=2*d;
15 l=1.5*d;
16 ds=1.5*d;
17 Tak=40;
18 sigack=70;
19 Ftk=Td*2/d;
20 b=Ftk*10^3/(1*Tak);
21 t=2*Ftk*10^3/(sigack*l);
22 Taf=10;
23 tf=Td*10^3*2/(%pi*Taf*d1^2);
24 Ftb=Td*10^3/(1.5*d*4);
25 Tab=40;
26 db=sqrt(Ftb*4/(Tab*%pi));
27 D=4*d;
28 trp=d/6;
29 Ftb1=Td*10^3/(45*4);
30 db1=sqrt(Ftb1*4/(Tab*%pi));
31
32 // printing data in scilab o/p window
33 printf("d is %0.0f mm      ",d);
34 printf("\n b is %0.0f mm      ",b);
35 printf("\n t is %0.0f mm      ",t);
36 printf("\n db is %0.2f mm      ",db);
37 printf("\n db1 is %0.2f mm      ",db1);
38
39 //The answer to Key thickness 't' is calculated
    incorrectly in the book.

```

---

#### Scilab code Exa 14.7 KC7

```

1 // sum 14-5
2 clc;
3 clear;
4 P=30*10^3;

```

```

5 N=1440;
6 w=2*%pi*N/60;
7 T=P/w;
8 d=36;
9 d1=30;
10 d2=2*d;
11 d3=d1*2;
12 l=1.5*d;
13 Dp=3.5*d;
14 n=6;
15 Ft=(2*T)/(Dp*n);
16 p=0.5;
17 A=Ft/p;
18 Lf=d;
19 dp=A/Lf;
20 M=Ft*10^3*(5+(Lf/2));
21 db=(32*M/(%pi*40))^(1/3);
22 db=15;
23 T=(4*526)/(%pi*db^2);
24 sigb=32*M/(%pi*db^3);
25 sigmax=(sigb/2)+sqrt(((sigb/2)^2)+(T^2));
26 b=d/4;
27 t=6;
28 Lf=36;
29 La=10;
30 Do=126+30+(2*(5+1))+(2*6);
31
32 // printing data in scilab o/p window
33 printf("sigmax is %0.2f MPa      ",sigmax);
34 printf("\n b is %0.0f mm      ",b);
35 printf("\n t is %0.0f mm      ",t);
36 printf("\n Lf is %0.0f mm      ",Lf);
37 printf("\n Do is %0.0f mm      ",Do);

```

---



# Chapter 15

## SHAFTS

Scilab code Exa 15.2 S2

```
1 // sum 15-2
2 clc;
3 clear;
4 dA=150;
5 dB=250;
6 alpha=20*%pi/180;
7 W=400;
8 sigyt=400;
9 sigut=500;
10 Kb=1.5;
11 Kt=2;
12 T=W*dA/2;
13 Pt=T/(dB/2);
14 Pr1=W*tan(alpha);
15 Pr2=Pt*tan(alpha);
16 RDH=((W*120)-(Pt*320))/440;
17 RcH=W-RDH-Pt;
18 //RcH=400+65.5-240;
19 McH=0;
20 MAH=RcH*120;
21 MBH=RDH*120;
```

```

22 RDV=((Pr1*120)-(Pr2*320))/440;
23 RcV=Pr1-RDV-Pr2;
24 MAV=RcV*120;
25 MBV=RDV*120;
26 Mmax=sqrt((MAH^2)+(MAV^2));
27 T=30*10^3;
28 Ta=0.135*sigut;
29 d=16*sqrt((Kb*Mmax)^2+(Kt*T)^2)/(%pi*Ta);
30 d=d^(1/3);
31
32 // printing data in scilab o/p window
33 printf("d is %0.2f mm      ",d);

```

---

### Scilab code Exa 15.3 S3

```

1 // sum 15-3
2 clc;
3 clear;
4 P=16*746;
5 N=3000;
6 w=2*%pi*N/60;
7 T=P/w*10^3;
8 sigy=400;
9 Ty=sigy/2;
10 FOS=2;
11 Ta=Ty/FOS;
12 d=T*16/(%pi*Ta);
13 d1=d^(1/3);
14 r=3;
15 D=d1+(2*r);
16 SCF=1.196
17 Tys=Ta/SCF;
18 d=T*16/(%pi*Tys);
19 d2=d^(1/3);
20 d=14;

```

```

21 D=d+(2*r);
22
23 // printing data in scilab o/p window
24 printf("d1 is %0.2f mm      ",d1);
25 printf("\n d2 is %0.2f mm      ",d2);

```

---

#### Scilab code Exa 15.4 S4

```

1 // sum 15-4
2 clc;
3 clear;
4 P1=24*10^3;
5 P2=10*10^3;
6 sigyt=460;
7 Tya=sigyt*0.3;
8 SCF=2.84;
9 Ta=Tya/SCF;
10 N=400;
11 w=2*pi*N/60;
12 T1=P1/w;
13 T2=P2/w;
14 d1=T1*16*10^3/(pi*Ta);
15 d1=d1^(1/3);
16 d2=T2*16*10^3/(pi*Ta);
17 d2=d2^(1/3);
18 theta1=pi/3600;
19 l1=120;
20 G=84*10^3;
21 d3=T1*10^3*l1*32/(pi*G*theta1);
22 d3=d3^(1/4);
23 d4=T2*11*10^3*32/(pi*G*theta1);
24 d4=d4^(1/4);
25
26 // printing data in scilab o/p window
27 printf("d1 is %0.2f mm      ",d1);

```

```
28     printf("\n d2 is %0.2 f mm      ",d2);
29     printf("\n d3 is %0.1 f mm      ",d3);
30     printf("\n d4 is %0.2 f mm      ",d4);
```

---

### Scilab code Exa 15.5 S5

```
1 // sum 15-5
2 clc;
3 clear;
4 d=200;
5 r=d/2;
6 N=300;
7 P=5000;
8 D=500;
9 R=D/2;
10 u=0.3;
11 E=205*10^3;
12 G=84*10^3;
13 Ta=60;
14 Kb=1.5;
15 Kt=2;
16 w=2*%pi*N/60;
17 beta1=20*%pi/180;
18 V=r*w;
19 v=R*w;
20 // Let T1-T2 =T
21 T=P/V;
22 x=u*%pi/sin(beta1);
23 T2=T/((exp(x)-1));
24 T1=T2*exp(x);
25 t=P/v;
26 y=u*%pi;
27 T3=t/((exp(x)-1));
28 T4=T3*exp(x);
29 T=P/w;
```

```

30 Rc=2612;;
31 RA=645.1;
32 MB=96.76;
33 MC=-208.96;
34 d=16*10^3*sqrt((Kb*MC)^2+(Kt*T)^2)/(%pi*Ta);
35 d=d^(1/3);
36 l=380;
37 J=%pi*d^4/32;
38 theta=T*10^3*l/(G*J);
39 theta=theta*180/%pi;
40
41 // printing data in scilab o/p window
42 printf("d is %0.1f mm      ",d);
43 printf("\n theta is %0.2f deg      ",theta);

```

---

### Scilab code Exa 15.6 S6

```

1 // sum 15-6
2 clc;
3 clear;
4 T=400;
5 Pt=4800;
6 Pg=3600;
7 sigyt=360;
8 E=205*10^3;
9 G=80*10^3;
10 Kb=2;
11 Kt=1.5;
12 FOS=3;
13 RC=((Pt*90)+(Pg*200))/140;
14 RA=8400-RC;
15 MB=RA*0.9;
16 MC=Pg*0.045;
17 Te=sqrt((Kb*MC)^2+(Kt*T)^2);
18 Ta=0.577*sigyt/FOS;

```

```

19 d=16*10^3*Te/(%pi*Ta);
20 d=d^(1/3);
21 L=110;
22 J=%pi*d^4/32;
23 T=400;
24 theta=T*10^3*L/(G*J);
25 theta=theta*180/%pi;
26
27 // printing data in scilab o/p window
28 printf("d is %0.0f mm      ",d);
29 printf("\n theta is %0.4f deg      ",theta);

```

---

#### Scilab code Exa 15.7 S7

```

1 // sum 15-7
2 clc;
3 clear;
4 T=47*10^3;
5 M=32*10^3;
6 d=20;
7 siga=32*M/(%pi*d^3);
8 Tm=16*T/(%pi*d^3);
9 sige=75;
10 Tys=165;
11 n=1/sqrt((siga/sige)^2+(Tm/Tys)^2);
12
13 // printing data in scilab o/p window
14 printf("n is %0.2f      ",n);

```

---

# Chapter 16

## POWER SCREWS

Scilab code Exa 16.1 PS1

```
1 // sum 16-1
2 clc;
3 clear;
4 d=30;
5 W=20*10^3;
6 r1=8;
7 r2=16;
8 p=6;
9 u1=0.2;
10 u2=0.15;
11 dm=d-(p/2);
12 alpha=atan(p/(%pi*dm));
13 phi=atan(u1);
14 rm=(r1+r2)/2;
15 Ttr=W*((dm*tan(alpha+phi)/2)+(u2*rm));
16 Ttr=Ttr*10^-3;
17
18 // printing data in scilab o/p window
19 printf("Ttr is %0.3f Nm      ",Ttr);
20
21 //The answer to Ttr is slightly different than in
```

the book due to rounding-off of values.

---

### Scilab code Exa 16.2 PS2

```
1 // sum 16-2
2 clc;
3 clear;
4 d=50;
5 W=20*10^3;
6 r1=10;
7 r2=30;
8 p=7;
9 u1=0.12/cosd(15);
10 u2=0.15;
11 dm=d-(p/2);
12 alpha=atan(3*p/(%pi*dm));
13 phi=atan(u1);
14 rm=(r1+r2)/2;
15 Tr=W*((dm*tan(alpha+phi)/2)+(u2*rm));
16 Tr=Tr*10^-3;
17 Te=W*((dm*tan(phi-alpha)/2)+(u2*rm));
18 Te=Te*10^-3;
19 n=dm/2*tan(alpha)/(dm*tan(alpha+phi)/2+(u2*rm));
20 L=0.30;
21 Ph=Tr/L;
22
23 // printing data in scilab o/p window
24 printf("Tr is %0.2 f Nm      ",Tr);
25 printf("\n Te is %0.3 f Nm      ",Te);
26 printf("\n n is %0.4 f          ",n);
27 printf("\n Ph is %0.2 f N        ",Ph);
28
29 //The answers to Tr, Te and Ph is slightly
    different than in the book due to rounding-off
    of values.
```



---

### Scilab code Exa 16.3 PS3

```
1 // sum 16-3
2 clc;
3 clear;
4 d=30;
5 W=5*10^3;
6 p=5;
7 rm=45/2;
8 u1=0.15/cosd(14.5);
9 u2=0.15;
10 dm=d-(p/2);
11 alpha=atan(p/(%pi*dm));
12 phi=atan(u1);
13 Tr1=W*((dm*tan(alpha+phi)/2)+(u2*rm));
14 Tr1=Tr1*10^-3;
15 n1=dm/2*tan(alpha)/(dm*tan(alpha+phi)/2+(u2*rm));
16 T1=W*((dm*tan(phi-alpha)/2)+(u2*rm));
17 T1=T1*10^-3;
18 n2=dm/2*tan(alpha)/(dm*tan(phi-alpha)/2+(u2*rm));
19 u2=0.02;
20 Tr2=W*((dm*tan(alpha+phi)/2)+(u2*rm));
21 Tr2=Tr2*10^-3;
22 n3=dm/2*tan(alpha)/(dm*tan(alpha+phi)/2+(u2*rm));
23 Te=W*((dm*tan(phi-alpha)/2)+(u2*rm));
24 Te=Te*10^-3;
25 n4=dm/2*tan(alpha)/(dm*tan(phi-alpha)/2+(u2*rm));
26
27 // printing data in scilab o/p window
28 printf("Tr1 is %0.3f Nm      ",Tr1);
29 printf("\n n1 is %0.4f      ",n1);
30 printf("\n T1 is %0.3f Nm      ",T1);
31 printf("\n n2 is %0.4f      ",n2);
32 printf("\n Tr2 is %0.3f Nm      ",Tr2);
```

```

33     printf("\n n3 is %0.4 f      ",n3);
34     printf("\n Te is %0.3 f Nm      ",Te);
35     printf("\n n4 is %0.4 f      ",n4);
36
37     //The answer to T1 is misprinted in the book.

```

---

#### Scilab code Exa 16.4 PS4

```

1 // sum 16-4
2 clc;
3 clear;
4 d=28;
5 P=300;
6 L=180;
7 p=8;
8 r1=16;
9 r2=46;
10 rm=(r1+r2)/2;
11 u1=0.12;
12 u2=0.15;
13 dm=d-(p/2);
14 alpha=atan(p/(%pi*dm));
15 phi=atan(u1);
16 T=P*L;
17 F=T/((dm*tan(alpha+phi)/2)+(u2*rm));
18 F=F*10^-3;
19
20 // printing data in scilab o/p window
21 printf("F is %0.3 f kN      ",F);

```

---

#### Scilab code Exa 16.5 PS5

```

1 // sum 16-5

```

```

2  clc;
3  clear;
4  d=25;
5  p=8;
6  F=392.4;
7  L=250;
8  l=p*2;
9  u=0.14;
10 dm=d-(p/2);
11 alpha=atan(l/(%pi*dm));
12 phi=atan(u);
13 T=dm*tan(alpha+phi)/2;
14 M=F*L;
15 P=M/T*10^-3;
16
17 // printing data in scilab o/p window
18 printf("P is %0.1f kN      ",P);

```

---

### Scilab code Exa 16.6 PS6

```

1 // sum 16-6
2 clc;
3 clear;
4 d=52;
5 W=2.2*10^3;
6 p=8;
7 r1=15;
8 r2=30;
9 rm=(r1+r2)/2;
10 u1=0.15/cosd(14.5);
11 dm=d-(p/2);
12 alpha=atan(p/(%pi*dm));
13 phi=atan(u1);
14 Ts=W*dm*tan(alpha+phi)/2;
15 u2=0.12;

```

```

16 Tc=u2*W*rm;
17 T=10^-3*(Ts+Tc);
18 N=40;
19 w=2*%pi*N/60;
20 P=T*w*10^-3;
21 To=W*dm/2*tan(alpha);
22 n=To/(T*10^3);
23
24 // printing data in scilab o/p window
25 printf("P is %0.2f KW      ",P);
26 printf("\n n is %0.4f      ",n);

```

---

#### Scilab code Exa 16.7 PS7

```

1 // sum 16-7
2 clc;
3 clear;
4 alpha=atan(2*0.2/(%pi*0.9));
5 u1=0.15;
6 phi=atan(u1);
7 P=200;
8 L=250;
9 Tt=P*L;
10 W=10*10^3;
11 u2=0.15;
12 x=Tt/W;
13 d=x/0.1716;
14 d=30;
15 p=6;
16 dr=0.8*d;
17 d=24;
18 p=5;
19 dr=d-p;
20 dm=d-(p/2);
21

```

```

22 // printing data in scilab o/p window
23 printf("d is %0.0f mm      ",d);
24 printf("\n p is %0.0f mm      ",p);

```

---

### Scilab code Exa 16.8 PS8

```

1 // sum 16-8
2 clc;
3 clear;
4 FOS=3;
5 sigut=380;
6 Ta=0.577*sigut/FOS;
7 d=25;
8 Tus=460;
9 Ps=%pi*d*Tus;
10 siga=127;
11 dr=sqrt(Ps*4/(%pi*siga));
12 d=30;
13 p=6;
14 dr=d-p;
15 dm=d-(p/2);
16 u1=0.15;
17 alpha=atan(p*2/(%pi*dm));
18 phi=atan(u1);
19 T=Ps*dm*tan(alpha+phi)/2;
20 T1=16*T/(%pi*dr^3);
21 sigc=4*Ps/(%pi*dr^2);
22 sigmax=sigc/2+sqrt((sigc/2^2)+(T1^2));
23 Tmax=sqrt((sigc/2^2)+(T1^2));
24 n=tan(alpha)/tan(alpha+phi);
25 Uo=Ps/2;
26 Ui=Uo/n;
27 wav=%pi/2;
28 wmax=2*wav;
29 I=Ui*2/wmax^2;

```

```
30 k=0.4;
31 Ir=0.9*I*10^-3;
32 m=Ir/k^2;
33 R=0.4;
34 rho=7200;
35 a=sqrt(m/(2*pi*R*rho));
36 T=T*10^-3;
37
38 // printing data in scilab o/p window
39 printf("T is %0.3f Nm      ",T);
40 printf("\n n is %0.4f      ",n);
41 printf("\n a is %0.5f mm      ",a);
42
43 //The difference in the answers of T is due to
    rounding-off of values.
```

---

# Chapter 17

## SLIDING CONTACT BEARINGS

Scilab code Exa 17.1 SCB1

```
1 // sum 17-1
2 clc;
3 clear;
4 Ta=22;
5 u=7/10^9;
6 nj=20;
7 r=25;
8 l=2*r;
9 Ao=30000;
10 Uo=15.3/10^3;
11 c=0.025;
12 //specific weight of the material is rho
13 rho=8.46*(10^-6);
14 Cp=179.8;
15 Tf=Ta+(16*%pi^3*u*nj^2*l*r^3/(Uo*Ao*c));
16 // avg mean film temperature is Tav
17 Tav=(Tf-Ta)/2;
18 x= l*c*rho*%pi*r*nj*Cp*10^3;
19 y=Ao*Tav*Uo;
```

```
20 delT=y/x;
21
22 // printing data in scilab o/p window
23 printf("Tav is %0.2f degC ",Tav);
24 printf("\n delT is %0.1f degC ",delT);
```

---

### Scilab code Exa 17.2 SCB2

```
1 // sum 17-2
2 clc;
3 clear;
4 l=60;
5 d=60;
6 r=d/2;
7 ho=0.008;
8 c=0.04;
9 S=0.0446;
10 nj=1260/60;
11 W=6000;
12 p=W/(l*d);
13 u=S*(c/r)^2*p/nj;
14 u=u*10^9;
15
16 // printing data in scilab o/p window
17 printf("u is %0.3f cP ",u);
```

---

### Scilab code Exa 17.3 SCB3

```
1 // sum 17-3
2 clc;
3 clear;
4 d=60;
5 r=30;
```



```

6 l=60;
7 c=0.8*10^-3*r;
8 ho=0.2*c;
9 W=21000/2;
10 p=W/(l*d);
11 S=0.0446;
12 nj=1440/60;
13 u=S*(c/r)^2*p/nj;
14 u=u*10^9;
15 // since Q/(r*nj*l)=4.62
16 Q=4.62*r*c*nj*l;
17 Q=Q*60/10^6;
18
19 // printing data in scilab o/p window
20 printf("u is %0.3f cP ",u);
21 printf("\n Q is %0.4f lpm ",Q);

```

---

#### Scilab code Exa 17.4 SCB4

```

1 // sum 17-4
2 clc;
3 clear;
4 l=60;
5 d=60;
6 r=d/2;
7 W=3000;
8 p=W/(l*d);
9 u=30*10^-9;
10 c=0.06;
11 nj=1440/60;
12 S=(r/c)^2*u*nj/p;
13 //For ratio l/d=1, values of different parameters
    are given in matrix A corresponding to S
14 A=[1 0.264 0.6 5.79 3.99
15     1 0.121 0.4 3.22 4.33];

```

```

16 //let ho/c=x
17 x=(A(1,3))-((A(1,3)-(A(2,3)))*((A(1,2))-S)/((A(1,2))
    -(A(2,2))));
18 //let y= (r/c)*f=CFV
19 y=(A(1,4))-((A(1,4)-(A(2,4)))*((A(1,2))-S)/((A(1,2))
    -(A(2,2))));
20 //let z=Q/(r*c*nj*l)=FV
21 z=(A(1,5))-((A(1,5)-(A(2,5)))*((A(1,2))-S)/((A(1,2))
    -(A(2,2))));
22 f=y*c/r;
23 ho=x*c;
24 Q=z*r*c*nj*l;
25 Q=Q*60/10^6;
26 delT=8.3*p*y/z;
27 //let power lost in friction be Pf
28 Pf=2*%pi*nj*f*W*r/10^6;
29
30 // printing data in scilab o/p window
31 printf("f is %0.5f ",f);
32 printf("\n ho is %0.3f mm ",ho);
33 printf("\n Q is %0.3f lpm ",Q);
34 printf("\n delT is %0.1f degC ",delT);
35 printf("\n Pf is %0.4f KW ",Pf);

```

---

### Scilab code Exa 17.5 SCB5

```

1 // sum 17-5
2 clc;
3 clear;
4 W=22000;
5 nj=960/60;
6 p=2.4;
7 u=20*10^-9;
8 d=sqrt(W/p);
9 d=96;

```

```

10 r=d/2;
11 l=d;
12 S=0.0446;
13 pact=W/(l*d);
14 //x=r/c;
15 x=sqrt(S*pact/(u*nj));
16 c=r/x;
17 ho=0.2*c;
18 Q=r*c*nj*l*4.62;
19 Q=Q*60/10^6;
20
21 // printing data in scilab o/p window
22 printf("d is %0.0f mm ",d);
23 printf("\n l is %0.0f mm ",l);
24 printf("\n ho is %0.4f mm ",ho);
25 printf("\n Q is %0.3f lpm ",Q);
26
27 //The difference in answer to Q is due to rounding
    -off the value of c.

```

---

### Scilab code Exa 17.6 SCB6

```

1 // sum 17-6
2 clc;
3 clear;
4 W=400*10^3;
5 Ro=200;
6 Ri=160;
7 ho=0.1;
8 t=150;
9 // specific gravity is rho
10 rho=0.86;
11 pi=2*W*log(Ro/Ri)/(%pi*(Ro^2-Ri^2));
12 zk=(0.22*t)-(180/t);
13 z=rho*zk;

```

```

14 u=z/(10^9);
15 Q=%pi*pi*ho^3/(6*u*log(Ro/Ri));
16 Q=Q*60/10^6;
17
18 // printing data in scilab o/p window
19 printf("pi is %0.3f MPa ",pi);
20 printf("\n Q is %0.2f lpm ",Q);
21
22 //The difference in answer to Q is due to rounding
    -off of values.

```

---

#### Scilab code Exa 17.7 SCB7

```

1 //sum 17-7
2 clc;
3 clear;
4 //let number of pads be n
5 n=4;
6 W=100*10^3;
7 Ro=125;
8 Ri=50;
9 t=200;
10 ho=0.15;
11 pi=2*W*log(Ro/Ri)/(%pi*(Ro^2-Ri^2));
12 zk=(0.22*t)-(180/t);
13 // specific gravity is rho
14 rho=0.86;
15 z=rho*zk;
16 u=z/(10^9);
17 Q=%pi*pi*ho^3/(6*u*log(Ro/Ri));
18 Q=Q*60/10^6;
19
20 // printing data in scilab o/p window
21 printf("pi is %0.2f MPa ",pi);
22 printf("\n Q is %0.3f lpm ",Q);

```



# Chapter 18

## ROLLING BEARINGS

Scilab code Exa 18.1 RB1

```
1 // sum 18-1
2 clc;
3 clear;
4 Pr=16*103;
5 u=0.0011;
6 F=u*Pr;
7 r=20*10-3;
8 //Let frictional moment be M
9 M=F*r;
10 N=1440;
11 w=2*%pi*N/60;
12 Pf=M*w;
13
14 // printing data in scilab o/p window
15 printf("Pf is %0.2 f W      ",Pf);
```

---

Scilab code Exa 18.2 RB2

```

1 // sum 18-2
2 clc;
3 clear;
4 C=5590;
5 Ca=2500;
6 Pa=625;
7 Pr=1250;
8 V=1;
9 X=0.56;
10 Y=1.2;
11 P1=(X*V*Pr)+(Y*Pa);
12 L1=(C/P1)^3;
13 V=1.2;
14 P2=(X*V*Pr)+(Y*Pa);
15 L2=(C/P2)^3;
16
17 // printing data in scilab o/p window
18 printf("L1 is %0.1f million revolutions ",L1);
19 printf("\n L2 is %0.2f million revoltions ",L2)
    ;

```

---

#### Scilab code Exa 18.4 RB4

```

1 // sum 18-4
2 clc;
3 clear;
4 P=20*10^3;
5 Co=22400;
6 C=41000;
7 Ln=(C/P)^3;
8 Lh=Ln*10^6/(720*60);
9
10 // printing data in scilab o/p window
11 printf("Lh is %0.3f hrs ",Lh);

```

---

### Scilab code Exa 18.5 RB5

```
1 // sum 18-5
2 clc;
3 clear;
4 R1x=120;
5 R1y=250;
6 R2x=300;
7 R2y=400;
8 Lh=8000;
9 N=720;
10 Ln=Lh*60*N*10^-6;
11 R1=sqrt(R1x^2+R1y^2);
12 R2=sqrt(R2x^2+R2y^2);
13 //Let load factor be Ks
14 Ks=1.5;
15 P1=R1*Ks;
16 P2=R2*Ks;
17 C1=P1*(Ln^(1/3));
18 C2=P2*(Ln^(1/3));
19 //let designation ,d,D,B,C at bearing B1 be De1,d1,D1
    ,B1,C1
20 d1=25;
21 D1=37;
22 B1=7;
23 C1=3120;
24 De1=61805;
25 //let designation ,d,D,B,C at bearing B2 be De2,d2,D2
    ,B2,C2
26 d2=25;
27 D2=47;
28 B2=8;
29 C2=7620;
30 De2=16005;
```



```

31
32 // printing data in scilab o/p window
33 printf(" Designation of Bearing B1 is %0.0 f      ",
        De1);
34 printf("\n d1 is %0.0 f mm      ",d1);
35 printf("\n D1 is %0.0 f mm      ",D1);
36 printf("\n B1 is %0.0 f mm      ",B1);
37 printf("\n C1 is %0.0 f N      ",C1);
38 printf("\n Designation of Bearing B2 is %0.0 f
        ",De2);
39 printf("\n d2 is %0.0 f mm      ",d2);
40 printf("\n D2 is %0.0 f mm      ",D2);
41 printf("\n B2 is %0.0 f mm      ",B2);
42 printf("\n C2 is %0.0 f N      ",C2);
43
44 disp('Bearing 61805 at B1 and 16005 at B2 can be
        installed.')
```

---

#### Scilab code Exa 18.6 RB6

```

1 // sum 18-6
2 clc;
3 clear;
4 P=7500;
5 N=1440;
6 w=2*%pi*N/60;
7 T=P/w;
8 r=0.2;
9 //Let T1-T2=t
10 t=T/r;
11 T2=t/2.5;
12 T1=3.5*T2;
13 R=0.125;
14 Ft=T/R;
15 Fr=Ft*tan(20*%pi/180);
```

```

16 // RD & RA are reaction forces calculated in
    vertical and horizontal directions from FBD by
    force equilibrium
17 RDv=186.5;
18 RAv=236.2;
19 RDh=36.2;
20 RAh=108.56;
21 RA=sqrt(RAv^2+RAh^2);
22 RD=sqrt(RDv^2+RDh^2);
23 Ks=1.4;
24 P1=RA*Ks;
25 P2=RD*Ks;
26 //let designation ,d,D,B,C at bearing B1 be De1,d1,C1
27 d1=25;
28 C1=3120;
29 De1=61805;
30 //let designation ,d,D,B,C at bearing B2 be De2,d2,C2
31 d2=25;
32 C2=2700;
33 De2=61804;
34 L1=(C1/P1)^3;
35 Lh1=L1*10^6/(720*60);
36 L2=(C2/P2)^3;
37 Lh2=L2*10^6/(720*60);
38
39 // printing data in scilab o/p window
40 printf("Lh1 is %0.0f hrs      ",Lh1);
41 printf("\n Lh2 is %0.0f hrs      ",Lh2);
42
43 //Incorrect value of P2 is taken in the book while
    calculating L2.

```

---

Scilab code Exa 18.7 RB7

```

1 // sum 18-7

```

```

2  clc;
3  clear;
4  P=3500;
5  Lh=6000;
6  N=1400;
7  R98=0.98;
8  R90=0.9;
9  L98=Lh*60*N/10^6;
10 x=(log(1/R98)/log(1/R90))^(1/1.17);
11 L90=L98/x;
12 C=P*L90^(1/3);
13
14  // printing data in scilab o/p window
15  printf("C is %0.0f N      ",C);
16
17  //The difference in the value of C is due to
    rounding-off of value of L.

```

---

### Scilab code Exa 18.8 RB8

```

1  // sum 18-8
2  clc;
3  clear;
4  n=3;
5  P=3;
6  //Let Reliability of system be R
7  R=0.83;
8  L94=6;
9  R94=(R)^(1/n);
10 x=(log(1/R94)/log(1/0.90))^(1/1.17);
11 L90=L94/x;
12 C=P*L90^(1/3);
13
14  // printing data in scilab o/p window
15  printf("C is %0.3f kN      ",C);

```

```
16
17 //The difference in the value of C is due to
    rounding-off of value of L.
```

---

### Scilab code Exa 18.9 RB9

```
1 // sum 18-9
2 clc;
3 clear;
4 P1=3000;
5 P2=4000;
6 P3=5000;
7 N1=1440;
8 N2=1080;
9 N3=720;
10 t1=1/4;
11 t2=1/2;
12 t3=1/4;
13 n1=N1*t1;
14 n2=N2*t2;
15 n3=N3*t3;
16 N=(n1+n2+n3);
17 Pe=(((n1*P1^3)+(n2*P2^3)+(n3*P3^3))/N)^(1/3);
18 Lh=10*10^3;
19 L=Lh*60*N/10^6;
20 C=Pe*L^(1/3);
21
22 // printing data in scilab o/p window
23 printf("C is %0.0f N      ",C);
24
25 //The difference in the value of C is due to
    rounding-off of value of Pe
```

---

### Scilab code Exa 18.10 RB10

```
1 // sum 18-10
2 clc;
3 clear;
4 Co=695;
5 C=1430;
6 Pa1=200;
7 Pr1=600;
8 x=Pa1/Co;
9 y=Pa1/Pr1;
10 e=0.37+((0.44-0.37)*0.038/0.28);
11 X=1;
12 Y=0;
13 P1=600;
14 Pa2=120;
15 Pr2=300;
16 X=0.56;
17 Y=1.2-(0.2*0.042/0.12);
18 P2=(X*Pr2)+(Y*Pa2);
19 N1=1440;
20 N2=720;
21 t1=2/3;
22 t2=1/3;
23 n1=N1*t1;
24 n2=N2*t2;
25 N=(n1+n2);
26 Pe((((n1*P1^3)+(n2*P2^3))/N)^(1/3));
27 L=(C/Pe)^3;
28 Lh=L*10^6/(N*60);
29
30 // printing data in scilab o/p window
31 printf("Lh is %0.2f hrs      ",Lh);
32
33 //The difference in the value of Lh is due to
    rounding-off of value of Pe
```

---

# Chapter 19

## FLYWHEEL

Scilab code Exa 19.1 F1

```
1 // sum 19-1
2 clc;
3 clear;
4 R=1200;
5 b=300;
6 t=150;
7 N=500;
8 m=7100*10^-9*b*t;
9 Ar=b*t;
10 Aa=Ar/4;
11 C=(20280/t^2)+0.957+(Ar/Aa);
12 w=2*%pi*N/60;
13 V=w*R*10^-3;
14 siga=2*10^3*m*V^2/(C*Aa*3);
15 theta=30*%pi/180;
16 alpha=30*%pi/180;
17 x1=10^3*m*(V^2)/(b*t);
18 y1=cos(theta)/(3*C*sin(alpha));
19 z1=2000*R*10^-3/(C*t)*((1/alpha)-(cos(theta)/sin(
    alpha)));
20 sigrr1=x1*(1-y1+z1);
```

```

21 theta=0*%pi/180;
22 x2=10^3*m*(V^2)/(b*t);
23 y2=cos(theta)/(3*C*sin(alpha));
24 z2=2000*R*10^-3/(C*t)*((1/alpha)-(cos(theta)/sin(
    alpha)));
25 sigrr2=x2*(1-y2-z2);
26
27 // printing data in scilab o/p window
28 printf("axial stress is %0.2f MPa      ",sigma);
29 printf("\n tensile stress for theta=30deg is %0.1f
    MPa      ",sigrr1);
30 printf("\n tensile stress for theta=0deg is %0.2f
    MPa      ",sigrr2);
31
32 //The difference in the value of sigrr1 and sigrr2
    is due to rounding-off of values.

```

---

### Scilab code Exa 19.2 F2

```

1 // sum 19-2
2 clc;
3 clear;
4 N=350;
5 theta1=asin(sqrt((3-0.6)/4));
6 theta1=theta1*180/%pi;
7 theta2=(180)-theta1;
8 //Ti=16000+6000*sind(3*theta);
9 //To=16000+3600*sind(theta);
10 a=-3600*(cosd(theta2)-cosd(theta1));
11 b=2000*(cosd(3*theta2)-cosd(3*theta1));
12 c=a+b;
13 delU=c;
14 Ks=0.05;
15 w=2*%pi*N/60;
16 I=delU/(Ks*w^2);

```

```

17 V=25;
18 Ir=I*0.95;
19 R=V/w;
20 Mr=Ir/R^2;
21 rho=7150;
22 t=sqrt(Mr*(10^6)/(2*pi*R*2*rho));
23 b=2*t;
24
25 // printing data in scilab o/p window
26 printf("t is %0.2f mm ",t);
27 printf("\n b is %0.2f mm ",b);
28 printf("\n R is %0.3f m ",R);

```

---

### Scilab code Exa 19.3 F3

```

1 // sum 19-3
2 clc;
3 clear;
4 N=300;
5 Ks=0.03;
6 rho=7150;
7 Kr=0.9;
8 w=2*pi*N/60;
9 WD=(300*2*pi)+(4*pi*200/4);
10 Tm=400;
11 delU=pi*200/16;
12 Ir=Kr*delU/(w^2*Ks);
13 R=Ir/(rho*1.5*0.1*0.1*2*pi);
14 R=R^(1/5);
15 t=0.1*R*1000;
16 b=1.5*t;
17
18 // printing data in scilab o/p window
19 printf("t is %0.2f mm ",t);
20 printf("\n b is %0.2f mm ",b);

```



```
21     printf("\n R is %0.4f m      ",R);
```

---

#### Scilab code Exa 19.4 F4

```
1 //sum 19-4
2 clc;
3 clear;
4 d=20;
5 t=12;
6 Tus=450;
7 Pmax=%pi*d*t*Tus;
8 WD=Pmax*t/2*10^-3;
9 n=0.95;
10 Wi=WD/n;
11 delU=5*Wi/6;
12 N=300;
13 w=2*%pi*N/60;
14 Ks=0.2;
15 I=delU/(Ks*w^2);
16 Ir=I*0.9;
17 R=0.5;
18 m=Ir/R^2;
19 rho=7150;
20 t=sqrt(m*10^6/(rho*2*%pi*R*2));
21 b=2*t;
22
23 // printing data in scilab o/p window
24 printf("t is %0.1f mm      ",t);
25 printf("\n b is %0.1f mm      ",b);
26 printf("\n R is %0.1f m      ",R);
```

---

#### Scilab code Exa 19.5 F5

```

1 // sum 19-5
2 clc;
3 clear;
4 U=(500*2*%pi)+(3*%pi*500/2);
5 Tm=U/(2*%pi);
6 delU=2.25*%pi*125/2;
7 Ks=0.1;
8 N=250;
9 w=2*%pi*N/60;
10 I=delU/(Ks*w^2);
11 t=0.03;
12 rho=7800;
13 R=(I*2/(%pi*rho*t))^(1/4);
14 V=R*w;
15 v=0.3;
16 sigmax=rho*V^2*(3+v)/8*10^-6;
17
18 // printing data in scilab o/p window
19 printf("R is %0.3f m      ",R);
20 printf("\n sigmax is %0.2f MPa      ",sigmax);

```

---

#### Scilab code Exa 19.6 F6

```

1 // sum 19-6
2 clc;
3 clear;
4 N=1.5*8*60;
5 l=200;
6 t=1.5/2;
7 W=350*10^3;
8 WD=0.15*l*W*10^-6;
9 n=0.9; //since frictional effect is 10%, efficiency
        of system is 90%
10 Wi=WD/n;
11 L=400;

```

```

12 delU=(L-(0.15*1))/(L)*10^3*Wi;
13 Ks=0.12;
14 w=2*%pi*N/60;
15 I=delU/(Ks*w^2);
16 Ir=I*0.9;
17 R=0.7;
18 m=Ir/R^2;
19 rho=7150;
20 t=sqrt(m*10^6/(rho*2*%pi*R*1.5));
21 b=1.5*t;
22
23 // printing data in scilab o/p window
24 printf("t is %0.1f mm      ",t);
25 printf("\n b is %0.1f mm      ",b);

```

---

### Scilab code Exa 19.7 F7

```

1 // sum 19-7
2 clc;
3 clear;
4 N=144;
5 //Let n be no. of punches/ min
6 n=8;
7 //Let t be timr for 1 punch
8 t=60/n;
9 theta=N/60*2*%pi*0.6;
10 T=2.1;
11 U=T*theta;
12 //Let U1 be revolution of crankshaft in t sec
13 U1=t*N/60*2*%pi;
14 delU=(U1-theta)/U1*U*10^3;
15 w=2*%pi*1440/60;
16 Ks=0.1;
17 I=delU/(Ks*w^2);
18 Ir=I*0.9;

```

```
19 rho=7100;
20
21 R=Ir/(rho*0.2*0.1*2*%pi);
22 R=R^(1/5);
23 t=0.1*R*1000;
24 b=0.2*R*10^3;
25 t=40;
26 b=80;
27 R=400;
28 // printing data in scilab o/p window
29 printf("t is %0.0f mm      ",t);
30 printf("\n b is %0.0f mm      ",b);
31 printf("\n R is %0.0f mm      ",R);
```

---

# Chapter 20

## FLAT BELT DRIVE

Scilab code Exa 20.1 FBD1

```
1 // sum 20-1
2 clc;
3 clear;
4 b=0.2;
5 P=50*10^3;
6 v=20;
7 m=1.95;
8 d=0.3;
9 D=0.9;
10 C=5.8;
11 u=0.4;
12 //Let density be rho
13 rho=1000;
14 E=40;
15 //Let T1-T2 = T
16 T=P/v;
17 //Let the centrifugal tension be Tc
18 Tc=m*v^2;
19 alpha=asind((D+d)/(2*C));
20 theta=180+(2*alpha);
21 theta=theta*%pi/180;
```

```

22 x = exp(u*theta);
23 T2=((1-x)*Tc)-T)/(1-x);
24 //T1=T+T2;
25 T1=T+T2;
26 t=m/(b*rho)*10^3;
27 //Let maximum stress be sigmax
28 b=200;
29 d=300;
30 sigmax=(T1/(b*t)+((E*t)/d));
31 sigmin=(T2/(b*t));
32
33 // printing data in scilab o/p window
34 printf("T1 is %0.1f N ",T1);
35 printf("\n T2 is %0.1f N ",T2);
36 printf("\n t is %0.2f mm ",t)
37 printf("\n theta is %0.2f rad ",theta)
38 printf("\n sigmax is %0.2f N/mm^2 ",sigmax);
39 printf("\n sigmin is %0.3f N/mm^2 ",sigmin);
40
41 //The answer for T1 is miscalculated in the book.

```

---

### Scilab code Exa 20.2 FBD2

```

1 // sum 20-2
2 clc;
3 clear;
4 P=12*10^3;
5 d=0.2;
6 D=0.5;
7 C=2;
8 sigmax=2*10^6;
9 t=8*10^-3;
10 //Let density be rho
11 rho=950;
12 u=0.38;

```

```

13 N=1500;
14 //Let angle of contact = thetad
15 thetad=180-(2*asind((D-d)/(2*C)));
16 thetad=thetad*%pi/180;
17 thetaD=(2*%pi)-thetad;
18 v=(2*%pi*N*d)/(60*2);
19 //Let T1-T2=T
20 T=P/v;
21 x=exp(u*thetad);
22 b=(T*x)/((1-x)*t*((rho*v^2)-(sigmax)));
23 b=b*10^3;
24 //Let breadth of the pulley be b1
25 b1=b*10^3+13; //Table 20-3
26 L=sqrt((4*C^2)-(C*(D-d)^2))+((D*thetaD)+(d*thetad))
    /2;
27 // Let pulley crown for d=h1, D=h2
28 h1=0.6; //Table 20-4
29 h2=1;
30
31 // printing data in scilab o/p window
32 printf("b is %0.2f mm ",b)
33 printf("\n L is %0.2f m ",L)
34 printf("\n b1 is %0.2f mm ",b1);
35 printf("\n h1 is %0.1f mm ",h1);
36 printf("\n h2 is %0.1f mm ",h2);

```

---

### Scilab code Exa 20.3 FBD3

```

1 // sum 20-3
2 clc;
3 clear;
4 P=11;
5 N=1440;
6 n=480;
7 C=2.4;

```

```

8 //Let power transmitted from high speed belt =P1
9 P1=0.0118;
10 V=5;
11 Ks=1.2;
12 v=15;
13 d=v*10^3*60/(2*pi*N);
14 d=0.2;
15 D=N/n*d;
16 //Let angle of contact =thetaA
17 thetaA=180-(2*asind((D-d)/(2*C)));
18 thetaA=thetaA*pi/180;
19 v=(2*pi*N*d)/(60*2);
20 //Let the arc of contact correction factor be Ka
21 Ka=1.05;
22 Pd=P*Ka*Ks;
23 //Let corrected load rating=Pc
24 Pc=P1*v/V;
25 b=Pd/(Pc*4);
26 thetaB=(2*pi)-thetaA;
27 L=sqrt((4*C^2)-((D-d)^2))+((d*thetaA/2)+(D*thetaB)
      /2);
28
29
30 // printing data in scilab o/p window
31 printf("v is %0.2f m/s ",v)
32 printf("\n b is %0.3f mm ",b)
33 printf("\n L is %0.4f m ",L);

```

---

#### Scilab code Exa 20.4 FBD4

```

1 // sum 20-4
2 clc;
3 clear;
4 N=1440;
5 i=2.5;

```



```

6 C=3600;
7 //let load factor be LF
8 LF=1.3;
9 P=12*10^3;
10 n=N/i;
11 V=16;
12 d=V*10^3*60/(2*pi*N);
13 d=220;
14 D=d*i;
15 V=2*pi*N*d/(2*60*1000);
16 v=5;
17 //Let power transmittes dfrom high speed belt =P1
18 P1=0.0118;
19 //Let LR be the load rating of belt
20 LR=P1/v*V;
21 theta=180+(2*asind((D-d)/(2*C)));
22 theta=theta*pi/180;
23 //Let Arc of contact connection factor be CF
24 CF=1-(0.03/2);
25 Pd=P*LF*CF;
26 b=Pd/(LR*5);
27 b=80;
28 L=sqrt((4*C^2)-(D+d)^2)+(theta*(D+d)/2);
29 L=L*10^-3;
30
31 // printing data in scilab o/p window
32 printf("V is %0.1f m/s ",V)
33 printf("\n b is %0.0f mm ",b)
34 printf("\n L is %0.3f m ",L);

```

---

#### Scilab code Exa 20.5 FBD5

```

1 // sum 20-5
2 clc;
3 clear;

```

```

4 i=3.6;
5 N=1440;
6 d=220;
7 Ks=1.2;
8 Kf=1.1;
9 C=5000;
10 u=0.8;
11 D=i*d;
12 //From table 20-7, the following data is available
13 t=5;
14 b=120;
15 Fa=30.64;
16 //let weight density be w
17 w=0.106*10^5;
18 Cp=0.71; //From table 20-6
19 Cv=1;
20 T1=Fa*b*t*Cp*Cv;
21 m=w*b*t/10^6;
22 V=2*pi*N*d/(2*60*1000);
23 Tc=m*V^2/9.81;
24 theta=180+(2*asind((D-d)/(2*C)));
25 theta=theta*pi/180;
26 x=u*theta;
27 T2=Tc+((T1-Tc)/exp(x));
28 Pd=(T1-T2)*V*10^-3;
29 P=Pd/(Ks*Kf);
30
31 // printing data in scilab o/p window
32 printf("V is %0.2f m/s ",V);
33 printf("\n Pd is %0.2f KW ",Pd);
34 printf("\n P is %0.1f KW ",P);
35
36 //The value of T2 is calculated incorrectly ,
    therefore there is a difference in the values
    of Pd and P.

```

---

### Scilab code Exa 20.6 FBD6

```
1 // sum 20-6
2 clc;
3 clear;
4 i=2.5;
5 C=4500;
6 N=960;
7 P=20*10^3;
8 Ks=1.15;
9 Kf=1.10;
10 t=8;
11 //let weight density be w
12 w=0.110*10^5;
13 m=w*t/10^6;
14 Fa=8.75;
15 d=200;
16 D=i*d;
17 u=0.4;
18 V=2*%pi*N*d/(2*60*1000);
19 Pd=P*Ks*Kf;
20 Cp=1;
21 Cv=0.6;
22 //to find b
23 T1=Fa*t*Cp*Cv;
24 Tc=m*V^2/9.81;
25 theta=180-(2*asind((D-d)/(2*C)));
26 theta=theta*%pi/180;
27 x=u*theta;
28 T2=Tc+((T1-Tc)/exp(x));
29 T=Pd/V;
30 b=T/(T1-T2);
31 //b=90;
32 L=sqrt((4*C^2)-(D+d)^2)+(theta*(D+d)/2);
```

```

33 L=L*10^-3;
34
35 // printing data in scilab o/p window
36 printf("V is %0.2f m/s ",V)
37 printf("\n b is %0.3f mm ",b)
38 printf("\n L is %0.3f m ",L);

```

---

### Scilab code Exa 20.7 FBD7

```

1 // sum 20-7
2 clc;
3 clear;
4 b=160;
5 t=7;
6 P=3*10^3;
7 Ks=1.2;
8 d=160;
9 N=1440;
10 D=480;
11 C=2400;
12 w=11200;
13 u=0.4;
14 Fa=7.2;
15 m=w*b*t/10^6;
16 V=2*%pi*N*d/(2*60*1000);
17 Tc=m*V^2/9.81;
18 Cp=0.6; //from table 20-6
19 Cv=0.98; //from table 20-7
20 Ta=Fa*b*Cp*Cv;
21 T=P/V;
22 theta=180-(2*asind((D-d)/(2*C)));
23 theta=theta*%pi/180;
24 x=u*theta;
25 //T2=Tc+((T1-Tc)/exp(x));
26 T2=(T+((exp(x)*Tc)-Tc))/(exp(x)-1);

```

```
27 T1=T+T2;
28 Kf=Ta/T1;
29 Pd=P*Ks*Kf;
30 Pd=Pd*10^-3;
31
32 // printing data in scilab o/p window
33 printf("Tc is %0.0f N ",Tc);
34 printf("\n T1 is %0.2f N ",T1);
35 printf("\n T2 is %0.2f N ",T2);
36 printf("\n Kf is %0.2f ",Kf);
37 printf("\n Pd is %0.1f KW ",Pd);
38
39 //The difference in values of T1 and T2 is due to
    rounding-off of values.
```

---

# Chapter 21

## V BELT DRIVE

Scilab code Exa 21.1 VBELT1

```
1 // sum 21-1
2 clc;
3 clear;
4 P1=12*10^3;
5 d=0.3;
6 D=0.9;
7 C=0.9;
8 A=230*10^-6;
9 //density is rho
10 rho=1100;
11 N=1500;
12 //Maximum stress is sig
13 sig=2.1*10^6;
14 //semi groove angle is b
15 b=20*%pi/180;
16 u=0.22;
17 m=rho*A;
18 v=2*%pi*N*d/(60*2);
19 Tc=m*v^2;
20 T1=A*sig;
21 //wrap angle is thetaA
```

```

22 ang=(D-d)/(2*C);
23 thetaA=%pi/180*(180-(2*asind(ang)));
24 thetaB=((2*%pi)-thetaA);
25 x=u*thetaB;
26 T2=Tc+((T1-Tc)/exp(x));
27 P2=(T1-T2)*v;
28 n=P1/P2;
29 n=3; //(rounding off to nearest whole number)
30
31 // printing data in scilab o/p window
32 printf("Tc is %0.1f N ",Tc);
33 printf("\n T1 is %0.0f N ",T1);
34 printf("\n T2 is %0.1f N ",T2);
35 printf("\n P2 is %0.0f W ",P2);
36 printf("\n n is %0.0f ",n);

```

---

### Scilab code Exa 21.2 VBELT2

```

1 // sum 21-2
2 clc;
3 clear;
4 D=0.6;
5 d=0.3;
6 C=0.9;
7 m=0.193;
8 n=2;
9 N=1500;
10 u=0.3;
11 v=2*%pi*N/60*d/2;
12 P=150*10^3;
13 Tc=m*v^2;
14 //let T1-T2=T
15 T=P/(n*v);
16 thetaA=%pi/180*(180-(2*asind((D-d)/(2*C))));
17 thetaB=((2*%pi)-thetaA);

```

```

18 //Groove angle=b
19 b=17.5*%pi/180;
20 x=u*thetaA/sin(b);
21 y=exp(x);
22 c=(Tc*(1-y));
23 T2=(T+(Tc*(1-y)))/(y-1);
24 //T2=(T-y)/Tc;
25 T1=T+Tc;
26 Lp=2*sqrt((C^2)-((D-d)/2)^2)+(thetaA*d/2)+(thetaB*D
    /2);
27 v=sqrt(T/(3*m));
28
29 // printing data in scilab o/p window
30 printf("Tc is %0.2f N ",Tc);
31 printf("\n T1 is %0.0f N ",T1);
32 printf("\n T2 is %0.2f N ",T2);
33 printf("\n Lp is %0.3f m ",Lp);
34 printf("\n v is %0.2f m/s ",v);
35 printf("\nThe designation of the belt is B-3251-45
    ");
36
37 //The difference in values of T1 and T2 is due to
    rounding-off of values.

```

---

### Scilab code Exa 21.3 VBELT3

```

1 // sum 21-3
2 clc;
3 clear;
4 C=1;
5 m=0.35;
6 d=0.25;
7 P=22*10^3;
8 //Let the smaller pulley dia be n
9 //Let the larger pulley dia be N

```



```

10 n=1000;
11 N=400;
12 D=d*n/N;
13 v=2*%pi*n*d/(60*2);
14 Tc=m*v^2;
15 topwidth=22;
16 h=14;
17 bottomwidth=topwidth-(2*h*tand(20));
18 A=(topwidth+bottomwidth)/2*h;
19 //let allowable tension be Ta
20 Ta=2.2;
21 T1=A*Ta;
22 u=0.28;
23 thetaA=%pi/180*(180-(2*asind((D-d)/(2*C))));
24 thetaB=((2*%pi)-thetaA);
25 //Groove angle=b=19
26 b=19*%pi/180;
27 x=u*thetaA/sin(b);
28 T2=Tc+((T1-Tc)/exp(x));
29 n=P/((T1-T2)*v);
30 Lp=2*sqrt((C^2)-((D-d)/2)^2)+(thetaA*d/2)+(thetaB*D
    /2);
31
32 // printing data in scilab o/p window
33 printf("Tc is %0.2f N ",Tc);
34 printf("\n T1 is %0.1f N ",T1);
35 printf("\n T2 is %0.1f N ",T2);
36 printf("\n n is %0.1f ",n);
37 printf("\n Lp is %0.3f m ",Lp);
38 printf("\nThe designation of the belt is C-3414-47
    ");
39
40 // difference in value of Lp is due to rounding-off
    the values of thetaA and thetaB.

```

---

#### Scilab code Exa 21.4 VBELT4

```
1 // sum 21-4
2 clc;
3 clear;
4 P=12*10^3;
5 Ks=1.1;
6 Pd=12*10^3*Ks;
7 N=1440;
8 B=17;
9 t=11;
10 d=200;
11 i=3;
12 D=i*d;
13 C=1000;
14 // since angle of contact theta is very small
15 theta=(D-d)/C;
16 theta=theta*180/%pi;
17 Kc=0.8;
18 Lp=(2*C)+(%pi/2*(D+d))+(((D-d)^2)/(4*C));
19 Li=Lp-45;
20 Ki=1.1;
21 //let number of v-belts required = n
22 //let the KW rating be KWR
23 KWR=5.23;
24 n=(P*Ks)/(KWR*Ks*Ki*10^3);
25 n=3;
26
27 // printing data in scilab o/p window
28 printf("D is %0.1f mm ",D);
29 printf("\n C is %0.1f mm ",C);
30 printf("\n n is %0.3f ",n);
31 printf("\n Li is %0.0f mm ",Li)
```

---

#### Scilab code Exa 21.5 VBELT5

```

1 // sum 21-5
2 clc;
3 clear;
4 N=800;
5 P=20;
6 i=2.5;
7 Ks=1.5; //(from table for 3-5 hrs/day)
8 Pd=P*Ks;
9 d=250;
10 D=i*d;
11 C=1.6*D;
12 Lp=(2*C)+(%pi*(D+d)/2)+((D-d)^2)/(4*C);
13 Li=Lp+74;
14 Listd=3454;
15 Lp=Listd+74;
16 p=[1 -1.0768 0.0175];
17
18 function r= myroots (p)
19
20 a= coeff (p ,0);
21 b= coeff (p ,1);
22 c= coeff (p ,2);
23 r(1)=( -b+ sqrt (b^2 -4*a*c ))/(2* a);
24 r(2)=( -b- sqrt (b^2 -4*a*c ))/(2* a);
25 endfunction
26 z=roots(p);
27 KW=9.4;
28 Kc=0.795;
29 K1=1;
30 n=Pd/(KW*Kc*K1);
31
32
33 // printing data in scilab o/p window
34 printf("C is %0.4f m ",z);
35 printf("\n Pd is %0.0f KW ",Pd);
36 printf("\n n is %0.2f KW ",n);

```

---

# Chapter 22

## FRICTION CLUTCHES

Scilab code Exa 22.1 FC221

```
1 // 22-1
2 clc;
3 clear;
4 u=0.28 //(coefficient of friction)
5 N=300 //(Engine rpm)
6 I=7.2
7 Pmax= 0.1;
8 R1=70;
9 R2=110;
10 n=2; //(Both sides of the plate are effective)
11 //Using Uniform Wear Theory
12 //Axial Force W
13 W=n*%pi*Pmax*R1*(R2-R1);
14 //Frictional Torque Tf
15 Tf=u*W*(R1+R2)/2*(10^-3);
16 w=2*%pi*N/60;
17 //Power P
18 P=Tf*w;
19 //Torque = Mass moment of inertia*angular
    acceleration
20 a=Tf/I;
```

```

21 t=w/a;
22 //Angle turned by driving shaft theta1 through which
    slipping takes place
23 theta1=w*t;
24 //angle turned by driven shaft theta2
25 theta2=a*(t^2)/2;
26 E=Tf*(theta1-theta2);
27
28 // printing data in scilab o/p window
29 printf("\nThe force is %0.1f N",W);
30 printf("\nThe Torque is %0.2f Nm",Tf);
31 printf("\nThe Power is %0.0f W",P);
32 printf("\nThe angular acceleration is %0.2f rad/sec
    ^2",a);
33 printf("\nThe time taken is %0.1f sec",t);
34 printf("\nThe energy is %0.2f Nm",E);
35
36 //The difference in the answer of energy 'E' is due
    to rounding-off of values.

```

---

### Scilab code Exa 22.2 FC222

```

1 // 22-2
2 clc;
3 clear;
4 //Power P
5 P=80*10^3; //(Watt)
6 N=3000; //(Engine rpm)
7 w=2*pi*3*10^3/60
8 Tf=8*10^4/w;
9 Rm=100; //(mm)
10 p=0.2 //N/mm^2
11 u=0.22
12 // let width b= (R1-R2).
13 // Axial force W=2*pi*Rm*b*p

```

```

14 //Torque T=u*W*Rm
15 b=Tf/(u*2*%pi*(Rm^2)*p);
16 b=50;
17 R2=Rm+b;
18 R1=Rm-b;
19 Di=2*R1; //inner diameter
20 W=2*%pi*Rm*b*p;
21 n=8; //n is number of springs
22 //Axial force per spring W1
23 W1=W/n;
24 W1=W1+15;
25 //axial deflection del
26 del=10;
27 //stiffness k
28 k=W1/del;
29 // Spring index C
30 C=6;
31 //number of coils n1
32 n1=6; //Assumption
33 d=k*n*n1*(C^3)/(80*10^3);
34 d=11; // Rounding off to nearest standard value
35 D=C*d;
36 clearance=2;
37 FL=((n1+2)*d)+(2*del)+clearance; // two end coils ,
    therefore (2*del)
38
39 // printing data in scilab o/p window
40
41 printf("\nThe Torque is %0.2f Nm",Tf);
42 printf("\nThe width is %0.0f mm",b);
43 printf("\nThe force is %0.0f N",W);
44 printf("\nThe Axial force per spring is %0.0f N",W1)
    ;
45 printf("\nThe Spring stiffness is %0.0f N/mm",k);
46 printf("\nThe Spring wire diameter is %0.0f mm",d);
47 printf("\nThe Mean coil diameter is %0.0f mm",D);
48 printf("\nThe Free length is %0.0f mm",FL);

```

---

### Scilab code Exa 22.3 FC223

```
1 // 22-3
2 clc;
3 clear;
4 //Power P
5 P=40*10^3 //Watt
6 n1=100; //rpm
7 n2=400; //rpm
8 //Speed factor Ks
9 Ks=0.9+0.001*n2;
10 //Clutch power Pc
11 Pc=P*n2/(n1*Ks)*10^-3;
12
13 // printing data in scilab o/p window
14 printf("\nThe Speed factor is %0.1f ",Ks);
15 printf("\nThe clutch power is %0.0f KW",Pc);
```

---

### Scilab code Exa 22.4 FC224

```
1 //22-4
2 clc;
3 clear;
4 // plot Torque vs Ro/Ri
5 //x=Ro/Ri
6 //According to Uniform Wear theory
7 x=[0 0.2 0.4 0.577 0.6 0.8 1.0];
8 n=length(x);
9 for i=1:n
10     Tf(i)=(x(i)-(x(i)^3));
```

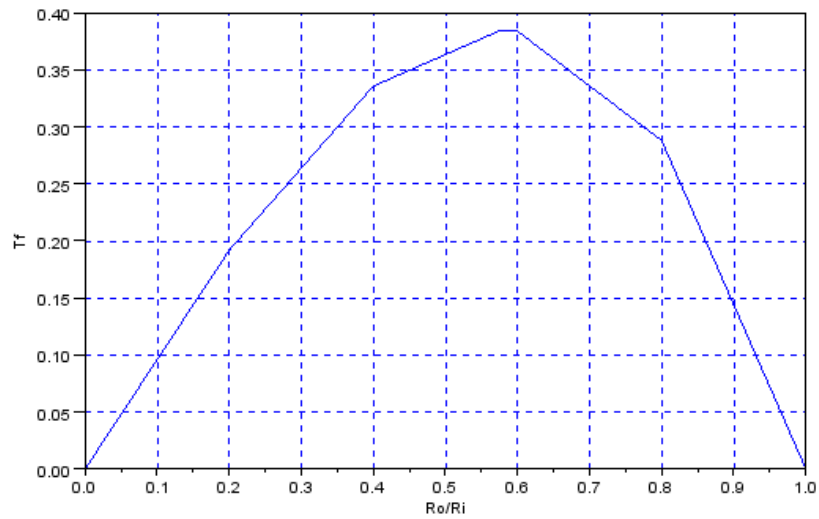


Figure 22.1: FC224

```

11 end
12 plot (x,Tf);
13 xtitle('','Ro/Ri');
14 ylabel('Tf');
15 xgrid(2);

```

---

#### Scilab code Exa 22.5 FC225

```

1 // 22-5
2 clc;
3 clear;
4 n1=4;
5 n2=3;
6 n=(n1+n2-1);
7 R2=80;
8 R1=50;

```



```

 9 //According to Uniform Pressure Theory
10 //W=p*pi*((R2^2)-(R1^2)) T=n*2*u*W*((R2^3)-(R1^3))
    /(((R2^2)-(R1^2))*3)
11 P=15*10^3;
12 N=1400;
13 u=0.25;
14 w=2*pi*N/60;
15 T=P/w;
16 W=T*3*((R2^2)-(R1^2))/(n*2*u*((R2^3)-(R1^3)))*10^3;
17 p=W/(pi*((R2^2)-(R1^2)));
18
19 // printing data in scilab o/p window
20 printf("\nThe angular speed is %0.2f rad/sec",w);
21 printf("\nThe Torque is %0.3f Nm",T);
22 printf("\nThe uniform pressure is %0.3f N/mm^2",p);
23 printf("\nThe Force is %0.1f N",W);

```

---

#### Scilab code Exa 22.6 FC226

```

1 //FRICTION CLUTCHES
2 // PAGE 584, 22-6
3 clc;
4 P=5*10^3;
5 N=1000;
6 w=2*pi*N/60;
7 Rm=50;
8 pm=0.3;
9 Tf=P/w;
10 u=0.1;
11 R2=50*2/(0.6+1);
12 R1=0.6*R2;
13 //According to uniform Wear theory
14 W=pm*Rm*(R2-R1)*2*pi;
15 n=Tf*(10^3)/(u*W*Rm);
16 pmax=pm*Rm/R1;

```

```

17
18 // printing data in scilab o/p window
19 printf("\nThe angular speed is %0.2f rad/sec",w);
20 printf("\nThe Torque is %0.3f Nm",Tf);
21 printf("\nThe Inner radius is %0.1f mm",R1);
22 printf("\nThe Outer radius is %0.1f mm",R2);
23 printf("\nThe number of contacting surfaces is %0.0f
    ",n);
24 printf("\nThe max. pressure is %0.1f N/mm^2",pmax);

```

---

#### Scilab code Exa 22.7 FC227

```

1 // 22-7
2 clc;
3 clear;
4 P=12*10^3;
5 N=750 //Speed=N
6 w=2*%pi*N/60;
7 Tf=P/w;
8 p1=0.12;
9 a=12.5; //Semi-cone angle
10 u=0.3;
11 k=u*0.18246*1.121/0.21644;
12 R1=(Tf*(10^3)/k)^(1/3);
13 R2=R1*1.242;
14 Rm=1.121*R1;
15 W=2*%pi*p1*R1*(R2-R1);
16
17 // printing data in scilab o/p window
18 printf("\nThe angular speed is %0.2f rad/sec",w);
19 printf("\nThe Torque is %0.1f Nm",Tf);
20 printf("\nThe Inner radius is %0.1f mm",R1);
21 printf("\nThe Outer radius is %0.1f mm",R2);
22 printf("\nThe mean radius is %0.2f mm",Rm);
23 printf("\nThe axial force is %0.0f N",W);

```

24

25 //The difference in the answer is due to rounding-  
off of values.

---

### Scilab code Exa 22.8 FC228

```
1 //22-8
2 clc;
3 clear;
4 //semi-cone angle is given as 15 degree
5 k=sin(15*%pi/180);
6 u=0.3;
7 W=300;
8 Rm=90/2;
9 Tf=u*W*Rm/k;
10 Tf=Tf*(10^-3);
11 I=0.4;
12 a=Tf/I;
13 N=1440;
14 w=2*%pi*N/60;
15 t=w/a;
16 //During Slipping
17 theta1=w*t;
18 theta2=theta1/2;
19 U=Tf*(theta1-theta2);
20
21 // printing data in scilab o/p window
22 printf("\nThe Torque is %0.3f Nm",Tf);
23 printf("\nThe angular acceleration is %0.3f rad/sec
    ^2",a);
24 printf("\nThe angular speed is %0.1f rad/sec",w);
25 printf("\nThe time taken is %0.2f sec",t);
26 printf("\nThe Energy lost in friction is %0.0f Nm",U
    );
```

---

### Scilab code Exa 22.9 FC229

```
1 // 22-9
2 clc;
3 clear;
4 P=15*10^3;
5 Ka=1.25;
6 N=1500;
7 w=2*%pi*N/60;
8 Tf=P/w;
9 d=(Tf*16/(50*%pi))^(1/3);
10 d=25;
11 Rm=5*d;
12 Pav=0.12;
13 u=0.22;
14 b=Tf/(%pi*u*Pav*(Rm^2));
15 b=40;
16 R1=Rm-(b*sin(15*%pi/180)/2);
17 R2=Rm+(b*sin(15*%pi/180)/2);
18
19 // printing data in scilab o/p window
20 printf("\nThe Torque is %0.2f Nm",Tf);
21 printf("\nThe shaft diameter is %0.0f mm",d);
22 printf("\nThe width is %0.0f mm",b);
23 printf("\nThe Inner radius is %0.1f mm",R1);
24 printf("\nThe Outer radius is %0.1f mm",R2);
```

---

### Scilab code Exa 22.10 FC2210

```
1 // 22-10
2 clc;
3 clear;
```

```

4 w2=2*%pi*1400/60;
5 w1=0.8*w2;
6 P=40*10^3;
7 T=P/w2;
8 n=4;
9 T1=T/4;
10 R=0.16; //Inner radius of drum
11 r=0.13; //radial distance of each shoe from axis of
    rotation
12 u=0.22; //coefficient of friction
13 x=u*r*R*((w2^2)-(w1^2))
14 m =T1/x;
15 l=R*%pi/3;
16 N=T1/(R*u);
17 p=1*10^5;
18 b=N/(p*l)*10^3;
19
20 // printing data in scilab o/p window
21 printf("\nThe full speed is %0.1f rad/sec",w2);
22 printf("\nThe engagement speed is %0.2f rad/sec",w1)
    ;
23 printf("\nThe number of shoes is %0.0f ",n);
24 printf("\nThe Torque is %0.1f Nm",T);
25 printf("\nThe Torque per shoe is %0.1f Nm",T1);
26 printf("\nThe mass per shoe is %0.2f kg",m);
27 printf("\nThe length of friction lining is %0.5f m",
    l);
28 printf("\nThe width is %0.1f mm",b);

```

---

# Chapter 23

## BRAKES

Scilab code Exa 23.1 B23 1

```
1 // sum 23-1
2 clc;
3 clear;
4 W=20e3;
5 m=W/9.81;
6 //diameter of brake drum
7 Db=0.6;
8 p=1;
9 Vi=1;
10 Vf=0;
11 D=1;
12 R=0.5;
13 wi=Vi/R;
14 wf=0;
15 w=1;
16 Vav=0.5;
17 S=2;
18 t=S/Vav;
19 //angle turned by by hoist drum=theta
20 theta=0.5*wi*t;
21 K.E=0.5*m*Vi^2;
```

```

22 P.E=2*W;
23 T.E=K.E+P.E;
24 T=T.E/theta;
25 P=wi*T*10^-3;
26 Rb=Db/2;
27 Ft=0.5*T*p/Rb;
28 u=0.35;
29 N=Ft/u;
30 //contact area of brake lining=A
31 A=N/p;
32 b=0.3*Db;
33 L=A*10^-6/(b);
34 //angle subtended at brake drum centre=theta2
35 theta2=2*(asin(L/Db));
36 theta2=theta2*180/%pi; // converting radian to
    degree
37
38 // printing data in scilab o/p window
39 printf("T is %0.1f Nm ",T);
40 printf("\n P is %0.4f kW ",P);
41 printf("\n b is %0.2f m ",b);
42 printf("\n L is %0.3f m ",L);
43 printf("\n theta2 is %0.0f deg ",theta2);

```

---

### Scilab code Exa 23.2 B23 2

```

1 // sum 23-2
2 clc;
3 clear;
4 b=80;
5 t=2;
6 theta=225*%pi/180;
7 u=0.22;
8 //F1/F2=e^(u*theta)
9 //let F1/F2=x;

```

```

10 x=exp(u*theta);
11 //maximum tensile stress in steel tape is sigma
12 sigma=60;
13 A=b*t;
14 F1=sigma*A;
15 F2=F1/x;
16 r=0.2;
17 T=(F1-F2)*r;
18 OA=30;
19 OB=100;
20 OC=350;
21 P=((F2*OB)+(F1*OA))/OC;
22 OA=F2*OB/F1;
23
24 // printing data in scilab o/p window
25 printf("F1 is %0.0f N ",F1);
26 printf("\n F2 is %0.1f N ",F2);
27 printf("\n T is %0.2f Nm ",T);
28 printf("\n OA is %0.2f mm ",OA);

```

---

### Scilab code Exa 23.3 B23 3

```

1 // sum 23-3
2 clc;
3 clear;
4 theta=%pi/3;
5 r=160;
6 u=0.3;
7 pmax=0.9;
8 b=40;
9 R=(4*r*sin(theta))/((2*theta)+sin(2*theta));
10 //frictional torque is T
11 T=2*u*pmax*b*(r^2)*sin(theta);
12 T=2*T*10^-3;
13 Rx=0.5*pmax*b*r*((2*theta)+(sin(2*theta)))*10^-3;

```



```

14 Ry=u*Rx;
15
16 // printing data in scilab o/p window
17 printf("T is %0.2 f Nmm ",T);
18 printf("\n R is %0.3 f mm ",R);
19 printf("\n Rx is %0.3 f kN ",Rx);
20 printf("\n Ry is %0.2 f kN ",Ry);

```

---

#### Scilab code Exa 23.4 B23 4

```

1 // sum 23-4
2 clc;
3 clear;
4 d=320;
5 r=d/2;
6 b=50;
7 u=0.3;
8 pmax=1;
9 c=115*2;
10 // From to fig. 23-9, distance OA=R is calculated.
11 R=sqrt(115^2+66.4^2);
12 C=115*2;
13 theta1=0;
14 theta2=120*%pi/180;
15 theta0=120*%pi/180;
16 thetamax=%pi/2;
17 Tr=u*pmax*b*r^2*(cos(theta1)-cos(theta2))/sin(
    thetamax)*10^-3;
18 //the notation 'r' is used for moments of right hand
    shoe, similarly 'l' for the left shoe.
19 Mfr=u*pmax*b*r*(4*r*(cos(theta1)-cos(theta2))+(R*(
    cos(2*theta1)-cos(2*theta2))))/(4*sin(thetamax))
    *10^-3;
20 Mpr=pmax*b*r*R*((2*theta0)-(sin(2*theta2)-(sin(
    theta1))))/(4*sin(thetamax))*10^-3;

```

```

21 F=(Mpr-Mfr)/c*10^3;
22 //Mpl+Mfl=F*c;
23 x=F*c*10^-3;
24 y=(Mpr/pmax)+(Mfr/pmax);
25 pmax2=x/y;
26 Tl=pmax2*Tr;
27 Mpl=pmax2*Mpr;
28 Mfl=pmax2*Mfr;
29 T=Tl+Tr;
30
31 // printing data in scilab o/p window
32 printf("Tr is %0.0f Nm ",Tr);
33 printf("\n Mf is %0.2f Nm ",Mfr);
34 printf("\n Mp is %0.2f Nm ",Mpr);
35 printf("\n Tl is %0.1f Nm ",Tl);
36 printf("\n Mfl is %0.2f Nm ",Mfl);
37 printf("\n Mpl is %0.2f Nm ",Mpl);
38 printf("\n F is %0.1f N ",F);
39 printf("\n T is %0.1f Nm ",T);
40
41 //The difference in the answers are due to
    rounding-off of values.

```

---

### Scilab code Exa 23.5 B23 5

```

1 // sum 23-5
2 clc;
3 clear;
4 m=1100;
5 V=65*5/18;
6 t=4;
7 r=0.22;
8 mb=12;
9 C=460;
10 S=0.5*V*t;

```

```

11 //Total kinetic energy TE=K.E(vehicle)+K.E(rotating
    parts).
12 TE=((0.5*m*(V^2))+(0.1*0.5*m*(V^2)));
13 E=TE/4;
14 w=V/r;
15 theta=S/r;
16 T=E/theta;
17 delT=E/(mb*C);
18
19 // printing data in scilab o/p window
20 printf("S is %0.2f m ",S);
21 printf("\n E is %0.2f Nm ",E);
22 printf("\n T is %0.2f Nm ",T);
23 printf("\n delT is %0.2f ",delT);
24
25 //The difference in the answers are due to rounding-
    off of values.

```

---

### Scilab code Exa 23.6 B23 6

```

1 // sum 23-6
2 clc;
3 clear;
4 T=35000;
5 u=0.4;
6 p=0.7;
7 r=200;
8 N=T/(u*r)
9 b=sqrt(N/p);
10 l=b;
11 //2theta = theta2
12 theta2=2*asin(1/(2*r));
13 F=u*N;
14 P=((250*N)-(u*N*80))/550;
15 Ry=N-P;

```

```

16 Rx=u*N;
17 R=sqrt(Rx^2+Ry^2);
18 w=2*pi*100/60;
19 // Rate of heat generated is Q
20 Q=u*N*w*r/1000;
21
22 // printing data in scilab o/p window
23 printf("N is %0.1f N ",N);
24 printf("\n b is %0.0f mm ",b);
25 printf("\n P is %0.1f N ",P);
26 printf("\n R is %0.2f N ",R);
27 printf("\n Q is %0.2f J/s ",Q);
28
29 //The answer to Rate of heat generated 'Q' is
   calculated incorrectly in the book.

```

---

#### Scilab code Exa 23.7 B23 7

```

1 // sum 23-7
2 clc;
3 clear;
4 Vi=20*5/18;
5 Vf=0;
6 m=80;
7 pmax=1;
8 u=0.1;
9 S=50;
10 KE=0.5*m*Vi^2;
11 N=KE/(u*S*2);
12 t=sqrt(N/(pmax*3));
13 b=3*t;
14
15 // printing data in scilab o/p window
16 printf("KE is %0.1f Nm ",KE);
17 printf("\n N is %0.2f N ",N);

```

```
18     printf("\n t is %0.1f mm ",t);
19     printf("\n b is %0.1f mm ",b);
20
21 //The difference in the answers are due to rounding-
    off of values.
```

---

# Chapter 24

## ROPE DRIVE

Scilab code Exa 24.1 RD1

```
1 // sum 24-1
2 clc;
3 clear;
4 P=150000;
5 m=0.4;
6 D=1.8;
7 d=0.6;
8 C=4.2;
9 V=15;
10 Fc=m*V^2;
11 BL=44.81*10^3;
12 FOS=35;
13 F1=BL/FOS;
14 theta=%pi-(2*asin((D-d)/(2*C)));
15 beta=22.5*%pi/180;
16 u=0.13;
17 x=u*theta/sin(beta);
18 F2=(F1-Fc)/exp(x);
19 n=P/((F1-F2)*V);
20 n=13;
21
```

```
22 // printing data in scilab o/p window
23 printf("n is %0.0f ",n);
```

---

### Scilab code Exa 24.2 RD2

```
1 // sum 24-2
2 clc;
3 clear;
4 W=1000;
5 m=0.498;
6 BL=78;
7 d=12;
8 Am=0.39*d^2;
9 dw=sqrt(Am*4/(6*19*%pi));
10 Ew=74.4*10^3;
11 Ds=56*d;
12 sigb=Ew*dw/Ds;
13 Wb=sigb*%pi*(d^2)/4*10^-3;
14 l=20;
15 Ws=m*l;
16 a=1.2;
17 Wa=a*(W/2+Ws)*10^-3;
18 //Let the static load be Ps
19 Ps=(W/2+Ws)*9.81*10^-3;
20 //let the effective load be Peff
21 Peff=Ps+Wb+Wa;
22 FOS1=BL/Peff;
23 FOS2=BL/(5+0.612);
24
25 // printing data in scilab o/p window
26 printf("annual FOS is %0.2f ",FOS1);
27 printf("\n FOS neglecting bending load is %0.1f
    ",FOS2);
```

---

### Scilab code Exa 24.3 RD3

```
1 // sum 24-3
2 clc;
3 clear;
4 d=12;
5 sigut=1960;
6 Pb=0.0025*sigut;
7 Ds=480;
8 F=Pb*d*Ds/2;
9 W=F*2*10^-3;
10
11 // printing data in scilab o/p window
12 printf("W is %0.3 f kN    ",W);
```

---

### Scilab code Exa 24.4 RD4

```
1 // sum 24-4
2 clc;
3 clear;
4 sigut=1770;
5 Pb=0.0018*sigut;
6 W=4000;
7 a=2.5/2;
8 Ws=90*0.5;
9 Wa=(W+Ws)*a/9.81;
10 Weff=W+Wa;
11 d=sqrt(Weff*2/(23*Pb));
12 d=12;
13
14 // printing data in scilab o/p window
15 printf("d is %0.0 f mm    ",d);
```





# Chapter 25

## GEARS

Scilab code Exa 25.1 G1

```
1 // sum 25-1
2 clc;
3 clear;
4 Zp=25;
5 Zg=60;
6 m=5;
7 dp=m*Zp;
8 dg=m*Zg;
9 CD=(dp+dg)/2;
10 ha=m;
11 hf=1.25*m;
12 c=hf-ha;
13 r=0.4*m;
14
15 // printing data in scilab o/p window
16 printf("dp is %0.0 f mm ",dp);
17 printf("\n dg is %0.0 f mm ",dg);
18 printf("\n CD is %0.1 f mm ",CD);
19 printf("\n ha is %0.0 f mm ",ha);
20 printf("\n hf is %0.2 f mm ",hf);
21 printf("\n c is %0.2 f mm ",c);
```

```
22     printf("\n r is %0.0 f mm    ",r);
```

---

### Scilab code Exa 25.2 G2

```
1 // sum 25-2
2 clc;
3 clear;
4 N=800;
5 P=6000;
6 n=200;
7 Cs=1.4;
8 sigb=150;
9 FOS=2;
10 Zp=18;
11 Zg=Zp*N/n;
12 Y=%pi*(0.154-(0.912/Zp));
13 p=[1 0 -9.5846 -38.135];
14
15 function r= myroots (p)
16
17 a= coeff (p ,0);
18 b= coeff (p ,1);
19 c= coeff (p ,2);
20 d= coeff (p, 3);
21 r(1)=( -b+ sqrt (b^2 -4*a*c ))/(2* a);
22 r(2)=( -b- sqrt (b^2 -4*a*c ))/(2* a);
23 endfunction
24 m=roots(p);
25 m=4.5;
26 dp=m*Zp;
27 dg=m*Zg;
28 // printing data in scilab o/p window
29     printf("dp is %0.0 f mm    ",dp);
30     printf("\n dg is %0.0 f mm    ",dg);
```

---

### Scilab code Exa 25.3 G3

```
1 // sum 25-3
2 clc;
3 clear;
4 Zp=30;
5 N=1000;
6 Zg=75;
7 m=5;
8 b=60;
9 sigut=450;
10 BHN=350;
11 Cs=1.5;
12 FOS=2;
13 dp=m*Zp;
14 dg=m*Zg;
15 v=2*%pi*N*dp/(60*1000*2);
16 Cv=3/(3+v);
17 sigb=450/3;
18 Y=0.358;
19 Sb=m*b*sigb*Y;
20 Q=(2*Zg)/(Zp+Zg);
21 K=0.16*(BHN/100)^2;
22 Sw=b*dp*Q*K;
23 Pt=Sb*Cv/(Cs*FOS);
24 P=Pt*v;
25 P=P*10^-3;
26
27 // printing data in scilab o/p window
28 printf("Sb is %0.0f N ",Sb);
29 printf("\n Sw is %0.0f N ",Sw);
30 printf("\n P is %0.3f kW ",P);
31
32 //The difference in the value of Sw is due to
```

rounding-off of the value of Q.

---

#### Scilab code Exa 25.4 G4

```
1 // sum 25-4
2 clc;
3 clear;
4 n=240;
5 P=8000;
6 N=1200;
7 CD=300;
8 Cs=1.5;
9 alpha=20*%pi/180;
10 G=N/n;
11 dp=CD*2/6;
12 dg=5*dp;
13 v=2*%pi*N*dp/(60*1000*2);
14 Cv=3/(3+v);
15 Pt=P/v;
16 Peff=Pt*Cs/Cv;
17 m=4;
18 b=10*m;
19 FOS=2;
20 Sb=Peff*FOS;
21 sigut=600;
22 sigb=sigut/3;
23 Zp=dp/m;
24 Zg=dg/m;
25 Q=(2*Zg)/(Zp+Zg);
26 K=Sb/(b*dp*Q);
27 BHN=sqrt(K/0.16)*100;
28 BHN=333;
29
30 // printing data in scilab o/p window
31 printf("BHN is %0.0f ",BHN);
```

---

### Scilab code Exa 25.5 G5

```
1 // sum 25-5
2 clc;
3 clear;
4 alpha=20*%pi/180;
5 N=800;
6 P=6000;
7 sigut=450;
8 i=5;
9 Cs=1.3;
10 v=3.6;
11 FOS=2;
12 Pt=P/v;
13 Cv=3/(3+v);
14 sigb=sigut/3;
15 dp=3.6*1000*2*60/(2*%pi*N);
16 dp=86;
17 Sb=Pt*Cs/Cv*FOS;
18 //Let x be m^2*Y
19 x=Sb/(10*sigb);
20 m=5;
21 Zp=18;
22 dp=m*Zp;
23 Zg=i*Zp;
24 dg=m*Zg;
25 b=10*m;
26 phip=m+(0.25*sqrt(dp));
27 ep=32+(2.5*phip);
28 phig=m+(0.25*sqrt(dg));
29 eg=32+(2.5*phig);
30 e=ep+eg;
31 e=e*10^-3;
32 Ps=Cs*Pt;
```

```

33 r1=dp/2;
34 r2=dg/2;
35 Pd=e*N*Zp*b*r1*r2/(2530*sqrt(r1^2+r2^2));
36 Q=(2*Zg)/(Zp+Zg);
37 K=Sb/(b*dp*Q);
38 BHN=sqrt(K/0.16)*100;
39
40 // printing data in scilab o/p window
41 printf("Ps is %0.2f N ",Ps);
42 printf("\n Pd is %0.1f N ",Pd);
43 printf("\n BHN is %0.0f ",BHN);

```

---

#### Scilab code Exa 25.6 G6

```

1 // sum 25-4
2 clc;
3 clear;
4 P=9000;
5 N=900;
6 n=150;
7 sigut=750;
8 BHN=300;
9 Cs=1.5;
10 FOS=2;
11 i=N/n;
12 x=sqrt(i);
13 Zp=18;
14 Zg=x*Zp;
15 Zg=44;
16 //Let actual speed reduction be xa
17 xa=Zg/Zp;
18 n1=N/xa^2;
19 T1=P*60/(2*%pi*N);
20 i2=N/xa;
21 T2=N/i2*T1;

```

```

22 m=6;
23 dp=Zp*m;
24 dg=m*Zg;
25 phip=m+(0.25*sqrt(dp));
26 ep=16+(1.25*phip);
27 phig=m+(0.25*sqrt(dg));
28 eg=16+(1.25*phig);
29 e=ep+eg;
30 e=e*10^-3;
31 Pt=26000;
32 Ps=Cs*Pt;
33 r1=dp/2;
34 r2=dg/2;
35 b=10*m;
36 Pd=e*i2*Zp*b*r1*r2/(2530*sqrt(r1^2+r2^2));
37 Q=(2*Zg)/(Zp+Zg);
38 sigb=sigut/3;
39 Y=0.308;
40
41 Sb=b*m*sigb*Y;
42 K=0.16*(BHN/100)^2;
43 Sw=b*dp*K*Q;
44
45 // printing data in scilab o/p window
46 printf("m is %0.0f mm ",m);
47 printf("\n Pd is %0.3f N ",Pd);
48 printf("\n Sw is %0.0f N ",Sw);
49
50 //The difference in the values is due to rounding-
    off of the values.

```

---



# Chapter 26

## HELICAL GEARS

Scilab code Exa 26.1 HG1

```
1 // sum 26-1
2 clc;
3 clear;
4 Zp=20;
5 Zg=50;
6 alphan=20*%pi/180;
7 phi=15*%pi/180;
8 mn=4;
9 m=mn/cos(phi);
10 alpha=180/%pi*atan(tan(alphan)/(cos(phi)));
11 dp=Zp*m;
12 dg=Zg*m;
13 ha=4;
14 hd=1.25*mn;
15 //Let addendum circle dia of pinion be Pa
16 Pa=dp+(2*mn);
17 //Let dedendum circle dia of pinion be Pd
18 Pd=dp-(2.5*mn);
19 //Let addendum circle dia of gear be Ga
20 Ga=dg+(2*mn);
21 //Let dedendum circle dia of gear be Gd
```

```

22 Gd=dg-(2.5*mn);
23 b=%pi*mn/sin(phi);
24
25 // printing data in scilab o/p window
26 printf("m is %0.2f mm ",m);
27 printf("\n alpha is %0.3f deg ",alpha);
28 printf("\n Pa is %0.1f mm ",Pa);
29 printf("\n Pd is %0.1f mm ",Pd);
30 printf("\n Ga is %0.0f mm ",Ga);
31 printf("\n Gd is %0.0f mm ",Gd);
32 printf("\n b is %0.2f mm ",b);

```

---

#### Scilab code Exa 26.2 HG2

```

1 // sum 26-2
2 clc;
3 clear;
4 P=5000;
5 Zp=25;
6 Zg=50;
7 mn=4;
8 alphan=20*%pi/180;
9 phi=20*%pi/180;
10 N=1200;
11 m=mn/cos(phi);
12 dp=Zp*m;
13 dg=Zg*m;
14 v=2*%pi*N*dp/(60*2*1000);
15 Pt=P/v;
16 Pa=Pt*tan(phi);
17 Pr=Pt*tan(alphan)/cos(phi);
18
19 // printing data in scilab o/p window
20 printf("Pt is %0.2f N ",Pt);
21 printf("\n Pa is %0.1f N ",Pa);

```

```
22     printf("\n Pr is %0.2f N  ",Pr);
```

---

### Scilab code Exa 26.3 HG3

```
1 // sum 26-3
2 clc;
3 clear;
4 Zp=24;
5 Zg=72;
6 alphan=20*%pi/180;
7 phi=24*%pi/180;
8 N=720;
9 mn=5;
10 b=50;
11 sigut=600;
12 BHN=360;
13 Cs=1.4;
14 FOS=2;
15 sigb=sigut/3;
16 dp=mn*Zp/cos(phi);
17 Zp=Zp/(cos(phi))^3;
18 Zg=Zg/(cos(phi))^3;
19 Y=0.358+((0.364-0.358)*1.48/2);
20 Sb=b*mn*sigb*Y;
21 Q=(2*Zg)/(Zp+Zg);
22 K=0.16*(BHN/100)^2;
23 Sw=b*dp*Q*K/(cos(phi)^2);
24 v=2*%pi*N*dp/(60*2*1000);
25 Cv=5.6/(5.6+sqrt(v));
26 Peff=Sb/FOS;
27 Pt=Peff*Cv/Cs;
28 P=Pt*v;
29 P=P*10^-3;
30
31 // printing data in scilab o/p window
```

```

32     printf("P is %0.3f kW    ",P);
33
34 //The difference in the value is due to rounding-off
    of the values.

```

---

#### Scilab code Exa 26.4 HG4

```

1 // sum 26-4
2 clc;
3 clear;
4 Zp=25;
5 Zg=100;
6 P=5000;
7 N=2000;
8 alphan=20*%pi/180;
9 phi=15*%pi/180;
10 sigut=660;
11 Cs=1.5;
12 FOS=1.8;
13 v=10;
14 Zp1=Zp/(cos(phi))^3;
15 Zg1=Zg/(cos(phi))^3;
16 Y=0.348+(0.74*0.004);
17 sigb=sigut/3;
18 Cv=5.6/(5.6+sqrt(v));
19 //Sb=FOS*Peff
20 mn=FOS*P*Cs*60*1000*2*cos(phi)/(2*%pi*N*Cv*Zp*12*
    sigb*Y);
21 mn=mn^(1/3);
22 mn=2.5;
23 dp=mn*Zp/cos(phi);
24 Q=(2*Zg)/(Zp+Zg);
25 b=12*mn;
26 Sb=12*sigb*Y;
27 K=Sb*(cos(phi)^2)/(dp*Q*b);

```

```

28 BHN=sqrt(K/0.16)*100;
29 dg=mn*Zg/cos(phi);
30 phip=mn+(0.25*sqrt(dp));
31 ep=16+(1.25*phip);
32 phig=mn+(0.25*sqrt(dg));
33 eg=16+(1.25*phig);
34 e=ep+eg;
35 e=e*10^-3;
36 r1=dp/2;
37 r2=dg/2;
38 Pd=e*N*Zp1*b*r1*r2/(2530*sqrt(r1^2+r2^2));
39 v=2*pi*N*dp/(60*2*1000);
40 //Let tangential component be TC
41 TC=(Cs*1845/mn)+(Pd*cos(alphan)*cos(phi));
42
43 Sb=b*mn*sigb*Y;
44
45 // printing data in scilab o/p window
46 printf("mn is %0.1 f mm ",mn);
47 printf("\n TC is %0.0 f N ",TC);
48 printf("\n Sb is %0.1 f N ",Sb);
49
50 //The difference in the value of Sb is due to
    rounding-off of t

```

---

# Chapter 27

## STRAIGHT BEVEL GEARS

Scilab code Exa 27.1 SBG1

```
1 // sum 27-1
2 clc;
3 clear;
4 P=8000;
5 N1=400;
6 N2=200;
7 i=N1/N2; // i=Zg/Zp=dg/dp
8 gamma1=atan(1/i);
9 gamma2=90-gamma1;
10 rp=200;
11 R=rp/sin(gamma1);
12 b=0.2*R;
13 rm1=rp-(b*sin(gamma1)/2);
14 Pt=P*1000*60/(2*pi*N1*rm1);
15 alpha=20*pi/180;
16 Ps=Pt*tan(alpha);
17 Pr=Ps*cos(gamma1);
18 Pa=Ps*sin(gamma1);
19
20 // printing data in scilab o/p window
21 printf("Pt is %0.0f N ",Pt);
```

```

22     printf("\n Ps is %0.2 f N  ",Ps);
23     printf("\n Pr is %0.2 f N  ",Pr);
24     printf("\n Pa  is %0.2 f N  ",Pa);
25
26 //The difference in the values is due to rounding-
    off of the values.

```

---

### Scilab code Exa 27.2 SBG2

```

1 // sum 27-2
2 clc;
3 clear;
4 alpha=20*%pi/180;
5 Zp=20;
6 Zg=36;
7 m=4;
8 sigut=600;
9 b=25;
10 dp=m*Zp;
11 rp=dp/2;
12 dg=m*Zg;
13 rg=dg/2;
14 gamma1=atan(rp/rg);
15 Zpv=Zp/cos(gamma1);
16 Y=0.33+0.003*0.88;
17 sigb=sigut/3;
18 Sb=m*b*sigb*Y;
19
20 // printing data in scilab o/p window
21 printf("Zpv is %0.2 f  ",Zpv);
22 printf("\n Sb is %0.0 f N  ",Sb);

```

---

### Scilab code Exa 27.3 SBG3

```

1 // sum 27-3
2 clc;
3 clear;
4 m=6;
5 Zp=30;
6 Zg=45;
7 dp=m*Zp;
8 rp=dp/2;
9 dg=m*Zg;
10 rg=dg/2;
11 R=sqrt(rg^2+rp^2);
12 gamma1=180/%pi*asin(rp/R);
13 gamma2=(90-gamma1);
14 ha=6;
15 hf=1.25*ha;
16 phi=180/%pi*atan(ha/R);
17 beta=180/%pi*atan(hf/R);
18 //let Face Cone Angle be FCA
19 FCA=(gamma1+phi);
20 //Let Root cone angle be RCA
21 RCA=(gamma1-beta);
22
23 // printing data in scilab o/p window
24 printf(" gamma1 is %0.1f deg ",gamma1);
25 printf("\n gamma2 is %0.1f deg ",gamma2);
26 printf("\n R is %0.2f mm ",R);
27 printf("\n FCA is %0.3f deg ",FCA);
28 printf("\n RCA is %0.2f deg ",RCA);

```

---

#### Scilab code Exa 27.4 SBG4

```

1 // sum 27-4
2 clc;
3 clear;
4 alpha=20*%pi/180;

```



```

5 Zp=25;
6 Zg=40;
7 m=5;
8 b=30;
9 BHN=400;
10 dp=m*Zp;
11 rp=dp/2;
12 dg=m*Zg;
13 rg=dg/2;
14 gamma1=atan(rp/rg);
15 gamma1=180/%pi*gamma1;
16 gamma2=(90-gamma1);
17 a=cosd(gamma2);
18 Zp1=Zp/cos(gamma1);
19 Zg1=Zg/a;
20 Q=(2*Zg1)/(Zp1+Zg1);
21 K=0.16*(BHN/100)^2;
22 Sw=0.75*b*dp*Q*K/cosd(gamma1);
23
24 // printing data in scilab o/p window
25 printf("Sw is %0.1f N ",Sw);
26
27 //The difference in the value of Sw is due to
    rounding-off of the value of Q.

```

---

#### Scilab code Exa 27.5 SBG5

```

1 // sum 27-5
2 clc;
3 clear;
4 Zp=20;
5 Zg=36;
6 m=4;
7 b=25;
8 BHN=360;

```

```

9 Np=750;
10 FOS=1.75;
11 dp=m*Zp;
12 rp=dp/2;
13 dg=m*Zg;
14 rg=dg/2;
15 gamma1=atan(dp/dg);
16 gamma1=180/%pi*gamma1;
17 gamma2=(90-gamma1);
18 a=cosd(gamma2);
19 Zp1=Zp/cosd(gamma1);
20 Zg1=Zg/a;
21 Q=(2*Zg1)/(Zp1+Zg1);
22 K=0.16*(BHN/100)^2;
23 R=sqrt(rp^2+rg^2);
24 Y=0.33+0.003*0.86;
25 sigut=600;
26 sigb=sigut/3;
27 Sb=m*b*Y*sigb*(1-(b/R));
28 Sw=0.75*b*dp*Q*K/cosd(gamma1);
29
30 // printing data in scilab o/p window
31 printf("Sb is %0.0f N ",Sb);
32 printf("\n Sw is %0.1f N ",Sw);
33
34 //The answer to Sb is calculated incorrectly in the
    book.

```

---

### Scilab code Exa 27.6 SBG6

```

1 // sum 27-6
2 clc;
3 clear;
4 Dp=300;
5 rp=150;

```

```

6 //Let the angular velocity ratio be i
7 i=2/3;
8 rg=rp/i;
9 Dg=2*rg;
10 R=sqrt(rp^2+rg^2);
11 P=15000;
12 N=300;
13 Cs=1.5;
14 FOS=2;
15 sigb=100;
16 gamma1=atan(Dp/Dg);
17 gamma1=180/%pi*gamma1;
18 gamma2=(90-gamma1);
19 v=2*%pi*N*rp/(60*1000);
20 Cv=5.6/(5.6+sqrt(v));
21 Pt=P/v;
22 Peff=Pt*Cs/Cv;
23 Sb=Peff*FOS;
24 b=R/4;
25 //let x=m*Y
26 x=Sb/(b*sigb*(1-(b/R)));
27 m=6;
28
29 // printing data in scilab o/p window
30 printf("m*Y is %0.3 f mm^2 ",x);
31 printf("\n m is %0.0 f mm ",m);

```

---

### Scilab code Exa 27.7 SBG7

```

1 // sum 27-7
2 clc;
3 clear;
4 Zp=24;
5 Zg=36;
6 N=1400;

```

```

7 P=11600;
8 Cs=1.4;
9 FOS=2;
10 sigut=600;
11 sigb=sigut/3;
12 gamma1=atan(Zp/Zg);
13 gamma1=180/%pi*gamma1;
14 gamma2=(90-gamma1);
15 a=cosd(gamma2);
16 Zp1=Zp/cosd(gamma1);
17 Zg1=Zg/a;
18 Q=(2*Zg1)/(Zp1+Zg1);
19 v=1.76;
20 Pt=P/v;
21 Cv=5.6/(5.6+sqrt(v));
22 Peff=Pt*Cs/Cv;
23 x=Peff*FOS;
24 Y=0.352+(0.003*0.85);
25 y=2*sigb*Y*(1-(6/21.63));
26 m=sqrt(x/y);
27 // Design is safe for m=4
28 m=4;
29 b=6*m;
30 dp=24*m;
31 rp=48;
32 dp=dp/cosd(gamma1);
33 v=2*%pi*N*rp/(60*1000);
34 Cv=5.6/(5.6+sqrt(v));
35 Sb=y*m^2;
36 //Sw=Sb;
37 K=Sb/(0.75*b*dp*Q);
38 BHN=sqrt(K/0.16)*100;
39
40 // printing data in scilab o/p window
41 printf("m is %0.0f mm ",m);
42 printf("\n BHN is %0.0f ",BHN);
43
44 //The answer to BHN is calculated incorrectly in

```

the book.

---

### Scilab code Exa 27.8 SBG8

```
1 // sum 27-8
2 clc;
3 clear;
4 Zp=40;
5 Zg=60;
6 P=3500;
7 N=600;
8 Cs=1.5;
9 sigb=55;
10 gamma1=atan(Zp/Zg);
11 gamma1=180/%pi*gamma1;
12 gamma2=(90-gamma1);
13 a=cosd(gamma2);
14 Zp1=Zp/cosd(gamma1);
15 Zg1=Zg/a;
16 Q=(2*Zg1)/(Zp1+Zg1);
17 // Design is safe for m=6
18 m=6;
19 b=6*m;
20 dp=Zp*m;
21 rp=dp/2;
22 dg=Zg*m;
23 rg=dg/2;
24 R=sqrt(rp^2+rg^2);
25
26 // printing data in scilab o/p window
27 printf("m is %0.0f mm ",m);
28 printf("\n b is %0.0f mm ",b);
29 printf("\n R is %0.0f mm ",R);
```

---

# Chapter 28

## WORM AND WORM WHEEL SET

Scilab code Exa 28.1 WWS1

```
1 // sum 28-1
2 clc;
3 clear;
4 Z1=1;
5 Z2=30;
6 q=10;
7 m=5;
8 d=q*m;
9 D=m*Z2;
10 //let the speed reduction ratio be G
11 G=Z2/Z1;
12 CD=(d+D)/2;
13
14 // printing data in scilab o/p window
15 printf("G is %0.0f ",G);
16 printf("\n CD is %0.0f mm ",CD);
17 printf("\n d is %0.0f mm ",d);
18 printf("\n D is %0.0f mm ",D);
```

---

### Scilab code Exa 28.2 WWS2

```
1 // sum 28-2
2 clc;
3 clear;
4 Z1=1;
5 Z2=52;
6 q=10;
7 m=8;
8 i=Z2/Z1;
9 CD=((m*q)+(m*Z2))/2;
10 lambda=atan(Z1/q);
11 d=q*m;
12 da=m*(q+2);
13 df=m*(q+2-(4.4*cos(lambda)));
14 pa=m*pi;
15 D=m*Z2;
16 Da=m*(Z2+(4*cos(lambda))-2);
17 Df=m*(Z2-2-(0.4*cos(lambda)));
18
19 // printing data in scilab o/p window
20 printf(" i is %0.0 f ",i);
21 printf("\n CD is %0.0 f mm ",CD);
22 printf("\n pa is %0.2 f mm ",pa);
23 printf("\n da is %0.0 f mm ",da);
24 printf("\n df is %0.3 f mm ",df);
25 printf("\n Da is %0.3 f mm ",Da);
26 printf("\n Df is %0.3 f mm ",Df);
```

---

### Scilab code Exa 28.3 WWS3

```
1 // sum 28-3
```

```

2  clc;
3  clear;
4  Z1=2;
5  Z2=60;
6  q=10;
7  m=5;
8  P=6000;
9  N=1440;
10 u=0.08;
11 alpha=20*%pi/180;
12 lambda=atan(Z1/q);
13 d=m*q;
14 w=2*%pi*N/60;
15 T=P/w;
16 Ptw=T*10^3/(d/2);
17 a=cos(alpha);
18 b=cos(lambda);
19 x=sin(alpha);
20 y=sin(lambda);
21 Paw=Ptw*(((a*b)-(u*y))/((a*y)+(u*b)));
22 Prw=Ptw*y/((a*y)+(u*b));
23 //Paw=Ptw*((cos(alpha)*cos(lambda))-(u*sin(lambda)))
    //((cos(alpha)*sin(lambda))+(u*cos(lambda)));
24 //Prw=Ptw*((sin(alpha))/((cos(alpha)*sin(lambda))+(u
    *cos(lambda))));
25
26 // printing data in scilab o/p window
27 printf("Ptw=Pag is %0.1 f N ",Ptw);
28 printf(" \n Paw=Ptg is %0.0 f N ",Paw);
29 printf(" \n Prw=Prg is %0.0 f N ",Prw);
30
31 //The difference in the value is due to rounding-off
    the values.

```

---

Scilab code Exa 28.4 WWS4



```

1 // sum 28-4
2 clc;
3 clear;
4 Z1=2;
5 Z2=40;
6 q=8;
7 m=5;
8 d=q*m;
9 P=1.2;
10 lambda=atan(Z1/q);
11 N=1000;
12 Vt=2*%pi*N*20/(60*1000);
13 Vs=Vt/cos(lambda);
14 u=0.032;
15 alpha=20*%pi/180;
16 x=cos(alpha);
17 y=tan(lambda);
18 z=(cos(lambda))/sin(lambda);
19 n=(x-(u*y))/(x+(u*z));
20 //Let power output be Po
21 Po=P*n;
22 //Let power lost in friction be Pf
23 Pf=P-Po;
24
25 // printing data in scilab o/p window
26 printf("P is %0.1f kW ",P);
27 printf("\n Po is %0.3f kW ",Po);
28 printf("\n Pf is %0.3f kW ",Pf);

```

---

#### Scilab code Exa 28.5 WWS5

```

1 // sum 28-5
2 clc;
3 clear;
4 Z1=2;

```

```

5 Z2=54;
6 q=10;
7 m=8;
8 P=4000;
9 A=1.8;
10 K=16;
11 N=1000;
12 u=0.028;
13 lambda=atan(Z1/q);
14 alpha=20*%pi/180;
15 d=m*q;
16 Vt=2*%pi*N*d/(2*60*1000);
17 Vs=Vt/cos(lambda);
18 x=cos(alpha);
19 y=tan(lambda);
20 z=(cos(lambda))/sin(lambda);
21 n=(x-(u*y))/(x+(u*z));
22 delT=P*(1-n)/(K*A);
23
24 // printing data in scilab o/p window
25 printf("n is %0.3f ",n);
26 printf("\n delT is %0.2f deg ",delT);

```

---

### Scilab code Exa 28.6 WWS6

```

1 //sum 28-6
2 clc;
3 clear;
4 Z1=1;
5 Z2=30;
6 q=10;
7 m=6;
8 //Let the ultimate strength of gear is sigut
9 //Let the allowable strength of wheel is sigb
10 sigut=450;

```

```
11 sigb=84;
12 N=1200;
13 n=N/Z2;
14 alpha=20*%pi/180;
15 d=m*q;
16 D=Z2*m;
17 b=3*d/4;
18 V=2*%pi*n*D/(2*60*1000);
19 Cv=6/(6+V);
20 y=0.154-(0.912/Z2);
21 Y=%pi*y;
22 Sb=sigb*b*Cv*m*Y;
23 K=0.415;
24 Sw=b*D*K;
25
26 // printing data in scilab o/p window
27 printf("Sb is %0.0f N ",Sb);
28 printf("\n Sw is %0.0f N ",Sw);
29
30 //The difference in the value of Sb is due to
   rounding-off the values.
```

---

# Chapter 29

## GEARBOX

Scilab code Exa 29.1 GB1

```
1 // sum 29-1
2 clc;
3 clear;
4 Ts1=16;
5 Ts2=18;
6 Ts3=20;
7 Ts4=25;
8 Tr1=64;
9 Tr2=63;
10 Tr3=70;
11 Tr4=50;
12 //Let Nr1/Nr2=G1
13 G1=1+(Ts1/Tr1);
14 //Let Nr1/Ni=G2
15 G2=(Ts2/(Tr2*(1-(1/G1)+(Ts2/Tr2)))));
16 //Let Ni/No=G3 (third gear)
17 G3=(1+(Ts3/Tr3))/((Ts3/Tr3)+G2);
18
19 //Let Ni/Nr1=G4
20 //The ratio calculations are done as above
21 G4=1.2857/0.2857;
```

```

22 //Let Ni/No =G5(second gear)
23 G5=-20/70;
24 //Let Ni/No=G6(first gear)
25 G6=1.2857/0.2857;
26 //Let Ni/No=G7(reverse gear)
27 G7=-1.7143/0.2857;
28
29 // printing data in scilab o/p window
30 printf("ratio for third gear is %0.3f ",G3);
31 printf("\n ratio for second gear is %0.4f ",G5);
32 printf("\n ratio for first gear is %0.1f ",G6);
33 printf("\n ratio for reverse gear is %0.3f ",G7)
    ;

```

---

#### Scilab code Exa 29.2 GB2

```

1 // sum 29-2
2 clc;
3 clear;
4 //Let reverse speed gear be RSG
5 RSG=5.5;
6 //Let T5/T6 = Z1
7 T1=2;
8 //Let T3/T7 = Z2
9 Z2=2.75;
10 T7=18;
11 T3=Z2*T7;
12 T3=50;
13 //Let T3/T1 =Z3
14 Z3=2.5;
15 T1=T3/Z3;
16 //Let T4/T2 = Z4
17 Z4=2.25/2;
18 T2=(T1+T3)/(Z4+1);
19 T4=T1+T3-T2;

```

```

20 //Let T5/T6=Z5
21 Z5=2;
22 T6=(T1+T3)/3;
23 T5=(T1+T3)-T6;
24 T7=18;
25 //let first gear ratio is G1
26 G1=50*47/(20*23);
27
28 //Let 2nd gear ratio is G2
29 G2=37*47/(33*23);
30 //Let 3rd gear ratio is G3
31 G3=1;
32 //Let reverse gear ratio is R
33 R=50*47/(18*23);
34
35 // printing data in scilab o/p window
36 printf("T1 is %0.0 f      ",T1);
37 printf("\n T2 is %0.0 f      ",T2);
38 printf("\n T3 is %0.0 f      ",T3);
39 printf("\n T4 is %0.0 f      ",T4);
40 printf("\n T5 is %0.0 f      ",T5);
41 printf("\n T6 is %0.0 f      ",T6);
42 printf("\n T7 is %0.0 f      ",T7);
43 printf("\n G1 is %0.3 f      ",G1);
44 printf("\n G2 is %0.3 f      ",G2);
45 printf("\n G3 is %0.1 f      ",G3);
46 printf("\n R is %0.3 f      ",R);

```

---

### Scilab code Exa 29.3 GB3

```

1 // sum 29-3
2 clc;
3 clear;
4 //Let the constant gear ratio be G
5 G=2;

```

```

6  x=5.5^(1/3);
7  G1=1;
8  G2=x;
9  G3=x*x;
10 G4=x^3;
11 T7=18;
12 T8=T7*(x^3)/2;
13 T8=51;
14 T5=69/2.558;
15 T6=69-27;
16 T4=69/1.8825;
17 T3=69-T4;
18 T1=23;
19 T2=46;
20 T9=18;
21 G1=T2*T8/(T1*T7);
22 G2=T2*T6/(T1*T5);
23 G3=1;
24 G4=-T2*T8/(T1*T9);
25
26 // printing data in scilab o/p window
27 printf("T1 is %0.0 f      ",T1);
28 printf("\n T2 is %0.0 f      ",T2);
29 printf("\n T3 is %0.0 f      ",T3);
30 printf("\n T4 is %0.0 f      ",T4);
31 printf("\n T5 is %0.0 f      ",T5);
32 printf("\n T6 is %0.0 f      ",T6);
33 printf("\n T7 is %0.0 f      ",T7);
34 printf("\n T8 is %0.0 f      ",T8);
35 printf("\n T9 is %0.0 f      ",T9);
36 printf("\n G1 is %0.3 f      ",G1);
37 printf("\n G2 is %0.3 f      ",G2);
38 printf("\n G3 is %0.3 f      ",G3);
39 printf("\n G4 is %0.3 f      ",G4);

```

---

# Chapter 30

## CHAIN DRIVE

Scilab code Exa 30.1 CD1

```
1 // sum 30-1
2 clc;
3 clear;
4 n1=17;
5 n2=51;
6 C=300;
7 p=9.52;
8 Ln=(2*C/p)+((n1+n2)/2)+((((n2-n1)/(2*pi))^2)*(p/C))
   ;
9 x=(Ln-((n2+n1)/2))^2;
10 y=8*(((n2-n1)/(2*pi))^2);
11 z=Ln-((n1+n2)/2);
12 C=(p/4)*(z+(sqrt(x-y)))
13
14
15 // printing data in scilab o/p window
16 printf("C is %0.2f mm ",C);
```

---

Scilab code Exa 30.2 CD2



```

1 // sum 30-2
2 clc;
3 clear;
4 G=4;
5 n1=17;
6 n2=n1*G;
7 N1=2300;
8 Kc=1.2; //from table 30-2
9 p=12.7; //fom table 30-1
10 D1=p*n1;
11 D2=p*n2;
12 phi=2*10.6;
13 x=tan(phi/2); //phi/2 = 10.6deg, from table 30-3
14 Da1=(p/x)+(0.6*p);
15 Da2=(p/x*4)+(0.6*p);
16 Cmin=Kc*((Da1+Da2)/2);
17 Ln1=(2*Cmin/p)+((n1+n2)/2)+((((n2-n1)/(2*%pi))^2)*(p
    /Cmin));
18 Ln1=80;
19 // printing data in scilab o/p window
20 printf("Ln is %0.0f ",Ln1);

```

---

### Scilab code Exa 30.3 CD3

```

1 // sum 30-3
2 clc;
3 clear;
4 N1=1000;
5 N2=500;
6 P=2.03*10^3; //from table 30-8
7 K1=1.26;
8 Ks=1;
9 //let Pc be the power transmitting capacity of the
    chain
10 Pc=P*K1/Ks;

```

```

11 p=9.52;
12 n1=21;
13 n2=42;
14 V=n1*p*N1/(60*10^3);
15 //Let the chain tension be T
16 T=Pc/V;
17 //Let the breaking load be BL
18 BL=10700;
19 FOS=BL/T;
20 C=50*p;
21 Ln=(2*C/p)+((n1+n2)/2)+((((n2-n1)/(2*pi))^2)*(p/C))
    ;
22 L=Ln*p;
23 Pc=Pc*10^-3;
24
25 // printing data in scilab o/p window
26 printf("Pc is %0.2f KW ",Pc);
27 printf("\n V is %0.3f m/s ",V);
28 printf("\n T is %0.1f N ",T);
29 printf("\n FOS is %0.2f ",FOS);
30 printf("\n L is %0.2f mm ",L);
31
32 //The difference in the value of L and T is due to
    rounding-off the values.

```

---

#### Scilab code Exa 30.4 CD4

```

1 // sum 30-5
2 clc;
3 clear;
4 G=2;
5 P=5000;
6 Ks=1.7;
7 Pd=P*Ks;
8 K2=1.7;

```

```

9  p=15.88;
10 n1=17;
11 n2=n1*G;
12 D1=n1*p;
13 D2=n2*p;
14 C=40*p;
15 Ln=(2*C/p)+((n1+n2)/2)+((((n2-n1)/(2*pi))^2)*(p/C))
    ;
16 L=Ln*p;
17
18 // printing data in scilab o/p window
19 printf("L is %0.2f mm ",L);
20 //The difference in the value of L is due to
    rounding-off the values.

```

---

# Chapter 31

## SEALS PACKING AND GASKETS

Scilab code Exa 31.1 SPG1

```
1 // sum 31-1
2 clc;
3 clear;
4 d=18;
5 lg=25+25;
6 Eb=210*10^3;
7 Ecl=90*10^3;
8 A=%pi*d^2/4;
9 kb=A*Eb/lg;
10 x=(5*(lg+(0.5*d))/(lg+(2.5*d)));
11 km=%pi*Ecl*d/(2*log(x));
12 C=kb/(kb+km);
13 sigp=600;
14 At=192;
15 Pi=0.75*sigp*At;
16 F=200;
17 C=0.322;
18 Pb=F*C*10^3;
19 FOS=2;
```

```

20 W=At*sigp;
21 N=Pb*FOS/(W-Pi);
22
23 // printing data in scilab o/p window
24 printf("N is %0.2f      ",N);

```

---

### Scilab code Exa 31.2 SPG2

```

1 // sum 31-2
2 clc;
3 clear;
4 d=16;
5 D=1.5*d;
6 t=20;
7 tg=4;
8 //Let Gasket diameter in compression zone be d1
9 d1=D+(2*t)+tg;
10 lg=40;
11 E=207*10^3;
12 kb=%pi*d^2*E/(lg*4);
13 Ec1=90*10^3;
14 x=(5*(lg+(0.5*d))/(lg+(2.5*d)));
15 kp=%pi*Ec1*d/(2*log(x));
16 Ag=%pi*(d1^2-d^2)/4;
17 Eg=480;
18 kg=Ag*Eg/tg;
19 km=kg*kp/(kg+kp);
20 C=kb/(kb+km);
21 At=157;
22 sigp=600;
23 Pi=0.75*At*sigp/2;
24 FOS=2;
25 Pf=At*sigp/FOS;
26 W=Pf-Pi;
27 P=W/C;

```

```

28 N=5;
29 F=P*N;
30 p=F*4/(%pi*120^2);
31
32 // printing data in scilab o/p window
33 printf("p is %0.3f N/mm^2      ",p);

```

---

### Scilab code Exa 31.3 SPG3

```

1 // sum 31-3
2 clc;
3 clear;
4 sigp=600;
5 FOS=3;
6 siga=sigp/FOS;
7 d=16;
8 D=1.5*d+60;
9 //Let Gasket diameter in compression zone be d1
10 d1=(300-160)/2;
11 //Let compressive stress in gasket for leak proof
    joint be sigl
12 sigl=12;
13 At=[1 157; 2 192; 3 245]
14 d=[1 16; 2 18; 3 20]
15
16 n=3;
17 for (i=1:n)
18     Pi(i,2)=At(i,2)*d(i,2)
19     Pc(i,2)=3*%pi*(d1^2-d(i,2)^2)
20     if (Pi(i,2)>=Pc(i,2)) then
21         printf("The Design is safe")
22     end
23 end
24
25

```

```
26
27 // printing data in scilab o/p window
28 printf("d is %0.0f mm      ",d(i,2));
```

---