c Cantilever type rotor with disk at the end span
c finite region
dimension her(2),hei(2)
open(203,file='w3w0.dat')
open(96,file='a.dat')
open(97,file='c.dat')
pi=3.14
write(*,*)'GIVE RADIUS AND LENGTH OF THE SHAFT in cm'
read(*,*)r1,bl
write(*,*)'GIVE RADIUS AND LENGTH OF THE DISC in cm 4,4'
read(*,*)rr1,bbl
den=7.83
ee=2.1e+12
area=pi*r1*r1
ei=ee*pi*(r1**4)/4
ams2=bl*den*area
c r1=0.4
c bl=60
c write(*,*)'GIVE MASS OF DISC 1570'
c read(*,*)ams1
ams1=pi*rr1*rr1*bbl*den
c ams1=1570.0
c ams2=192.0
c pi=3.14
c ei=4.14e+08
akxx=3.0 * ei/(bl**3)
akyy=akxx
w1=3.52*(sqrt(ei/(ams2*(bl**3))))
write(*,*)'GIVE THE DENSITY RATIO OF LIQUID TO METAL i.e. am1m/am1ms'
read(*,*)rolm
write(*,*)'GIVE THE GAP RATIO (R2-R1)/R1'
read(*,*)gb
write(*,*)'GIVE CO-EFFICIENT OF VISCOSITY '
read(*,*)un
aeq1 = akxx / (w1 * w1 * ams2)

aeq2 = akyy / (w1 * w1 * ams2)

am1ms = ams1 + aeq1 * ams2

am2ms = ams1 + aeq2 * ams2

am1 = ams1 * rolm

am2 = ams2 * rolm

am1m = am1 + aeq1 * am2

am2m = am1 + aeq2 * am2

am1ms = am1m / am1ms

am2ms = am2m / am2ms

c
est = ecc / r1

est = 1.0

w1w0 = sqrt(akxx / am1ms)

w2w0 = sqrt(akyy / am2ms)

write(203, *) w1w0

ggb = ((r1 + gb * r1) - rr1) / rr1

c
w1w0 = sqrt(akxx / am1ms)

w2w0 = sqrt(akyy / am2ms)

c
write(203, *) w1w0

wjh = 0.9

do 40 kk = 1, 30

write(‘*, *) kk

vj = 0.01

if (wjh .ge. (0.98)) then

vj = 0.001

endif

if (wjh .ge. (1.004)) then

vj = 0.01

endif

w = w1w0 * (wjh)

wjh = wjh + vj

c
w = w1w0 * (0.98 + kk * (0.0004))

unu = un / (r1 * r1 * w)

c
unu = un * w1w0 / w

c
write(‘*, *) unu, w1w0, ams1, ams1, ams2, aeq1

c
do 40 kk = 1, 70

c
write(‘*, *) kk

c
w = w1w0 * (0.9 + kk * (0.002))

c
unu = un / (r1 * r1 * w)
unu1 = sqrt(1/unu)
unu = un/(rr1*rr1*w)
uunu1 = sqrt(1/uunu)
call ho(rr1, uunu1, gb, her1, hei1)
call ho(r1, unu1, gb, her2, hei2)
her(1) = (am1*her1 + aeq1*am2*her2)/am1
her(2) = (am1*her1 + aeq2*am2*her2)/am2
hei(1) = (am1*hei1 + aeq1*am2*hei2)/am1
hei(2) = (am1*hei1 + aeq2*am2*hei2)/am2
w1wst = w/w1w0
w2wst = w/w2w0
c1 = (-1.0)*am1*mst*w1wst*hei(1)/(1+am1*mst*her(1))
bk1 = 1/(1+am1*mst*her(1))
a1 = est*(w1wst**2)/(1+am1*mst*her(1))
c2 = (-1.0)*am2*mst*w2wst*hei(2)/(1+am2*mst*her(2))
bk2 = 1/(1+am2*mst*her(2))
a2 = est*(w2wst**2)/(1+am2*mst*her(2))
sa1 = atan(c1*w1wst/(bk1-w1wst**2))
sa2 = atan(c2*w2wst/(bk2-w2wst**2))
getax = a1/(sqrt((bk1-w1wst)**2 + (c1*w1wst)**2))
getay = a2/(sqrt((bk2-w2wst)**2 + (c2*w2wst)**2))
tao = ((0.0+sa1)/w1wst)*(w2w0/w1w0)
gny = getay*sin(w2wst*tao-sa2)
def = sqrt(getax**2+gny**2)
write(96,*)w1wst, getax, w2wst, getay
write(97,*)w1wst, def, w2wst
stop
end
subroutine ho(r1, x, gb, far, fai)
write(*,*)'GIVE THE VALUE OF nue star'
read(*,*)unu
x = sqrt(1/unu)
write(*,*)'1'
xa = x
write(*,*)'GIVE THE VALUE OF R1 AND (R2-R1)/R1'
read(*,*)r1, gb
r2 = gb*r1+r1
xb = x*(r2/r1)
ga = r1/r2
gb = (r2-r1)/r1
call bes(xb, br0, bi0, br1, bi1, 1, qr0, qi0, qr1, qi1)
brb0 = br0
bib0 = bi0
brb1 = br1
\begin{verbatim}
  bib1=bi1
  qrb0=qr0
  qib0=qi0
  qrb1=qr1
  qib1=qi1

c
  call bes(xa,br0,bi0,br1,bi1,
  1 qr0,qi0,qr1,qi1)
  bra0=br0
  bia0=bi0
  bra1=br1
  bia1=bi1
  qra0=qr0
  qia0=qi0
  qra1=qr1
  qia1=qi1

c
  a11r=brb0*qra1-bib0*qia1+bra1*qrb0-bia1*qib0
  a11i=brb0*qia1+qra1*bib0+bra1*qib0+qrb0*bia1
  a22r=brb0*qrb1-bib0*qib1+brb1*qrb0-bib0*qib0
  a22i=brb0*qib1+qrb1*bib0+brb1*qib0+qrb0*bib1
  a33r=bra1*qrb1-bia1*qib1+brb1*qra1+bib1*qia1
  a33i=bra1*qib1+qrb1*bib1+brb1*qia1+qib1*qra1

  a11r=-xa/1.41
  a11i=-xa/1.41
  a22r=xa*r1/(1.41*r2)
  a22i=xa*r1/(1.41*r2)
  a33r=-2.0*(r1/r2)
  a33i=0.0

  a1r=a11r*a1i-a11i*a1r
  a1i=a11i*a1r+a11r*a1i
  a2r=a22r*a2i+a22i*a2r
  a2i=a22i*a2r+a22r*a2i
  a3r=a33r*a3i+a33i*a3r
  a3i=a33i*a3r+a33r*a3i

  ar=a1r+a2r+a3r
  ai=a1i+a2i+a3i

  d11r=(bra0*qrb1-bia0*qib1)+(-1.0)*(brb0*qrb0-bib1*qib0)+
  1 (brb0*qra0-bib1*qia0)+(-1.0)*(brb0*qrb1-bib0*qib1)
  d11i=(bra0*qib1+qrb1*bia0)+(-1.0)*(brb0*qib0+qrb0*bib1)+
  1 (brb0*qia0+qra0*bib1)+(-1.0)*(brb0*qib1+qrb1*bib0)

\end{verbatim}
d22r = (br0*qra1 - bib0*qia1) + (-1.0)*(bra1*qra0 - bia1*qia0) +
1 (bra1*qrb0 - bia1*qib0) + (-1.0)*(bra0*qra1 - bia0*qia1) +
1 (bra0*qrb0 - bia0*qib0) + (-1.0)*(bra1*qrb0 - bia1*qib0)

d22i = (br0*qia1 + qra1*bib0) + (-1.0)*(bra1*qia0 + qia0*bib0) +
1 (bra1*qib0 + qrb0*bia1) + (-1.0)*(bra0*qia1 + qia1*bib0)

d33r = (bra0*qrb0 - bia0*qib0) + (-1.0)*(br0*qra0 - bia0*qia0) +
1 (bra0*qib0 + qrb0*bia0) + (-1.0)*(bra0*qia0 + qia0*bib0)

\[
\begin{align*}
\text{d111}_r &= 2*xa*r1/(r2*1.41) \\
\text{d111}_i &= 2*xa*r1/(r2*1.41) \\
\text{d222}_r &= 2*r1*r1*xa/(r2*r2*1.41) \\
\text{d222}_i &= 2*r1*r1*xa/(r2*r2*1.41) \\
\text{d333}_r &= 0.0 \\
\text{d333}_i &= xa*xa*(1-((r1*r1)/(r2*r2))) \\
\end{align*}
\]

\[
\begin{align*}
\text{dr} &= \text{d1r} + \text{d2r} + \text{d3r} \\
\text{di} &= \text{d1i} + \text{d2i} + \text{d3i} \\
\text{far} &= 2*(ar*dr + ai*di)/(dr*dr + di*di) \\
\text{fai} &= 2*(ai*dr - ar*di)/(dr*dr + di*di) \\
\end{align*}
\]

\[
\begin{align*}
\text{c write(*,*)gb, far, fai} \\
\text{c write(*,*}, ar=, 'ai=, 'dr=, 'di=, 'dr, 'di, dr, 'di=, 'di} \\
\text{c write(*,*)'2'} \\
\text{return} \\
\text{end} \\
\text{subroutine bes(x, br0, bi0, br1, bi1,} \\
\text{qr0, qr1, q11) \\
\text{Dimension fw0(32), fw1(32), gw0(32), gw1(32) \\
\text{Dimension fwp0(32), fwm0(32), fwp1(32), fwm1(32) \\
\text{Dimension gwp0(32), gwm0(32), gwp1(32), gwm1(32) \\
\text{fvpx0=0.0}} \\
\text{fvmx0=0.0}} \\
\text{fvpx1=0.0}} \\
\text{fvmx1=0.0}} \\
\text{gvpx0=0.0}} \\
\text{gvmx0=0.0}} \\
\text{gvpx1=0.0}} \\
\text{gvmx1=0.0}} \\
\text{c write(*,*}, '3'} \\
\text{ee=2.718} \\
\text{pi=3.14}
\]
c read(*,*)x
  do 10 k = 1,20
  fw0(k)=1.0
  fw1(k)=1.0
  gw0(k)=1.0
  gw1(k)=1.0
  do 20 i = 1,k
  fw0(k)=fw0(k)*(0-((2*i-1)**2))/i
  fw1(k)=fw1(k)*(4-((2*i-1)**2))/i
  gw0(k)=gw0(k)*(0-((2*i-1)**2))/i
  gw1(k)=gw1(k)*(4-((2*i-1)**2))/i
 20 continue
  fwp0(k)=fw0(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
  fwm0(k)=fw0(k)*(cos(k*pi/4))/((8*x)**k)
  fwp1(k)=fw1(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
  fwm1(k)=fw1(k)*(cos(k*pi/4))/((8*x)**k)
  gwp0(k)=gw0(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
  gwm0(k)=gw0(k)*(sin(k*pi/4))/((8*x)**k)
  gwp1(k)=gw1(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
  gwm1(k)=gw1(k)*(sin(k*pi/4))/((8*x)**k)
c write(*,*)'7'
  fvpx0=fvpx0+fwp0(k)
  fvmx0=fvmx0+fwm0(k)
  fvpx1=fvpx1+fwp1(k)
  fvmx1=fvmx1+fwm1(k)
  gvpx0=gvpx0+gwp0(k)
  gvmx0=gvpx0+gw0(k)
  gvpx1=gvpx1+gwp1(k)
  gvmx1=gvpx1+gw0(k)
 10 continue
  fvpx0=1+fvpx0
  fvmx0=1+fvmx0
  fvpx1=1+fvpx1
  fvmx1=1+fvmx1
  al0=(x/1.41)-(pi/8)
  be0=al0+(pi/4)
  al1=(x/1.41)+(3*pi/8)
  be1=al1+pi/4
c write(*,*)'7'
c---------------------------------------------------------
if(x.gt.120)then
  xx1=120
else
  xx1=x
endif
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\[ ee_1 = e^{(-x_1/1.41)} \]
\[ qe_{x0} = (\sqrt{\pi/(2x)}) \cdot (ee_1) \cdot (f_{vx0} \cos(be_0) - g_{vx0} \sin(be_0)) \]
\[ qe_{x1} = (\sqrt{\pi/(2x)}) \cdot (ee_1) \cdot (f_{vx1} \cos(be_1) - g_{vx1} \sin(be_1)) \]
\[ qe_{i0} = (\sqrt{\pi/(2x)}) \cdot (ee_1) \cdot ((-1.0) \cdot f_{vx0} \sin(be_0) - g_{vx0} \cos(be_0)) \]
\[ qe_{i1} = (\sqrt{\pi/(2x)}) \cdot (ee_1) \cdot ((-1.0) \cdot f_{vx1} \sin(be_1) - g_{vx1} \cos(be_1)) \]
\[
\text{if}(x > 120) \text{then} \n\quad xx_2 = 120 \\
\text{else} \n\quad xx_2 = x \\
\text{endif} \\
\quad ee_2 = e^{((xx_2/1.41)} \\
\quad ber_{x0} = (ee_2) \cdot (f_{vx0} \cos(al_0) + g_{vx0} \sin(al_0))/\sqrt{2\pi x} - qe_{i0}/\pi \\
\quad ber_{x1} = (ee_2) \cdot (f_{vx1} \cos(al_1) + g_{vx1} \sin(al_1))/\sqrt{2\pi x} - qe_{i1}/\pi \\
\quad be_{i0} = (ee_2) \cdot (f_{vx0} \sin(al_0) - g_{vx0} \cos(al_0))/\sqrt{2\pi x} + qe_{x0}/\pi \\
\quad be_{i1} = (ee_2) \cdot (f_{vx1} \sin(al_1) - g_{vx1} \cos(al_1))/\sqrt{2\pi x} + qe_{x1}/\pi \\
\]
qr1=(-1.0)*qeix1
qi1=qerx1
write(*,*)'4'
return
end
Cantilever type rotor with disk at the end span

infinite region
dimension her(2),hei(2)
open(203,file='w3w0.dat')
open(96,file='a.dat')
open(97,file='c.dat')
pi=3.14
write(*,*)'GIVE RADIUS AND LENGTH OF THE SHAFT in cm'
read(*,*)r1,bl
write(*,*)'GIVE RADIUS AND LENGTH OF THE DISC in cm 4,4'
read(*,*)rr1,bbl
den=7.83
e=2.1e+12
area=pi*r1*r1
ei=ee*pi*(r1**4)/4
c ei=4.14e+08
ams2=bl*den*area

c r1=0.4
b=60
write(*,*)'GIVE MASS OF DISC 1570'
read(*,*)ams1
ams1=pi*rr1*rr1*bbl*den

c ams1=1570.0
ams2=192.0
pi=3.14
c ei=4.14e+08
akxx=3.0*ei/(b**3)
akyy=akxx
w1=3.52*(sqrt(ei/(ams2*(b**3))))
write(*,*)'GIVE THE DENSITY RATIO OF LIQUID TO METAL i.e. am1m/am1ms'
read(*,*)rolm
c write(*,*)'GIVE THE GAP RATIO (R2-R1)/R1'
read(*,*)gb
write(*,*)'GIVE CO-EFFICIENT OF VISCOSITY '
read(*,*)un
aeq1=akxx/(w1*w1*ams2)
aeq2=akyy/(w1*w1*ams2)
c aeq1=48/(pi**4)
c aeq2=aeq1
am1ms=ams1+aeq1*ams2
am2ms=ams1+aeq2*ams2
c w1=pi*pi*(sqrt(ei/(am1ms*(b**3))))
am1 = ams1 * rolm
am2 = ams2 * rolm
am1m = am1 + aeq1 * am2
am2m = am1 + aeq2 * am2
am1mst = am1m / am1ms
am2mst = am2m / am2ms

est = ecc / r1
est = 1.0
w1w0 = sqrt(akxx / am1ms)
w2w0 = sqrt(akyy / am2ms)
write(203, *) w1w0
wjh = 0.9
do 40 kk = 1, 30
write(***, kk)
vj = 0.01
if (wjh .ge. 0.98) then
  vj = 0.001
endif
if (wjh .ge. 1.004) then
  vj = 0.01
endif
w = w1w0 * (wjh)
wjh = wjh + vj

w = w1w0 * (0.98 + kk * (0.0004))
unu = un / (r1 * r1 * w)
unu1 = sqrt(1 / unu)
unu1 = sqrt(1 / unu)
call ho (r1, unu1, her1, hei1)
call ho (r1, unu1, her2, hei2)
her(1) = (am1 * her1 + aeq1 * am2 * her2) / am1m
her(2) = (am1 * her1 + aeq2 * am2 * her2) / am2m
hei(1) = (am1 * hei1 + aeq1 * am2 * hei2) / am1m
hei(2) = (am1 * hei1 + aeq2 * am2 * hei2) / am2m
w1wst = w * w1w0
w2wst = w * w2w0
c1 = (-1.0) * am1mst * w1wst * hei(1) / (1 + am1mst * her(1))
bk1 = 1 / (1 + am1mst * her(1))
a1 = est * (w1wst ** 2) / (1 + am1mst * her(1))
c2 = (-1.0) * am2mst * w2wst * hei(2) / (1 + am2mst * her(2))
bk2 = 1 / (1 + am2mst * her(2))
a2 = est * (w2wst ** 2) / (1 + am2mst * her(2))

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sa1=atan(c1*w1wst/(bk1-w1wst**2))
sa2=atan(c2*w2wst/(bk2-w2wst**2))
getax=a1/(sqrt((bk1-w1wst**2)**2 + (c1*w1wst)**2))
getay=a2/(sqrt((bk2-w2wst**2)**2 + (c2*w2wst)**2))

c   tao=(0.0+sa1)/w1wst
tao=((0.0+sa1)/w1wst)*(w2w0/w1w0)
gny=getay*sin(w2wst*tao-sa2)
def=sqrt(getax**2+gny**2)
write(96,*)w1wst,getax,w2wst,getay
40      write(97,*)w1wst,def,w2wst
stop
end

subroutine ho(r1,x,ar,ai)

Dimension fw0(32),fw1(32),gw0(32),gw1(32)
Dimension fwp0(32),fwm0(32),fwp1(32),fwm1(32)
Dimension gwp0(32),gwm0(32),gwp1(32),gwm1(32)

c   DOUBLE PRECISION anr,ani,adr,adi,qr0,qi0,qr1,qi1

fvpx0=0.0
fvmx0=0.0
fvpx1=0.0
fvmx1=0.0
gvpx0=0.0
gvmx0=0.0
gvpx1=0.0
gvmx1=0.0

e=2.718
pi=3.14

c   read(*,*)x

do 10 k = 1,20
fw0(k)=1.0
fw1(k)=1.0
gw0(k)=1.0
gw1(k)=1.0
do 20 i = 1,k
fw0(k)=fw0(k)*(0-((2*i-1)**2))/i
fw1(k)=fw1(k)*(4-((2*i-1)**2))/i
gw0(k)=gw0(k)*(0-((2*i-1)**2))/i
gw1(k)=gw1(k)*(4-((2*i-1)**2))/i
20      continue

fwp0(k)=fw0(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
fwm0(k)=fw0(k)*((cos(k*pi/4))/((8*x)**k)
fwp1(k)=fw1(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
fwm1(k)=fw1(k)*((cos(k*pi/4))/((8*x)**k)
gwp0(k)=gw0(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
gwm0(k)=gw0(k)*((sin(k*pi/4))/((8*x)**k)
gwp1(k) = gw1(k) * ((-1.0)**k) * (sin(k*pi/4))/((8*x)**k)
gwm1(k) = gw1(k) * (sin(k*pi/4))/((8*x)**k)
fvpx0 = fvpx0 + fwp0(k)
fvmx0 = fvmx0 + fwm0(k)
fvpx1 = fvpx1 + fwp1(k)
fvmx1 = fvmx1 + fwm1(k)
gvpx0 = gvpx0 + gwp0(k)
gvmx0 = gvmx0 + gwm0(k)
gvpx1 = gvpx1 + gwp1(k)
gvmx1 = gvmx1 + gwm1(k)

10 continue
fvpx0 = 1 + fvpx0
fvmx0 = 1 + fvmx0
fvpx1 = 1 + fvpx1
fvmx1 = 1 + fvmx1

al0 = (x/1.41) - (pi/8)
be0 = al0 + (pi/4)
al1 = (x/1.41) + (3*pi/8)
be1 = al1 + pi/4

if (x.gt.120) then
  xx1 = 120
else
  xx1 = x
endif

ee1 = ee**(-xx1/1.41)

qerx0 = (sqrt(pi/(2*x)))*(ee1**1) * (fvmx0*cos(be0) - gvmx0*sin(be0))
qerx1 = (sqrt(pi/(2*x)))*(ee1**1) * (fvmx1*cos(be1) - gvmx1*sin(be1))

qeix0 = (sqrt(pi/(2*x)))*(ee1**1) * (-1.0)*fvmx0*sin(be0) - gvmx0*cos(be0))
qeix1 = (sqrt(pi/(2*x)))*(ee1**1) * (-1.0)*fvmx1*sin(be1) - gvmx1*cos(be1))

if (x.gt.120) then
  xx2 = 120
else
  xx2 = x
endif

ee2 = ee**((xx2/1.41)

berx0 = (ee2)**(sqrt(2*pi*x) - qeix0/pi)
berx1 = (ee2)**(sqrt(2*pi*x) - qeix1/pi)
beix0 = (ee2)*((fvp0*sin(al0)-gvp0*cos(al0))/
1 sqrt(2*pi*x))+qer0/pi
beix1 = (ee2)*((fvp1*sin(al1)-gvp1*cos(al1))/
1 sqrt(2*pi*x))+qer1/pi
c I0() = br0()+i*bi0() from Abramowitz and Stegun
c I1() = br1()+i*bi1() Hand Book of Mathematical
functions
c k0() = kr0()+i*ki0() Functions
c k1() = kr1()+i*ki1()
C -----------------------------------------------
* br0=berx0
  bi0=beix0
  br1=beix1
  bi1=(-1.0)*berx1
qr0=qerx0
qi0=qeix0
qr1=(-1.0)*qeix1
qi1=qerx1
C -----------------------------------------------
adr=qr0-qi0
adi=qr0+qi0
anr=qr1*1.41
ani=qi1*1.41
C -----------------------------------------------
ar= 2*(anr*adr+ani*adi)/(x*(adr*adr+adi*adi))
ai= 2*(ani*adr-anr*adi)/(x*(adr*adr+adi*adi))
return
end
c Simply supported rotor
dimension a1(10),a2(10),bk1(10),bk2(10),sa1(10),sa2(10)
dimension getax(10),getay(10),tao(10),gny(10),def(10)
on(96, file='a.dat')
on(97, file='c.dat')
pi=3.14
write(*,*)'GIVE RADIUS AND LENGTH OF THE SHAFT in cm'
read(*,*) r1, bl
den=7.83
ee=2.1e+12
area=pi*r1*r1
ei=ee*pi*(r1**4)/4
ams=den*area

n=1
c r1=0.4
c bl=60
c ams=3.20
c pi=3.14
c ei=4.14e+08
b1=bl/r1
w1=pi*pi*(sqrt(ei/(ams*(bl**4)))))
w2=w1
write(*,*)'GIVE THE DENSITY RATIO OF LIQUID TO 1 METAL i.e. am1m/am1ms'
read(*,*) rolm
write(*,*)'GIVE THE GAP RATIO (R2-R1)/R1'
read(*,*) gb
write(*,*)'GIVE CO-EFFICIENT OF VISCOSITY '
read(*,*) un
am1ms=ams
am2ms=ams
am1m=am1ms*rolm
am2m=am2ms*rolm
am1mst=am1m/am1ms
am2mst=am2m/am2ms
c est=ecc/r1
est=1.0
c w1w0=sqrt(akxx/am1ms)
c w2w0=sqrt(akyy/am2ms)
wjh=0.9

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do 40 kk=1,30
write(*,*)kk
vj=0.01
if(wjh.ge.(0.98)) then
vj=0.001
endif
if(wjh.ge.(1.004)) then
vj=0.01
endif
w=w1*(wjh)
wjh=wjh+vj

do 40 kk=1,70
write(*,*)kk
w1wst=w/w1

unu=unu/(r1*r1*w)
unu=sqrt(1/unu)
call ho(r1,unu1,gb,her,hei)
w1wst=w1wst

unu1=sqrt(1/unu)
c a1(n)=(2.0/(n*pi))*est*(w1wst**2)*bls*((sin(n*pi/2))**2)
1/(1+am1mst*her)
a2(n)=(2.0/(n*pi))*est*(w2wst**2)*bls*((sin(n*pi/2))**2)
1/(1+am2mst*her)
c c1=(-1.0)*am1mst*w1wst*hei/(1+am1mst*her)
c2=(-1.0)*am2mst*w2wst*hei/(1+am2mst*her)
bk1(n)=(n**4)/(1+am1mst*her)
bk2(n)=(n**4)/(1+am2mst*her)
sa1(n)=atan(c1*w1wst/(bk1(n)-w1wst**2))
sa2(n)=atan(c2*w2wst/(bk2(n)-w2wst**2))
getax(n)=2*a1(n)/(sqrt((bk1(n)-w1wst**2)**2+(c1*w1wst)**2))
getay(n)=2*a2(n)/(sqrt((bk2(n)-w2wst**2)**2+(c2*w2wst)**2))
c tao(n)=(0.0+sa1(n))/w1wst
tao(n)=((0.0+sa1(n))/w1wst)*(w2/w1)
gny(n)=getay(n)*sin(w2wst*tao(n)-sa2(n))
def(n)=sqrt(getax(n)**2+gny(n)**2)
c write(*,*)a1(n),bk1(n),c1
write(96,*)w1wst,getax(n),w2wst,getay(n)
40 write(97,*)w1wst,def(n),w2wst
stop
d subroutine ho(r1,x,gb,far,fai)
c write(*,*)'GIVE THE VALUE OF nue star'
  c read(*,*)unu
  c x=sqrt(1/unu)
  xa=x
c write(*,*)'GIVE THE VALUE OF R1 AND (R2-R1)/R1'
c read(*,*)r1,gb
  r2=gb*r1+r1
  xb=x*(r2/r1)
  ga=r1/r2
  gb=(r2-r1)/r1
  call bes(xb,br0,bi0,br1,bi1,
  1 qr0,qi0,qr1,qi1)
  brb0=br0
  bib0=bi0
  brb1=br1
  bib1=bi1
  qrb0=qr0
  qib0=qi0
  qrb1=qr1
  qib1=qi1

  c--------------------------------------------------
  call bes(xa,br0,bi0,br1,bi1,
  1 qr0,qi0,qr1,qi1)
  bra0=br0
  bia0=bi0
  bra1=br1
  bia1=bi1
  qra0=qr0
  qia0=qi0
  qra1=qr1
  qia1=qi1
  c--------------------------------------------------
  a111r=-xa/1.41
  a111i=-xa/1.41
  a222r=xa*r1/(1.41*r2)
  a222i=xa*r1/(1.41*r2)
  a333r=-2.0*(r1/r2)
  a333i=0.0

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\begin{verbatim}
a1r = a111r * a11r - a111i * a11i
a1i = a111r * a11i + a11r * a111i
a2r = a222r * a22r - a222i * a22i
a2i = a222r * a22i + a22r * a222i
a3r = a333r * a33r - a333i * a33i
a3i = a333r * a33i + a33r * a333i

ar = a1r + a2r + a3r
ai = a1i + a2i + a3i

d11r = (bra0 * qrb1 - bib0 * qib1) + (-1.0) * (brb1 * qrb0 - bib1 * qib0) +
1 (brb1 * qia0 + qia1 * bib0) + (-1.0) * (bra0 * qib1 + qib0 * bib1) +
1 (bra0 * qia0 + qia1 * bib0) + (-1.0) * (brb1 * qib0 - bib1 * qib1) +
1 (brb1 * qia0 + qia1 * bib0) + (-1.0) * (bra0 * qib1 + qib0 * bib1).
d11i = (bra0 * qib1 + qib0 * bib1) + (-1.0) * (brb1 * qib0 + bib0 * qib1) +
1 (bra0 * qia0 + qia1 * bib0) + (-1.0) * (brb1 * qib0 + bib0 * qib1) +
1 (bra0 * qia0 + qia1 * bib0) + (-1.0) * (brb1 * qib0 + bib0 * qib1).
d222r = 2 * r1 * r1 * xa / (r2 * r1 * 1.41)
d222i = 2 * r1 * r1 * xa / (r2 * r1 * 1.41)
d333i = xa * xa * (1 - ((r1 * r1) / (r2 * r2)))
d11 = d11r * d11r - d11i * d11i

d = d1r + d2r + d3r

di = d1i + d2i + d3i
fa = 2 * (ar * dr + ai * di) / (dr * dr + di * di)
fi = 2 * (ai * dr - ar * di) / (dr * dr + di * di)
write(1, *, gb, far, fai)
write(1, *, ar = 'r, ar = 'i, ai = 'r, dr = 'i, di = 'i)
return

subroutine bes(x, br0, bi0, br1, bi1, qr0, qi0, qr1, qi1)
end
\end{verbatim}
Dimension fw0(32),fw1(32),gw0(32),gw1(32)
Dimension fwp0(32),fwm0(32),fWp1 (32),fWm1 (32)
Dimension gwp0(32),gwm0(32),gwp1(32),gwm1(32)
fvpx0=0.0
fvmx0=0.0
fvpx1=0.0
fvmx1=0.0
gvpx0=0.0
gvmx0=0.0
gvpx1=0.0
gvmx1=0.0
ee=2.718
pi=3.14
read(*,*) x

do 10 k = 1,20
   fw0(k)=1.0
   fw1(k)=1.0
   gw0(k)=1.0
   gw1(k)=1.0
   do 20 i = 1,k
      fw0(k)=fw0(k)*(0-((2*i-1)**2))/i
      fw1(k)=fw1(k)*(4-((2*i-1)**2))/i
      gw0(k)=gw0(k)*(0-((2*i-1)**2))/i
      gw1(k)=gw1(k)*(4-((2*i-1)**2))/i
   20 continue
   fwp0(k)=fw0(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
   fwp1(k)=fw1(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
   fwm0(k)=fw0(k)*(cos(k*pi/4))/((8*x)**k)
   fwm1(k)=fw1(k)*(cos(k*pi/4))/((8*x)**k)
   gwp0(k)=gw0(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
   gwp1(k)=gw1(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
   gwm0(k)=gw0(k)*(sin(k*pi/4))/((8*x)**k)
   gwm1(k)=gw1(k)*(sin(k*pi/4))/((8*x)**k)
10 continue
fvpx0=1+fvpx0
fvmx0=1+fvmx0
fvpx1=1+fvpx1
\[ fvmx_1 = fvmx_1 + 1 \]
\[ a_0 = \frac{x}{1.41} - \frac{\pi}{8} \]
\[ be_0 = a_0 + \frac{\pi}{4} \]
\[ a_1 = \frac{x}{1.41} + \frac{3\pi}{8} \]
\[ be_1 = a_1 + \frac{\pi}{4} \]

\[
if (x > 120) then \\
x_1 = 120 \\
else \\
x_1 = x \\
endif \\
ee1 = e^{-\frac{x}{1.41}} \\
qerx_0 = \sqrt{\frac{\pi}{2x}} \cdot e^{e1} \cdot (fvmx_0 \cos(be_0) - gvmx_0 \sin(be_0)) \\
qerx_1 = \sqrt{\frac{\pi}{2x}} \cdot e^{e1} \cdot (fvmx_1 \cos(be_1) - gvmx_1 \sin(be_1)) \\
qeix_0 = \sqrt{\frac{\pi}{2x}} \cdot e^{e1} \cdot (-1.0) \cdot fvmx_0 \sin(be_0) - gvmx_0 \cos(be_0)) \\
qeix_1 = \sqrt{\frac{\pi}{2x}} \cdot e^{e1} \cdot (-1.0) \cdot fvmx_1 \sin(be_1) - gvmx_1 \cos(be_1)) \\
\]

\[
if (x > 120) then \\
x_2 = 120 \\
else \\
x_2 = x \\
endif \\
ee2 = e^{-\frac{x}{1.41}} \\
berx_0 = (e2) \cdot \frac{((fvpx_0 \cos(al0) + gvpx_0 \sin(al0))/\sqrt{2\pi x}) - qeix_0}{\pi} \\
berx_1 = (e2) \cdot \frac{((fvpx_1 \cos(al1) + gvpx_1 \sin(al1))/\sqrt{2\pi x}) - qeix_1}{\pi} \\
beix_0 = (e2) \cdot \frac{((fvpx_0 \sin(al0) - gvpx_0 \cos(al0))/\sqrt{2\pi x}) + qerx_0}{\pi} \\
beix_1 = (e2) \cdot \frac{((fvpx_1 \sin(al1) - gvpx_1 \cos(al1))/\sqrt{2\pi x}) + qerx_1}{\pi} \\
\]

\[
qerx_0 = \sqrt{\frac{\pi}{2x}} \cdot e^{-\frac{x}{1.41}} \cdot (fvmx_0 \cos(be_0) - gvmx_0 \sin(be_0)) \\
qerx_1 = \sqrt{\frac{\pi}{2x}} \cdot e^{-\frac{x}{1.41}} \cdot (fvmx_1 \cos(be_1) - gvmx_1 \sin(be_1)) \\
qeix_0 = \sqrt{\frac{\pi}{2x}} \cdot e^{-\frac{x}{1.41}} \cdot (-1.0) \cdot fvmx_0 \sin(be_0) - gvmx_0 \cos(be_0)) \\
qeix_1 = \sqrt{\frac{\pi}{2x}} \cdot e^{-\frac{x}{1.41}} \cdot (-1.0) \cdot fvmx_1 \sin(be_1) - gvmx_1 \cos(be_1)) \\
\]

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c \( qeix1 = \sqrt{\frac{\pi}{2x}} \times (\exp(-x/1.41)) \times (1 \times (-1.0) \times fvmx1 \times \sin(be1) - gvmx1 \times \cos(be1)) \)
c \---------------------------------------------------------
c \( berx0 = \exp(x/1.41) \times (\frac{fvpx0 \times \cos(al0) + gvp0 \times \sin(al0)}{\sqrt{2 \pi x}}) - \frac{qeix0}{\pi} \)
c \( berx1 = \exp(x/1.41) \times (\frac{fvpx1 \times \cos(al1) + gvp1 \times \sin(al1)}{\sqrt{2 \pi x}}) - \frac{qeix1}{\pi} \)
c \( beix0 = \exp(x/1.41) \times (\frac{fvpx0 \times \sin(al0) - gvp0 \times \cos(al0)}{\sqrt{2 \pi x}}) + \frac{qerx0}{\pi} \)
c \( beix1 = \exp(x/1.41) \times (\frac{fvpx1 \times \sin(al1) - gvp1 \times \cos(al1)}{\sqrt{2 \pi x}}) + \frac{qerx1}{\pi} \)
c \---------------------------------------------------------
c \( I0() = br0() + i \times bi0() \) from Abramowitz and Stegun
c \( I1() = br1() + i \times bi1() \) Hand Book of Mathematical Functions
c \( k0() = kr0() + i \times ki0() \)
c \( k1() = kr1() + i \times ki1() \)
c \---------------------------------------------------------
br0 = berx0
bi0 = beix0
br1 = beix1
bi1 = (-1.0) \times berx1
qr0 = qerx0
qi0 = qeix0
qr1 = (-1.0) \times qeix1
qi1 = qerx1
return
end
c Simply supported cracked rotor in infinite viscous fluid
dimension a1(10),a2(10),bk1(10),bk2(10),sa1(10),sa2(10)
dimension getax(10),getay(10),tao(10),gny(10),def(10)
open(201, file='w.dat')
open(96, file='a.dat')
open(97, file='c.dat')
pi=3.14
write(*,*)'GIVE RADIUS AND LENGTH OF THE SHAFT in cm'
read(*,*)r1,bl
den=7.83
ee=2.1e+12
area=pi*r1*r1
ei=ee*pi*(r1**4)/4
ams=den*area

n=1
c r1=0.4
c bl=60
c ams=3.20
c pi=3.14
c ei=4.14e+08
bls=bl/r1
c akxx=48.0 * ei/(bl**3)
c akyy=akxx
w3=pi*pi*(sqrt(ei/(ams*(bl**4))))
read(201,*)w1,w2
write(*,*)'GIVE THE DENSITY RATIO OF LIQUID TO METAL i.e. am1m/am1ms'
read(*,*)rolm
c write(*,*)'GIVE THE GAP RATIO (R2-R1)/R1'
c read(*,*)gb
write(*,*)'GIVE CO-EFFICIENT OF VISCOSITY '
read(*,*)un
do 7 lw=1,2
if (lw.eq.2)then
pw1=w1
pw2=w2
w1=pw2
w2=pw1
endif
```fortran
      c aeq1=akxx/(w1*w1*ams2)
      c aeq2=akyy/(w1*w1*ams2)
      c aeq1=48/(pi**4)
      c aeq2=aeq1
      am1ms=ams
      am2ms=ams
      c w1=pi*pi*(sqrt(ei/(am1ms*(bl**3))))
      c am1=ams1*rolm
      c am2=ams2*rolm
      am1m=am1ms*rolm
      am2m=am2ms*rolm
      am1mst=am1m/am1ms
      am2mst=am2m/am2ms
      c est=ecc/r1
      est=1.0
      c w1w0=sqrt(akxx/am1ms)
      c w2w0=sqrt(akyy/am2ms)
      wjh=0.9
      do 40 kk=1,30
        write(*,*)kk
        vj=0.01
        if(wjh.ge.(0.98))then
          vj=0.001
        endif
        if(wjh.ge.(1.004))then
          vj=0.01
        endif
        w=w1*(wjh)
        wjh=wjh+vj
      enddo
      c do 40 kk=1,70
      c write(*,*)kk
      c w=w1*(0.9+kk*(0.002))
      unu=un/(r1*r1*w)
      c unu=un*w3/w
      c write(*,*)unu,w1w0,am1ms,ams1,ams2,aeq1
      unu1=sqrt(1/unu)
      call ho(r1,unu1,her,hei)
      w1wst=w/w1
      w2wst=w/w2
      wfw0=w/w3
      a1(n)=(2.0/(n*pi))*est*(w1wst**2)*bls*((sin(n*pi/2))**2)/(1+am1mst*her)
      a2(n)=(2.0/(n*pi))*est*(w2wst**2)*bls*((sin(n*pi/2))**2)
      321
```
\[ \frac{1}{1 + \text{am2mst}\times \text{her}} \]

\[ c_1 = (-1.0) \times \text{am1mst} \times \text{w1wst} \times \text{hei} / (1 + \text{am1mst} \times \text{her}) \]

\[ c_2 = (-1.0) \times \text{am2mst} \times \text{w2wst} \times \text{hei} / (1 + \text{am2mst} \times \text{her}) \]

\[ \text{bk1}(n) = (n^{**4}) / (1 + \text{am1mst} \times \text{her}) \]

\[ \text{bk2}(n) = (n^{**4}) / (1 + \text{am2mst} \times \text{her}) \]

\[ \text{sal}(n) = \text{atan}(c_1 \times \text{w1wst} / (\text{bk1}(n) - \text{w1wst}^{**2})) \]

\[ \text{sa2}(n) = \text{atan}(c_2 \times \text{w2wst} / (\text{bk2}(n) - \text{w2wst}^{**2})) \]

\[ \text{getax}(n) = 2 \times a_1(n) / (\text{sqrt}((\text{bk1}(n) - \text{w1wst}^{**2})^{**2} + (c_1 \times \text{w1wst})^{**2})) \]

\[ \text{getay}(n) = 2 \times a_2(n) / (\text{sqrt}((\text{bk2}(n) - \text{w2wst}^{**2})^{**2} + (c_2 \times \text{w2wst})^{**2})) \]

\[ \text{ctao}(n) = (0.0 + \text{sa1}(n)) / \text{w1wst} \]

\[ \text{tao}(n) = ((0.0 + \text{sa1}(n)) / \text{w1wst}) \times (\text{w2}/\text{w1}) \]

\[ \text{gny}(n) = \text{getay}(n) \times \text{sin}(\text{w2wst} \times \text{tao}(n) - \text{sa2}(n)) \]

\[ \text{def}(n) = \text{sqrt}((\text{getax}(n)^{**2} + \text{gny}(n)^{**2})) \]

\[ \text{if}(\text{lw} \leq 1) \text{then} \]

\[ \text{write}(96,*) \text{wfw0}, \text{def}(n), \text{w1wst}, \text{getax}(n) \]

\[ \text{else} \]

\[ \text{write}(97,*) \text{wfw0}, \text{def}(n), \text{w1wst}, \text{getax}(n) \]

\[ \text{endif} \]

\[ 40 \text{ continue} \]

\[ 7 \text{ continue} \]

\[ \text{stop} \]

\[ \text{end} \]

\[ \text{subroutine ho(r1,x,ar,ai)} \]

\[ \text{Dimension fw0}(32), \text{fw1}(32), \text{gw0}(32), \text{gw1}(32) \]

\[ \text{Dimension fwp0}(32), \text{fwm0}(32), \text{fw1}(32), \text{fwm1}(32) \]

\[ \text{Dimension gwp0}(32), \text{gwm0}(32), \text{gwp1}(32), \text{gwm1}(32) \]

\[ \text{fvpx0} = 0.0 \]

\[ \text{fvmx0} = 0.0 \]

\[ \text{fvpx1} = 0.0 \]

\[ \text{fvmx1} = 0.0 \]

\[ \text{gvpx0} = 0.0 \]

\[ \text{gvmx0} = 0.0 \]

\[ \text{gvpx1} = 0.0 \]

\[ \text{gvmx1} = 0.0 \]

\[ \text{ee} = 2.718 \]

\[ \text{pi} = 3.14 \]

\[ \text{read}(**,*)x \]

\[ \text{do} \text{ 10} \text{ k} = 1,20 \]

\[ \text{fw0}(k) = 1.0 \]

\[ \text{fw1}(k) = 1.0 \]

\[ \text{gw0}(k) = 1.0 \]

\[ \text{gw1}(k) = 1.0 \]

\[ \text{do} \text{ 20} \text{ i} = 1,k \]
\begin{align*}
fw_0(k) &= fw_0(k) \cdot (0 - ((2i - 1)^2) / i) \\
fw_1(k) &= fw_1(k) \cdot (4 - ((2i - 1)^2) / i) \\
gw_0(k) &= gw_0(k) \cdot (0 - ((2i - 1)^2) / i) \\
gw_1(k) &= gw_1(k) \cdot (4 - ((2i - 1)^2) / i) \\
\end{align*}

\begin{verbatim}
20 continue
fw_{p0}(k) = fw_0(k) \cdot ((-1.0)^k) \cdot (\cos(k \pi / 4)) / ((8x)^k) \\
fw_{m0}(k) = fw_0(k) \cdot (\cos(k \pi / 4)) / ((8x)^k) \\
fw_{p1}(k) = tw_1(k) \cdot ((-1.0)^k) \cdot (\cos(k \pi / 4)) / ((8x)^k) \\
fw_{m1}(k) = tw_1(k) \cdot (\cos(k \pi / 4)) / ((8x)^k) \\
gw_{p0}(k) = gw_0(k) \cdot ((-1.0)^k) \cdot (\sin(k \pi / 4)) / ((8x)^k) \\
gw_{m0}(k) = gw_0(k) \cdot (\sin(k \pi / 4)) / ((8x)^k) \\
gw_{p1}(k) = gw_1(k) \cdot ((-1.0)^k) \cdot (\sin(k \pi / 4)) / ((8x)^k) \\
gw_{m1}(k) = gw_1(k) \cdot (\sin(k \pi / 4)) / ((8x)^k) \\
fv_{px}0 = iv_{px}0 + fwp_{0}(k) \\
fv_{mx}0 = fm_{x}0 + fw_{m0}(k) \\
fv_{px}1 = fv_{px}0 + fwp_{1}(k) \\
fv_{mx}1 = fm_{x}1 + fw_{m1}(k) \\
gv_{px}0 = gv_{px}0 + gw_{p0}(k) \\
gv_{mx}0 = gm_{x}0 + gw_{m0}(k) \\
gv_{px}1 = gv_{px}1 + gw_{p1}(k) \\
gv_{mx}1 = gm_{x}1 + gw_{m1}(k) \\
10 continue
fv_{px}0 = 1 + fv_{px}0 \\
fv_{mx}0 = 1 + fv_{mx}0 \\
fv_{px}1 = 1 + fv_{px}1 \\
fv_{mx}1 = 1 + fv_{mx}1 \\
al0 = (x/1.41) - (pi/8) \\
be0 = al0 + (pi/4) \\
al1 = (x/1.41) + (3*pi/8) \\
be1 = al1 + (pi/4)
\end{verbatim}

\begin{align*}
\text{c} \quad \text{-----------------------} \\
qerx0 &= (\sqrt{\pi/(2x)}) \cdot (ee**-(x/1.41)) \\
1 & \cdot (fvx0*cos(be0) - gm0*sin(be0)) \\
qerx1 &= (\sqrt{\pi/(2x)}) \cdot (ee**-(x/1.41)) \\
1 & \cdot (fvx1*cos(be1) - gm1*sin(be1)) \\
qeix0 &= (\sqrt{\pi/(2x)}) \cdot (ee**-(x/1.41)) \\
1 & \cdot ((-1.0)*fvx0*sin(be0) - gm0*cos(be0)) \\
qeix1 &= (\sqrt{\pi/(2x)}) \cdot (ee**-(x/1.41)) \\
1 & \cdot ((-1.0)*fvx1*sin(be1) - gm1*cos(be1)) \\
\text{c} \quad \text{-----------------------} \\
berx0 &= (ee**-(x/1.41))*((fvx0*cos(al0)+gvx0*sin(al0))/ \\
1 sqrt(2*pi*x)) - qeix0/pi \\
berx1 &= (ee**-(x/1.41))*((fvx1*cos(al1)+gvx1*sin(al1))/ \\
1 sqrt(2*pi*x)) - qeix1/pi \\
beix0 &= (ee**-(x/1.41))*((fxv0*sin(al0)-gvx0*cos(al0))/ \\
1 sqrt(2*pi*x)) - qeix0/pi \\
beix1 &= (ee**-(x/1.41))*((fxv1*sin(al1)-gvx1*cos(al1))/ \\
1 sqrt(2*pi*x)) - qeix1/pi
\end{align*}
sqrt(2*pi*x) + qerx0/pi
beix1 = (ee**(x/1.41))*(fvp1*x1*sin(al1) - gp1*x1*cos(al1))/
sqrt(2*pi*x) + qerx1/pi

---

I0() = br0() + i*bi0() from Abramowitz and Stegun
I1() = br1() + i*bi1() Hand Book of Mathematical
k0() = kr0() + i*ki0() Functions
k1() = kr1() + i*ki1()

---

br0 = berx0
bi0 = beix0
br1 = beix1
bi1 = (-1.0)*berx1
qr0 = qerx0
qi0 = qeix0
qr1 = (-1.0)*qeix1
qi1 = qerx1

---

adr = qr0 - qi0
adi = qr0 + qi0
anr = qr1*1.41
ani = qi1*1.41

---

ar = 2*(anr*adr + ani*adi)/(x*(adr*adr + adi*adi))
ai = 2*(ani*adr - anr*adi)/(x*(adr*adr + adi*adi))

return
end
Simply supported cracked rotor in finite viscous fluid
dimension a1(10), a2(10), bk1(10), bk2(10), sa1(10), sa2(10)
dimension getax(10), getay(10), tao(10), gny(10), def(10)
open(96, file='a.dat')
open(201, file='w.dat')
open(97, file='c.dat')
pi=3.14
write(*,*)'GIVE RADIUS AND LENGTH OF THE SHAFT in cm'
read(*,*)r1, bl
den=7.83
ee=2.1e+12
area=pi*r1*r1
ei=ee*pi*(r1**4)/4
ams=den*area

r1=0.4
bl=60
ams=3.20
pi=3.14
ei=4.14e+08
bls=bl/r1
w3=pi*pi*(sqrt(ei/(ams*(bl**4))))
read(201,*), w1, w2
write(*,*)'GIVE THE DENSITY RATIO OF LIQUID TO METAL i.e. am1m/am1ms'
read(*,*)rolm
write(*,*)'GIVE THE GAP RATIO (R2-R1)/R1'
read(*,*)gb
write(*,*)'GIVE CO-EFFICIENT OF VISCOSITY'
read(*,*)un

do 7 lw=1,2
if (lw.eq.2) then
pw1=w1
pw2=w2
w1=pw2
w2=pw1
endif

am1ms=ams
am2ms=ams
am1m=am1ms*rolm
am2m=am2ms*rolm
am1mst=am1m/am1ms
am2mst=am2m/am2ms

c est=ecc/r1
est=1.0
c w1w0=sqrt(akxx/am1ms)
c w2w0=sqrt(akyy/am2ms)
wjh=0.9
do 40 kk=1,30
write(*,*)kk
vj=0.01
if(wjh.ge.(0.98))then
vj=0.001
endif
if(wjh.ge.(1.004))then
vj=0.01
endif
w=w1*(wjh)
wjh=wjh+vj
do 40 kk=1,70
write(*,*)kk
w=w1*(0.9+kk*(0.002))
unu=un/(r1*r1*w)
c write(*,*)unu,w1w0,am1ms,ams1,ams2,aeq1
unu1=sqrt(1/unu)
call ho(r1,unu1,gb,her,hei)
w1wst=w/w1
w2wst=w/w2
wfw0=w/w3
a1(n)=(2.0/(n*pi))*est*(w1wst**2)*bls*((sin(n*pi/2))**2)
1/(1+am1mst*her)
a2(n)=(2.0/(n*pi))*est*(w2wst**2)*bls*((sin(n*pi/2))**2)
1/(1+am2mst*her)
c1=(-1.0)*am1mst*w1wst*hei/(1+am1mst*her)
c2=(-1.0)*am2mst*w2wst*hei/(1+am2mst*her)
bk1(n)=(n**4)/(1+am1mst*her)
bk2(n)=(n**4)/(1+am2mst*her)
sa1(n)=atan(c1*w1wst/(bk1(n)-w1wst**2))
sa2(n)=atan(c2*w2wst/(bk2(n)-w2wst**2))
gegax(n)=2*a1(n)/(sqrt((bk1(n)-w1wst**2)**2+(c1*w1wst)**2))
gegay(n)=2*a2(n)/(sqrt((bk2(n)-w2wst**2)**2+(c2*w2wst)**2))
c tao(n)=(0.0+sa1(n))/w1wst
tao(n)=((0.0+sa1(n))/w1wst)*(w2/w1)
gny(n)=gegay(n)*sin(w2wst*tao(n)-sa2(n))
def(n)=sqrt(getax(n)**2+gny(n)**2)
c write(*,*)a1(n),bk1(n),c1
if(lw.eq.1)then
write(96,*),def(n),w1wst,getax(n)
else
write(97,*),def(n),w1wst,getax(n)
endif
40 continue
7 continue
stop
end
subroutine ho(r1,x,gb,far,fai)
c write(*,*)'GIVE THE VALUE OF nue star'
c read(*,*)unu
c x=sqrt(1/unu)
xa=x
c write(*,*)'GIVE THE VALUE OF R1 AND (R2-R1)/R1'
c read(*,*)r1,gb
r2=gb*r1+r1
xb=x*(r2/r1)
ga=r1/r2
gb=(r2-r1)/r1
call bes(xb,br0,bi0,br1,bi1,qr0,qi0,qr1,qi1)
brb0=br0
bib0=bi0
brb1=br1
bib1=bi1
qrb0=qr0
qib0=qi0
qrb1=qr1
qib1=qi1
c-----------------------------------------------------
call bes(xa,br0,bi0,br1,bi1,qr0,qi0,qr1,qi1)
bra0=br0
bia0=bi0
bra1=br1
bia1=bi1
qra0=qr0
qia0=qi0
qra1=qr1
qia1=qi1
-----------------------------------------------------
a11r=brb0*qra1-bib0*qia1+bra1*qrb0-bia1*qib0
\[ a_{11i} = b_{rb0} q_{ia1} + q_{ra1} b_{ib0} + b_{ra1} q_{ib0} + q_{rb0} b_{ia1} \\
\[ a_{22r} = b_{rb0} q_{rb1} - b_{ib0} q_{ib1} + b_{rb1} q_{rb0} - b_{ib1} q_{ib0} \\
\[ a_{22i} = b_{rb0} q_{ib1} + q_{rb1} b_{ib0} + b_{rb1} q_{ib0} + q_{rb0} b_{ib1} \\
\[ a_{33r} = b_{ra1} q_{rb1} - b_{ra1} b_{ia1} - b_{ra1} q_{rb1} + b_{ia1} q_{ra1} + b_{ib1} q_{ia1} \\
\[ a_{33i} = b_{ra1} q_{ib1} + q_{rb1} b_{ib0} + b_{ra1} q_{ib0} - q_{ra1} b_{ib1} \\
\[ c_{111r} = -x_{a} / 1.41 \\
\[ c_{111i} = -x_{a} / 1.41 \\
\[ c_{222r} = x_{a} r_{1} / (1.41 \times r_{2}) \\
\[ c_{222i} = x_{a} r_{1} / (1.41 \times r_{2}) \\
\[ c_{333r} = -2.0 \times (r_{1} / r_{2}) \\
\[ c_{333i} = 0.0 \\
\[ a_{1} r = a_{111r} a_{11i} + a_{11i} a_{111i} \\
\[ a_{1} i = a_{111r} a_{11i} + a_{11i} a_{111i} \\
\[ a_{2} r = a_{222r} a_{22i} + a_{22i} a_{222i} \\
\[ a_{2} i = a_{222r} a_{22i} + a_{22i} a_{222i} \\
\[ a_{3} r = a_{333r} a_{33i} + a_{33i} a_{333i} \\
\[ a_{3} i = a_{333r} a_{33i} + a_{33i} a_{333i} \\
\[ a_{1} r = a_{1} r + a_{2} r + a_{3} r \\
\[ a_{1} i = a_{1} i + a_{2} i + a_{3} i \\
\[ d_{11r} = (b_{ra0} q_{rb1} - b_{ia0} q_{ib0}) + (-1.0) \times (b_{rb1} q_{rb0} - b_{ib1} q_{ib0}) + 1 \times (b_{rb1} q_{rb0} - b_{ia0} q_{ia0}) + (-1.0) \times (b_{ra1} q_{ia0} + q_{ra1} b_{ia0}) + 1 \times (b_{ra1} q_{ia0} + q_{ra1} b_{ia0}) + (-1.0) \times (b_{ra0} q_{ia0} + q_{ra0} b_{ia0}) + 1 \times (b_{ra1} q_{ia0} + q_{ra1} b_{ia0}) + (-1.0) \times (b_{ra0} q_{ia0} + q_{ra0} b_{ia0}) \\
\[ d_{11i} = (b_{ra0} q_{rb1} - b_{ia0} q_{ib0}) + (-1.0) \times (b_{rb1} q_{rb0} - b_{ib1} q_{ib0}) + 1 \times (b_{rb1} q_{rb0} - b_{ia0} q_{ia0}) + (-1.0) \times (b_{ra1} q_{ia0} + q_{ra1} b_{ia0}) + 1 \times (b_{ra1} q_{ia0} + q_{ra1} b_{ia0}) + (-1.0) \times (b_{ra0} q_{ia0} + q_{ra0} b_{ia0}) \\
\[ d_{22r} = 2 \times x_{a} r_{1} / (r_{2} \times r_{1}) \\
\[ d_{22i} = 2 \times x_{a} r_{1} / (r_{2} \times r_{1}) \\
\[ d_{33r} = 0.0 \\
\[ d_{33i} = x_{a} x_{a} (1 - ((r_{1} r_{1}) / (r_{2} r_{2}))) \\
\[ d_{1} r = d_{111r} d_{11i} - d_{11i} d_{111i} \\
\[ d_{1} i = d_{111r} d_{11i} + d_{11i} d_{111i} \\
\[ d_{2} r = d_{222r} d_{22i} - d_{22i} d_{222i} \\
\[ d_{2} i = d_{222r} d_{22i} + d_{22i} d_{222i} \\
\[ d_{3} r = d_{333r} d_{33i} - d_{33i} d_{333i} \\
\[ d_{3} i = d_{333r} d_{33i} + d_{33i} d_{333i} \\
\[ 328 \]
d3i = d333r*d33i+d33r*d33i

c -------------------------------------------------------

\[ \begin{align*}
\text{dr} &= d1r + d2r + d3r \\
\text{di} &= d1i + d2i + d3i \\
\text{far} &= 2 \frac{(ar \cdot \text{dr} + ai \cdot \text{di})}{(\text{dr} \cdot \text{dr} + \text{di} \cdot \text{di})} \\
\text{fai} &= 2 \frac{(ai \cdot \text{dr} - ar \cdot \text{di})}{(\text{dr} \cdot \text{dr} + \text{di} \cdot \text{di})}
\end{align*} \]

c write(*,*) gb, far, fai

c write(*,*) ar='a', ar, 'ai=', ai, 'dr=', dr, 'di=', di

return
end

subroutine bes(x, br0, bi0, br1, bi1, qr0, qi0, qr1, qi1)
    Dimension fw0(32), fw1(32), gw0(32), gw1(32)
    Dimension fwp0(32), fwm0(32), fwp1(32), fwm1(32)
    Dimension gwp0(32), gwm0(32), gwp1(32), gwm1(32)
    fvpx0=0.0
    fvmx0=0.0
    fvpx1=0.0
    fvmx1=0.0
    gvpx0=0.0
    gvmx0=0.0
    gvpx1=0.0
    gvmx1=0.0
    ee=2.718
    pi=3.14

c read(*,*) x
    do 10 k = 1, 20
        fw0(k)=1.0
        fw1(k)=1.0
        gw0(k)=1.0
        gw1(k)=1.0
        do 20 i = 1, k
            fw0(k)=fw0(k)*(0-(2*i-1)**2)/i
            fw1(k)=fw1(k)*(4-(2*i-1)**2)/i
            gw0(k)=gw0(k)*(0-(2*i-1)**2)/i
            gw1(k)=gw1(k)*(4-(2*i-1)**2)/i
        20 continue
        fwp0(k)=fw0(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
        fwm0(k)=fw0(k)*(cos(k*pi/4))/((8*x)**k)
        fwp1(k)=fw1(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
        fwm1(k)=fw1(k)*(cos(k*pi/4))/((8*x)**k)
        gwp0(k)=gw0(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
        gwm0(k)=gw0(k)*(sin(k*pi/4))/((8*x)**k)
        gwp1(k)=gw1(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
        gwm1(k)=gw1(k)*(sin(k*pi/4))/((8*x)**k)
    10 continue
fvpx0=fvpx0+fwp0(k)  
fvmx0=fvmx0+fwm0(k)  
fvpx1=fvpx1+fwp1(k)  
fvmx1=fvmx1+fwm1(k)  
gvpx0=gvpx0+gwp0(k)  
gvmx0=gvmx0+gwm0(k)  
gvpx1=gvpx1+gwp1(k)  
gvmx1=gvmx1+gwm1(k)  
10  continue  
fvpx0=1+fvpx0  
fvmx0=1+fvmx0  
fvpx1=1+fvpx1  
fvmx1=1+fvmx1  
al0=(x/1.41)-(pi/8)  
be0=al0+(pi/4)  
al1=(x/1.41)+(3*pi/8)  
be1=al1+pi/4  

C  ____________________________________________  
if(x.gt.120)then  
    xx1=120  
else  
    xx1=x  
endif  
    ee1=ee**(-(xx1/1.41)  
    qerx0=(sqrt(pi/(2*x)))*(ee1  
        1 *(fvmx0*cos(be0)-gvmx0*sin(be0))  
    qerx1=(sqrt(pi/(2*x)))*(ee1  
        1 *(fvmx1*cos(be1)-gvmx1*sin(be1))  
    qeix0=(sqrt(pi/(2*x)))*(ee1  
        1 *((-1.0)*fvmx0*sin(be0)-gvmx0*cos(be0))  
    qeix1=(sqrt(pi/(2*x)))*(ee1  
        1 *((-1.0)*fvmx1*sin(be1)-gvmx1*cos(be1))  
C  ____________________________________________  
if(x.gt.120)then  
    xx2=120  
else  
    xx2=x  
endif  
    ee2=ee**((xx2/1.41)  
    berx0= (ee2)*((fvpx0*ccs(al0)+gvpx0*sin(al0))/  
        1 sqrt(2*pi*x))-qeix0/pi  
    berx1= (ee2)*((fvpx1*cos(al1)+gvpx1*sin(al1))/  
        1 sqrt(2*pi*x))-qeix1/pi  
    beix0= (ee2)*((fvpx0*sin(al0)-gvpx0*cos(al0))/  
        1 sqrt(2*pi*x))+qeix0/pi  
    beix1= (ee2)*((fvpx1*sin(al1)-gvpx1*cos(al1))/  
        1 sqrt(2*pi*x))+qeix1/pi
c I0() = brO()+i*biO() from Abramowitz and Stegun

c -----------------------------------------------------
c qerx0=(sqrt(pi/(2*x)))*(ee**(-x/1.41))
c 1 *(fvmxO*cos(beO)-gvmxO*sin(beO))
c qeix0=(sqrt(pi/(2*x)))*(ee**(-x/1.41))
c 1 *((-1.0)*fvmx0*sin(be0)-gvmx0*cos(be0))
c ---------------------------------------------------------
c berx0= (ee**(x/1.41))*((fvpx0*cos(al0)+gvpx0*sin(al0))/
c 1 sqrt(2*pi*x))-qeix0/pi

c I1() = br1()+i*bi1() Hand Book of Mathematical

c -----------------------------------------------------

br0=berx0
bi0=beix0
br1=beix1
bi1=(-1.0)*berx1
qr0=qerx0
qi0=qeix0
qr1=(-1.0)*qeix1
qi1=qerx1
return
end
c Cantilever type cracked rotor with disk
  at the end span in finite fluid region
dimension her(2),hei(2)
open(201,file='w.dat')
open(202,file='st.dat')
open(203,file='w3w0.dat')
open(96,file='a.dat')
open(97,file='c.dat')
pi=3.14
write(*,*)'GIVE RADIUS AND LENGTH OF THE SHAFT in cm'
read(*,*)r1,bl
write(*,*)'GIVE RADIUS AND LENGTH OF THE DISC in cm 4,4'
read(*,*)rr1,bbl
den=7.83
ee=2.1e+12
area=pi*r1*r1
ei=ee*pi*(r1**4)/4
ams2=bl*den*area.

c r1=0.4
c bl=60
c write(*,*)'GIVE MASS OF DISC 1570'
c read(*,*)ams1
  ams1=pi*rr1*rr1*bbl*den
c ams1=1570.0

c ams2=192.0

c pi=3.14
c ei=4.14e+08
c akxx=3.0 * ei/(bl**3)
c akyy=akxx
read(202,*)akxx,akyy
read(203,*)w3w0
w3=3.52*(sqrt(ei/(ams2*(bl**3))))
read(201,*)w1,w2
write(*,*)'GIVE THE DENSITY RATIO OF LIQUID TO METAL i.e. am1m/am1ms'
read(*,*)rolm
write(*,*)'GIVE THE GAP RATIO (R2-R1)/R1'
read(*,*)gb
write(*,*)'GIVE CO-EFFICIENT OF VISCOSITY '
read(*,*)un
do 7 lw=1,2
  if (lw.eq.2) then
    bkx=akxx
    bky=akyy
    pw1=w1
    pw2=w2
    akxx=bky
    akyy=bkx
    w1=pw2
    w2=pw1
  endif
aeq1=akxx/(w1*w1*ams2)
aeq2=akyy/(w2*w2*ams2)
am1ms=ams1+aeq1*ams2
am2ms=ams1+aeq2*ams2
am1=ams1*rolm
am2=ams2*rolm
am1m=am1+aeq1*am2
am2m=am1+aeq2*am2
am1ms=am1m/am1ms
am2ms=am2m/am2ms
c
est=ecc/r1
  est=1.0
  w1w0=sqrt(akxx/am1ms)
  w2w0=sqrt(akyy/am2ms)
ggb=((r1+gb*r1)-rr1)/rr1
  wjh=0.9
  do 40 kk=1,30
    write(*,*)kk
    vj=0.01
    if(wjh.ge.(0.98)) then
      vj=0.001
    endif
    if(wjh.ge.(1.004)) then
      vj=0.01
    endif
    w=w1w0*(wjh)
    wjh=wjh+vj
  c
  w=w1w0*(0.98+kk*(0.0004))
unu=un/(r1*r1*w)
c
unu=un*w1w0/w
c
write(*,*)unu,w1w0,am1ms,ams1,ams2,aeq1
c do 40 kk=1,70
  c write(*,*)kk
  c w=w1w0*(0.9+kk*(0.002))
    wfw0=w/w3w0
  c unu=un/(r1*r1*w)
  c unu=un*w3w0/w
    unu1=sqrt(1/unu)
    uunu=un/(rr1*rr1*w)
    uunu1=sqrt(1/uunu)
    call ho(rr1,unu1,gb,her1,hei1)
    call ho(r1,unu1,gb,her2,hei2)
    her1=(am1*her1+aeq1*am2*her2)/am1m
    her2=(am1*her1+aeq2*am2*her2)/am2m
    hei1=(am1*hei1+aeq1*am2*hei2)/am1m
    hei2=(am1*hei1+aeq2*am2*hei2)/am2m
  w1wst=w/w1w0
  w2wst=w/w2w0
  c1=(-1.0)*am1mst*w1wst*hei1/(1+am1mst*her1(1))
  bk1=1/(1+am1mst*her1(1))
  a1=est*(w1wst**2)/(1+am1mst*her1(1))
  c2=(-1.0)*am2mst*w2wst*hei2/(1+am2mst*her2(2))
  bk2=1/(1+am2mst*her2(2))
  a2=est*(w2wst**2)/(1+am2mst*her2(2))
  sa1=atan(c1*w1wst/(bk1-w1wst**2))
  sa2=atan(c2*w2wst/(bk2-w2wst**2))
  getax=a1/(sqrt((bk1-w1wst**2)**2 + (c1*w1wst)**2))
  getay=a2/(sqrt((bk2-w2wst**2)**2 + (c2*w2wst)**2))
  c tao=(0.0+sa1)/w1wst
  tao=((0.0+sa1)/w1wst)*(w2w0/w1w0)
  gny=getay*sin(w2wst*tao-sa2)
  def=sqrt(getax**2+gny**2)
  if(lw.eq.1)then
    write(96,*),fwf0,def,w1wst,getax
  else
    write(97,*),fwf0,def,w1wst,getax
  endif
40 continue
7 continue
stop
end
subroutine ho(r1,x,gb,far,fai)
c write(*,*)'GIVE THE VALUE OF nue star'
c read(*,*)unu
x=sqrt(1/unu)
xa=x
c write(*,*)'GIVE THE VALUE OF R1 AND (R2-R1)/R1'
c read(*,*)r1,gb
r2=gb*r1+r1
xb=x*(r2/r1)
ga=r1/r2
gb=(r2-r1)/r1
call bes(xb,br0,bi0,br1,bi1,1 qr0,qi0,qr1,qi1)
brb0=br0
bib0=bi0
brb1=br1
bib1=bi1
qrb0=qr0
qib0=qi0
qrb1=qr1
qib1=qi1
--------------------------------------------------------------------------------
call bes(xa,br0,bi0,br1,bi1,1 qr0,qi0,qr1,qi1)
bra0=br0
bia0=bi0
bra1=br1
bia1=bi1
qra0=qr0
qia0=qi0
qra1=qr1
qia1=qi1
--------------------------------------------------------------------------------
a11r=brb0*qra1-bib0*qia1+bra1*qrb0-bia1*qib0
a11i=brb0*qia1+qra1*bib0+bra1*qib0+qrb0*bia1
a22r=brb0*qrb1-bib0*qib1+brb1*qrb0-bib1*qib0
a22i=brb0*qib1+qrb1*bib0+brb1*qib0+qrb0*bib1
a33r=bra1*qrb1-bia1*qib1-brb1*qra1+bib1*qia1
a33i=bra1*qib1+qrb1*bia1-brb1*qia1-qra1*bib1
--------------------------------------------------------------------------------
a111r=-xa/1.41
a111i=-xa/1.41
a222r=xa*r1/(1.41*r2)
a222i=xa*r1/(1.41*r2)
a333r=-2.0*(r1/r2)
a333i=0.0
--------------------------------------------------------------------------------
a1r=a111r*a1lr-a111i*a11i
a1i=a111r*a11i+a11r*a111i
a2r=a222r*a22r-a222i*a22i
a2i=a222r*a22i+a22r*a222i
a3r=a333r*a33r-a333i*a33i
a3i=a333r*a33i+a33r*a333i

\[ \begin{align*}
\ar &= a1r+a2r+a3r \\
\ai &= a1i+a2i+a3i \\
d11r &= (bra0*qrb1-bia0*qib1)+(-1.0)*(brb1*qrb0-bib1*qib0)+ \\
&\quad \quad \quad \quad \quad ((-1.0)*(brb1*qra0-bib1*qia0)+(-1.0)*(brb0*qrb1-bib0*qib1)+ \\
&\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad (brb1*qia0+qra0*bib0)+(-1.0)*(brb0*qia0+qra0*bib0) \\
d11i &= (bra0*qib1+qrb1*bia0)+(-1.0)*(brb1*qib0+qrb0*bib1)+ \\
&\quad \quad \quad \quad \quad ((-1.0)*(brb1*qia0+bib1*qia0)+(-1.0)*(brb0*qia0+bib0*qia0)+ \\
&\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad (brb1*qia0+bib1*qia0)+(-1.0)*(brb0*qia0+bib0*qia0) \\
d22r &= (brb0*qra1-bib0*qia1)+(-1.0)*(bra1*qra0-bia1*qia0)+ \\
&\quad \quad \quad \quad \quad ((-1.0)*(bra1*qia0-bia1*qia0)+(-1.0)*(bra0*qia0-bia0*qia0)+ \\
&\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad (bra1*qia0+bia1*qia0)+(-1.0)*(bra0*qia0+bib0*qia0) \\
d22i &= (brb0*qia1+qra1*bib0)+(-1.0)*(bra1*qia0+qra0*bib0)+ \\
&\quad \quad \quad \quad \quad ((-1.0)*(bra1*qia0+qra0*bib0)+(-1.0)*(bra0*qia0+qra0*bib0)+ \\
&\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad (bra1*qia0+qra0*bib0)+(-1.0)*(bra0*qia0+qra0*bib0) \\
d33r &= (brb0*qrb0-bib0*qib0)+(-1.0)*(bra0*qrb0-bia0*qib0)+ \\
&\quad \quad \quad \quad \quad ((-1.0)*(bra0*qrb0-bia0*qib0)+(-1.0)*(bra0*qrb0-bia0*qib0)+ \\
&\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad (brb0*qrb0-bia0*qib0)+(-1.0)*(bra0*qrb0-bia0*qib0) \\
d33i &= (bra0*qib0+qrb0*bia0)+(-1.0)*(bra0*qib0+qrb0*bia0)+ \\
&\quad \quad \quad \quad \quad ((-1.0)*(bra0*qib0+qrb0*bia0)+(-1.0)*(bra0*qib0+qrb0*bia0)+ \\
&\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad (bra0*qib0+qrb0*bia0)+(-1.0)*(bra0*qib0+qrb0*bia0) \\
\end{align*} \]

dr = d1r+d2r+d3r
di = d1i+d2i+d3i
far=2*(ar*dr+ai*di)/(dr*dr+di*di)
fae=2*(ai*dr-ar*di)/(dr*dr+di*di)

write('(*,*)',gb,far,fae)
write('(*,*)',ar='ar','ai='ai,'dr='dr,'di='di)
return
end

subroutine bes(x,br0,bio,br1,bi1)
Dimension fw0(32),fw1(32),gw0(32),gw1(32)
Dimension fwp0(32),fwm0(32),fwp1(32),fwm1(32)
Dimension gwp0(32),gwm0(32),gwp1(32),gwm1(32)
fvp0=0.0
fvm0=0.0
fvp1=0.0
fvm1=0.0
gvp0=0.0
gvm0=0.0
gvp1=0.0
gvm1=0.0
ee=2.718
pi=3.14
c read(*,*)x
do 10 k = 1,20
fw0(k)=1.0
fw1(k)=1.0
gw0(k)=1.0
gw1(k)=1.0
do 20 i = 1,k
fw0(k)=fw0(k)*((2*i-1)**2)/i
fw1(k)=fw1(k)*((2*i-1)**2)/i
gw0(k)=gw0(k)*((2*i-1)**2)/i
gw1(k)=gw1(k)*((2*i-1)**2)/i
20 continue
fwp0(k)=fw0(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
fwm0(k)=fw0(k)*(cos(k*pi/4))/((8*x)**k)
fwp1(k)=fw1(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
fwm1(k)=fw1(k)*(cos(k*pi/4))/((8*x)**k)
gwp0(k)=gw0(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
gwm0(k)=gw0(k)*(sin(k*pi/4))/((8*x)**k)
gwp1(k)=gw1(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
gwm1(k)=gw1(k)*(sin(k*pi/4))/((8*x)**k)
fvp0=fvp0+fwp0(k)
fvm0=fvm0+fwm0(k)
fvp1=fvp1+fwp1(k)
fvm1=fvm1+fwm1(k)
gvp0=gvp0+gwp0(k)
gvm0=gvm0+gwm0(k)
gvp1=gvp1+gwp1(k)
gvm1=gvm1+gwm1(k)
10 continue
fvp0=1+fvp0
fvm0=1+fvm0
fvp1=1+fvp1
fvm1=1+fvm1
\[ a_0 = \frac{x}{1.41} - \frac{\pi}{8} \]
\[ b_0 = a_0 + \frac{\pi}{4} \]
\[ a_1 = \frac{x}{1.41} + \frac{3\pi}{8} \]
\[ b_1 = a_1 + \frac{\pi}{4} \]

\[
\begin{align*}
\text{if}(x \gt 120) & \text{then} \\
xx1 &= 120 \\
\text{else} \\
xx1 &= x \\
\text{endif} \\
\text{ee1} &= ee^{**(-xx1/1.41)} \\
\text{qerx0} &= (\sqrt{\pi/(2x)}) \times ((fvmx0 \times \cos(al0) - gvmx0 \times \sin(al0))) \\
\text{qerx1} &= (\sqrt{\pi/(2x)}) \times ((fvmx1 \times \cos(al1) - gvmx1 \times \sin(al1))) \\
\text{qeix0} &= (\sqrt{\pi/(2x)}) \times ((-1.0) \times fvmx0 \times \sin(al0) - gvmx0 \times \cos(al0)) \\
\text{qeix1} &= (\sqrt{\pi/(2x)}) \times ((-1.0) \times fvmx1 \times \sin(al1) - gvmx1 \times \cos(al1)) \\
\text{if}(x \gt 120) & \text{then} \\
xx2 &= 120 \\
\text{else} \\
xx2 &= x \\
\text{endif} \\
\text{ee2} &= ee^{**(xx2/1.41)} \\
\text{berx0} &= \left( \frac{ee2}{\sqrt{2\pi x}} \right) \times \left( \frac{fvp0x0 \times \cos(al0) + gvp0x0 \times \sin(al0)}{} \right) \\
\text{berx1} &= \left( \frac{ee2}{\sqrt{2\pi x}} \right) \times \left( \frac{fvp1x1 \times \cos(al1) + gvp1x1 \times \sin(al1)}{} \right) \\
\text{beix0} &= \left( \frac{ee2}{\sqrt{2\pi x}} \right) \times \left( \frac{-1.0 \times fvp0x0 \times \sin(al0) - gvp0x0 \times \cos(al0)}{} \right) \\
\text{beix1} &= \left( \frac{ee2}{\sqrt{2\pi x}} \right) \times \left( \frac{-1.0 \times fvp1x1 \times \sin(al1) - gvp1x1 \times \cos(al1)}{} \right) \\
\end{align*}
\]

\[
\begin{align*}
\text{br0} &= \text{berx0} \\
\text{bi0} &= \text{beix0} \\
\text{br1} &= \text{beix1} \\
\text{bi1} &= (-1.0) \times \text{berx1}
\end{align*}
\]
qr0=qerx0
qi0=qeix0
qr1=(-1.0)*qeix1
qi1=qerx1
return
end
Cantilever type cracked rotor with disk at the end span in infinite fluid region
dimension her(2), hei(2)
open(201, file='w.dat')
open(202, file='st.dat')
open(203, file='w4w0.dat')
open(96, file='a.dat')
open(97, file='c.dat')
pi=3.14
write(*,*)'GIVE RADIUS AND LENGTH OF THE SHAFT in cm'
read(*,*)r1, bl
write(*,*)'GIVE RADIUS AND LENGTH OF THE DISC in cm'
read(*,*)rr1, bbl
den=7.83
ee=2.1e+12
area=pi*r1*r1
ei=ee*pi*(r1**4)/4
ams2=bl*den*area

r1=0.4
bl=60
write(*,*)'GIVE MASS OF DISC 1570'
read(*,*)ams1
ams1=pi*rr1*rr1*bbl*den

ams1=1570.0
ams2=192.0
pi=3.14
ei=4.14e+08
read(202,*)akxx, akyy
akxx=3.0 * ei/(bl**3)
akyy=akxx
w3=3.52*(sqrt(ei/(ams2*(bl**3)))))
read(203,*)w3w0
read(201,*)w1, w2
write(*,*)'GIVE THE DENSITY RATIO OF LIQUID TO METAL i.e. am1m/am1ms'
read(*,*)rolm
write(*,*)'GIVE THE GAP RATIO (R2-R1)/R1'
read(*,*)gb
write(*,*)'GIVE CO-EFFICIENT OF VISCOSITY'
read(*,*)un

do 7 lw=1,2
if (lw.eq.2) then
bkx=akxx
bky=akyy
pw1=w1
pw2=w2
akxx=bky
akyy=bkx
w1=pw2
w2=pw1
endif

eaq1=akxx/(w1*w1*ams2)
eaq2=akyy/(w2*w2*ams2)
c
\[ aeq1 = \frac{48}{\pi^2} \]
c
eaq2=aeq1
am1ms=ams1+aeq1*ams2
am2ms=ams1+aeq2*ams2
\[ w1 = \pi^2 (\sqrt{ei/(am1ms*(bl**3))}) \]
am1=ams1*rolm
am2=ams2*rolm
am1m=am1+aeq1*am2
am2m=am1+aeq2*am2
am1mst=am1m/am1ms
am2mst=am2m/am2ms

c
est=ecc/r1

est=1.0
w1w0=sqrt(akxx/am1ms)
\[ w2w0 = \sqrt{akyy/am2ms} \]
wjh=0.9
do 40 kk=1,30
write(*,*)kk
vj=0.01
if(wjh.ge.(0.98))then
vj=0.001
endif
if(wjh.ge.(1.004))then
vj=0.01
endif
w=w1w0*(wjh)
wjh=wjh+vj
\[ w = w1w0*(0.9+kk*(0.002)) \]
unu=un/(r1*r1*w)
c
unu=un*w3w0/w
c
\[ write(*,*)unu,w1w0,am1ms,ams1,ams2,aeq1 \]
unu1=sqrt(1/unu)
\[ uunu = \frac{un}{rr1*rr1*w} \]
\[ uunu1 = \sqrt{1/uunu} \]
call ho(rr1,unu1,her1,hei1)
call ho(r1,unu1,her2,hei2)
her(1) = (am1*her1 + aeq1*am2*her2)/am1m
her(2) = (am1*her1 + aeq2*am2*her2)/am2m
hei(1) = (am1*hei1 + aeq1*am2*hei2)/am1m
hei(2) = (am1*hei1 + aeq2*am2*hei2)/am2m
w1wst = w/w1w0
w2wst = w/w2w0
wfw0 = w/w3w0
c1 = (-1.0)*am1mst*w1wst*hei(1)/(1+am1mst*her(1))
bk1 = 1/(1+am1mst*her(1))
a1 = est*(w1wst**2)/(1+am1mst*her(1))
c2 = (-1.0)*am2mst*w2wst*hei(2)/(1+am2mst*her(2))
bk2 = 1/(1+am2mst*her(2))
a2 = est*(w2wst**2)/(1+am2mst*her(2))
sa1 = atan(c1*w1wst/(bk1-w1wst**2))
sa2 = atan(c2*w2wst/(bk2-w2wst**2))
getax = a1/(sqrt((bk1-w1wst**2)**2 + (c1*w1wst)**2))
getay = a2/(sqrt((bk2-w2wst**2)**2 + (c2*w2wst)**2))
ctao = (0.0+sa1)/w1wst
tao = ((0.0+sa1)/w1wst)*(w2w0/w1w0)
gny = getay*sin(w2wst*tao-sa2)
def = sqrt(getax**2+gny**2)
if(lw.eq.1) then
write(96,*)wfw0,def,w1wst,getax
else
write(97,*)wfw0,def,w1wst,getax
endif
40 continue
7 continue
stop
end
subroutine ho(r1,x,ar,ai)
Dimension fw0(32),fw1(32),gw0(32),gw1(32)
Dimension fwp0(32),fwm0(32),fwp1(32),fwm1(32)
Dimension gwp0(32),gwm0(32),gwp1(32),gwm1(32)
fvpx0 = 0.0
fvmx0 = 0.0
fvpx1 = 0.0
fvmx1 = 0.0
gvpx0 = 0.0
gvmx0 = 0.0
gvpx1 = 0.0
gvmx1=0.0
e=2.718
pi=3.14
read(*,*)x
do 10 k=1,20
fw0(k)=1.0
fw1(k)=1.0
gw0(k)=1.0
gw1(k)=1.0
do 20 i=1,k
fw0(k)=fw0(k)*(0-((2*i-1)*'2))/i
fw1(k)=fw1(k)*(4-((2*i-1)*'2))/i
gw0(k)=gw0(k)*(0-((2*i-1)**2))/i
gw1(k)=gw1(k)*(4-((2*i-1)**2))/i
continue
fwp0(k)=fw0(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
fwm0(k)=fw0(k)*(cos(k*pi/4))/((8*x)**k)
fwp1(k)=fw1(k)*((-1.0)**k)*(cos(k*pi/4))/((8*x)**k)
fwm1(k)=fw1(k)*(cos(k*pi/4))/((8*x)**k)
gwp0(k)=gw0(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
gwm0(k)=gw0(k)*(sin(k*pi/4))/((8*x)**k)
gwp1(k)=gw1(k)*((-1.0)**k)*(sin(k*pi/4))/((8*x)**k)
gwm1(k)=gw1(k)*(sin(k*pi/4))/((8*x)**k)
fvpx0=fvpx0+fwp0(k)
fvmx0=fvpx0+fwm0(k)
fvpx1=fvpx1+fwp1(k)
fvmx1=fvpx1+fwm1(k)
gvpx0=gvpx0+gwp0(k)
gvmx0=gvpx0+gwm0(k)
gvpx1=gvpx1+gwp1(k)
gvmx1=gvpx1+gwm1(k)
continue
fvpx0=1+fvpx0
fvmx0=1+fvmx0
fvpx1=1+fvpx1
fvmx1=1+fvmx1
al0=(x/1.41)-(pi/8)
be0=al0+(pi/4)
al1=(x/1.41)+(3*pi/8)
be1=al1+pi/4
if(x.gt.120)then
xx1=120
else
xx1=x
endif
ee1=ee**(-xx1/1.41)
qerx0=(sqrt(pi/(2*x)))*(ee1)
1 *(fvmx0*cos(be0)-gvmx0*sin(be0))
qerx1=(sqrt(pi/(2*x)))*(ee1)
1 *(fvmx1*cos(be1)-gvmx1*sin(be1))
qei0=(sqrt(pi/(2*x)))*(ee1)
1 *((-1.0)*fvmx0*sin(be0)-gvmx0*cos(be0))
qei1=(sqrt(pi/(2*x)))*(ee1)
1 *((-1.0)*fvmx1*sin(be1)-gvmx1*cos(be1))

if(x.gt.120)then
xx2=120
else
xx2=x
endif
ee2=ee**(xx2/1.41)
berx0= (ee2)*((fvpx0*cos(al0)+gvpx0*sin(al0)) /
1 sqrt(2*pi*x))-qei0/pi
berx1= (ee2)*((fvpx1*cos(al1)+gvpx1*sin(al1)) /
1 sqrt(2*pi*x))-qei1/pi
beix0= (ee2)*((fvpx0*sin(al0)-gvpx0*cos(al0)) /
1 sqrt(2*pi*x))+qerx0/pi
beix1= (ee2)*((fvpx1*sin(al1)-gvpx1*cos(al1)) /
1 sqrt(2*pi*x))+qerx1/pi

c------------------------------------------------------
adr=qr0-qi0
adi=qr0+qi0
anr=qr1*1.41
ani=qi1*1.41
344
ar = 2*(anr*adr+ani*adi)/(x*(adr*adr+adi*adi))
ai = 2*(ani*adr-anr*adi)/(x*(adr*adr+adi*adi))
return
end