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**THE EFFECTS OF NONUNIFORM SWASH-PLATE
STIFFNESS ON COUPLED BLADE-CONTROL
SYSTEM DYNAMICS AND STABILITY**

Part II - Computer Program Listing

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Prepared by

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16. Abstract <p>This program was developed for investigating the effects of an anisotropically mounted flexible swash-plate, including blade out-of-track, on the vibratory and mechanical stability characteristics of helicopter rotor systems. The analysis which this program implements is based on a combined Laplace transform and associated matrix approach. The analysis and application of this program is presented in Part I of this report which is published as NASA CR. The program yields eigenvalues which indicate frequency and rate of growth or decay of a natural mode of the complex system. Blade modal response and swash-plate motion corresponding to a given eigenvalue are predicted.</p>					
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```

C      MAIN PROGRAM FOR NASA 5
      INTEGER CY18A,CY3
      COMPLEX EGNS(5),          ALM(287),EPS(287)
      COMPLEX REM(9)
      COMPLEX EGNN,EGNL,EGNC,REML,REMC
      COMPLEX DETSV
      COMPLEX CY1,CY2,CY5,CY6
      REAL CS(4,5),SN(4,5),CS1(4,10),SN1(4,10)
      COMPLEX D(3276),C(56)
      COMPLEX DD(252)
      COMMON/DC/D,C
      COMMON/IMSB/MS
      COMMON/BRIGD/EGNS
      COMMON/IBRIG/MINPN,MAXPN,NEGNS,NPRCNT,MXITER,MXERDR,ITDET
      COMMON/DD1/DD
      COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IEM(9)
      COMMON/RNAME/CS,SN
      COMMON/RNAME1/CS1,SN1
      COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
      COMMON/EPSA/EPS,REM
1      ,DETSV
      COMMON/CALM/ALM
      COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1      CY16,CY17,CY20,CY39,CY3,CY18A

C
      CALL MIDK
      CALL SETUP

C
      IF(IFV) 60,60,70
60  MODE=0
      NP=MINPN
66  MFP=0
      IF(NP-MAXPN)61,61,100
61  CY1=CY2*NP*CY4
      CALL MIDK
      DO 64  MS=1,NB
      CALL BARRAY
      CALL BLADE
64  CALL HBLOCK
      CALL QSOLN
      MFP=1
      CALL MIDK
      DO 65  MS=1,NB
      CALL BARRAY
65  CONTINUE
      NP=NP+1

```

```

GO TO 66
70 CONTINUE
KIN=NRIFC*NF+1
KFIN=NRIFC*NFP1
MFP=0
DO 99 L=1,NEGNS
DO 115 K=1,MXQ
115 ALM(K)=(1.,0.)
DO 76 L1=1,MXQ
76 EPS(L1)=(0.,0.)
MODE=0
ITI=0
74 DO 118 K=1,MXQ
ALM(K)=ALM(K)+EPS(K)
CMMM=CABS(ALM(K))
IF(CMMM .GT. .1E-50) GO TO 118
ALM(K)=(0.,0.)
118 CONTINUE
WRITE(NOUT,929) MXQ
WRITE(NOUT,930) (ALM(K),K=1,MXQ)
IF(ITI-1)73,75,77
73 CY1=EGNS(L)
GO TO 80
75 CY1 = (1+.00001*NPRCNT)*EGNS(L)
GO TO 80
77 CY1=EGNN
80 CONTINUE
CALL MIDK
DO 85 MS=1,NB
CALL BARRAY
CALL BLADE
85 CONTINUE
CALL EPSOLN
IF(MXITER .EQ. 0) GO TO 99
IF (ITI-1) 91,92,93
91 EGNL=CY1
REML=REM(ITEREM)
IF(ITDET.EQ.0) GO TO 98
REML=DETSV
WRITE (6,9875) EGNL,REML
9875 FORMAT (*OEGNL *,2G14.7,5X,*REML *,2G14.7)
GO TO 98
92 EGNC=CY1
REMC=REM(ITEREM)
IF(ITDET.EQ.0) GO TO 9200
REMC=DETSV
9200 CONTINUE
EGNN=EGNC-REMC*(EGNC-EGNL)/(REMC-REML)
WRITE (6,9876) EGNC,EGNN,REMC
9876 FORMAT (*OEGNC *,2G14.7,3X,*EGNN *,2G14.7,3X,*REMC *,2G14.7)

```

```

GO TO 98
93 EGNL=EGNC
   EGNC=C*Y1
   REML=REMC
   REMC=REM{ITEREM}
   IF(ITDET.EQ.0) GO TO 9300
   REMC=DETSV
9300 CONTINUE
   EGNN=EGNC-REMC*(EGNC-EGNL)/(REMC-REML)
   ER= CABS((EGNN-EGNC)/EGNC)
   WRITE (6,9877) EGNL,EGNC,EGNN
9877 FORMAT (*OEGNL *,2G14.7,3X,*EGNC *,2G14.7,3X,*EGNN *,2G14.7)
   WRITE (6,9878) REML,REMC,ER
9878 FORMAT (*OREML *,2G14.7,3X,*REMC *,2G14.7,3X,*ER *,2G14.7)
   IF(ER-.1**MXEROR) 94,94,95
94  MODE=1
   CALL MIDK
   DO 185 MS=1,NB
   CALL BARRAY
185 CONTINUE
   GO TO 99
95  IF(ITI-MXITER) 98,94,99
98  ITI=ITI+1
   GO TO 74
99  CONTINUE
100 CONTINUE
929 FORMAT(3(/),41X,I4,* VALUES OF UPDATED LAMBDA MATRIX*/)
930 FORMAT (10(1PE12.4))
   STOP
   END

```



```
SUBROUTINE MIDK
REAL Y(125), SD(7500)
COMPLEX B(588),H(84),FAB(49),FLB(49),CTB(49),FAH(7),FLH(7),CTH(
17)
COMPLEX SMLB(168),SMLC(168),SMLD(168)
COMPLEX FASB(14),FLSC(14),FLSD(14),FASD(14),CTSB(14),CTSD(14)
COMPLEX FLSB(14)
COMMON/BTS/B,SMLB,SMLC,SMLD,FASB,FLSB,CTSB,FLSC,FLSD,FASD,CTSD,
1 FAB,FLB,CTB
COMMON /RBTS/H,CTH,FLH,FAH
COMMON/SUB/Y
COMMON/SAIN/SD
RETURN
END
```

```

SUBROUTINE BARRAY
COMMON/IMSB/MS
INTEGER DM(6), EM(6)
INTEGER CY18A, CY3
REAL SD(7500)
REAL RREAL(144)
REAL Y(125)
COMPLEX CY1,CY2,CY5,CY6
COMPLEX SHAPE(12)
COMPLEX QU(287)
COMPLEX EPS(287),ALM(287)
COMPLEX DETSV
COMPLEX TH(84),FP(12),R(144),T(84)
COMPLEX REM(9)
COMPLEX B(588),H(84),FAB(49),FLB(49),CTB(49),FAH(7),FLH(7),CTH(
17)
COMPLEX SMLB(168),SMLC(168),SMLD(168)
COMPLEX FASB(14),FLSC(14),FLSD(14),FASD(14),CTSB(14),CTSD(14)
COMPLEX FLSB(14)
COMMON/SAIN/SD
COMMON/SUB/Y
COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1 CY16,CY17,CY20,CY39,CY3,CY18A
COMMON/BTS/B,SMLB,SMLC,SMLD,FASB,FLSB,CTSB,FLSC,FLSD,FASD,CTSD,
1 FAB,FLB,CTB
COMMON/CALM/ALM
COMMON /RBTS/H,CTH,FLH,FAH
COMMON/EPSA/EPS,REM
1 ,DETSV
EQUIVALENCE (EPS,QU)
DATA EM/1,15,29,42,57,70/
DATA DM/1,3,5,6,9,10/
REWIND 2
READ(2) SD
NCFEA=1
NCFLP=1
NCCT=1
IF(IFV) 12,12,13
12 DO 20 L=1,MXKQ
20 H(L)=(0.,0.)
13 DO 15 L=1,MXSMB
SMLB(L)=(0.,0.)
SMLC(L)=(0.,0.)
15 SMLD(L)=(0.,0.)
DO 22 K=1,MXCPK

```

```

22 B(K)=(0.,0.)
C INITIALIZE B,SMLB,SMLC,SMLD,BLOCKS TO LAMBDA
C MATRICES APART FROM FIRST COLUMN PRESENT IN FREE VIB CASE
DO 30 I=1,MXSMI
K=MXCSB*I-9
SMLC(K)=(1.,0.)
K=K+1
SMLB(K)=(1.,0.)
K=K+6
SMLD(K)=(1.,0.) *MFLAP
LM1=(I-1)*MXCPM
DO 30 M=1,6
K=LM1+EM(M)+12*IFV
30 B(K)=(1.,0.)
IF(IFV) 39,39,23
23 DO 38 I=1,MXSMI
NC2=MXCSB*I
NC1=(I-1)*NRIFC+MXT2P1+(MS-1)*NRBD
LM1=(I-1)*MXCPM
DO 34 M=1,6
K=LM1+DM(M)
L=NC1+M
34 B(K)=ALM(L)
K=NC2-21
L=NC1+7
SMLC(K)=ALM(L)
K=NC2-20
L=NC1+8
SMLB(K)=ALM(L)
IF(*MFLAP) 38,38,35
35 K=NC2-14
L=NC1+9
SMLD(K)=ALM(L)
38 CONTINUE
39 CONTINUE
32 CONTINUE
900 FORMAT(10(1PE12.4))
ISM=(MS-1)*NSD
DO 501 IS=1,NS
ISM1=ISM+(IS-1)*NSIZEY
NCPLX=1
DO 50 L=1,NSIZEY
M=ISM1+L
50 Y(L)=SD(M)
C MULTIPLY BY RIGID, BEND, AND ELAST WHICH ARE DEPENDENT
C ONLY ON SECTION NUMBER
IF (Y(116)) 80,80,55
55 CALL RIGID (RREAL)
LGO=1
C I SETS BLOCK POSITION IN FINAL ARRAY M,L SETS

```

C ELEMENT POSITION WITHIN A GIVEN BLOCK

```

60 DO 79 I=1,MXSMI
    IM1=(I-1)*12
    IF(IFV) 51,51,52
51 DO 61 M=1,12
    K=IM1+M
61 TH(M)=H(K)
    GO TO (62,63),NCPLX
62 CALL MLRC1(RREAL,TH)
    GO TO 64
63 CALL MLCC1(R,TH)
64 DO 65 M=1,12
    K=IM1+M
65 H(K)=TH(M)
52 LM1=(I-1)*MXCPM
    DO 66 M=1,MXCPM
    K=LM1+M
66 T(M)=B(K)
    GO TO (67,68),NCPLX
67 CALL MLRC2(RREAL,T,NCOLS)
    GO TO 69
68 CALL MLCC2(R,T,NCOLS)
69 DO 70 M=1,MXCPM
    K=LM1+M
    B(K)=T(M)
70 CONTINUE
    GO TO (77,71),NCFEA
71 LBM1=(I-1)*MXCSB
    DO 72 M=1,MXCSB
    K=LBM1+M
72 TH(M)=SMLC(K)
    GO TO (73,74),NCPLX
73 CALL MLRC2(RREAL,TH,NCSB)
    GO TO 75
74 CALL MLCC2(R,TH,NCSB)
75 DO 76 M=1,MXCSB
    K=LBM1+M
76 SMLC(K)=TH(M)
77 GO TO (78,711),NCCT
711 LBM1=(I-1)*MXCSB
    DO 721 M=1,MXCSB
    K=LBM1+M
721 TH(M)=SMLB(K)
    GO TO (731,741),NCPLX
731 CALL MLRC2(RREAL,TH,NCSB)
    GO TO 751
741 CALL MLCC2(R,TH,NCSB)
751 DO 761 M=1,MXCSB
    K=LBM1+M
761 SMLB(K)=TH(M)

```

```

78 GO TO (79,712), NCFLP
712 LBM1=(I-1)*MXCSB
    DO 722 M=1,MXCSB
        K=LBM1+M
722 TH(M)=SMLD(K)
    GO TO (732,742),NCPLX
732 CALL MLRC2(RREAL,TH,NCSB)
    GO TO 752
742 CALL MLCC2(R,TH,NCSB)
752 DO 762 M=1,MXCSB
        K=LBM1+M
762 SMLD(K)=TH(M)
79 CONTINUE
    GO TO (80,100,120),LGO
80 IF(Y(113)) 100,100,85
85 CALL BEND (RREAL)
    LGO=2
    GO TO 60
100 IF(Y(115)) 120,120,102
102 CALL ELAST(R)
    LGO=3
    NCPLX=2
    GO TO 60
C    MULTIPLY BY STIFFNESS AND MASS MATRICES WHICH ARE
C    DEPENDENT ON SHIFT NUMBER
120 DO 200 I=1,MXSMI
    IM1= (I-1)*12
    KSML=I-NFPI
    CY3=KSML
    CY5=CY1-CY2*CY3*CY4
    CY6=CY5*CY5
    IF (Y(117)) 145,145,125
125 CALL STIFF(R,CY5)
    LGO=1
129 IF(IFV) 130,130,127
130 DO 132 M=1,12
    K=IM1+M
132 TH(M)=H(K)
    CALL MLCC1(R,TH)
    DO 135 M=1,12
        K=IM1+M
135 H(K)=TH(M)
127 LM1=(I-1)*MXCPM
    DO 136 M=1,MXCPM
        K=LM1+M
136 T(M)=B(K)
    CALL MLCC2 (R,T,NCOLS)
    DO 137 M=1,MXCPM
        K=LM1+M
        B(K)=T(M)

```

```

137 CONTINUE
    GO TO (142,138),NCFEA
138 LBM1=(I-1)*MXCSB
    DO 139 M=1,MXCSB
      K=LBM1+M
139 TH(M)=SMLC(K)
    CALL MLCC2(R,TH,NCSB)
    DO 140 M=1,MXCSB
      K=LBM1+M
140 SMLC(K)=TH(M)
142 CONTINUE
    GO TO (400,401),NCFLP
401 LBM1=(I-1)*MXCSB
    DO 402 M=1,MXCSB
      K=LBM1+M
402 TH(M)=SMLD(K)
    CALL MLCC2(R,TH,NCSB)
    DO 403 M=1,MXCSB
      K=LBM1+M
403 SMLD(K)=TH(M)
400 CONTINUE
    GO TO (404,405),NCCT
405 LBM1=(I-1)*MXCSB
    DO 406 M=1,MXCSB
      K=LBM1+M
406 TH(M)=SMLB(K)
    CALL MLCC2(R,TH,NCSB)
    DO 407 M=1,MXCSB
      K=LBM1+M
407 SMLB(K)=TH(M)
404 CONTINUE
144 GO TO (145,170),LGO
145 IF(Y(112)) 200,200,148
148 IF(IFV) 150,150,146
146 CY18A=0
    GO TO 165
150 KMNP=KSML-NP
    IF(KMNP) 152,151,152
151 CY18A=0
    GO TO 165
152 IF(KMNP+1) 154,153,154
153 CY18A=1
    GO TO 165
154 IF(KMNP-1) 165,155,165
155 CY18A=-1
165 CALL MASSB(R,FP)
    LGO=2
    GO TO 129
170 IF(IFV) 171,171,200
171 DO 180 M=1,12

```

```

      K=IM1+M
180 H(K)=H(K)+FP(M)
200 CONTINUE
      IF (MODE .NE. 0) GO TO 347
      IF (MFP .NE. 0) GO TO 347
305 IF (IS-NFEA) 326,310,326
310 NCFEA=2
      DO 320 I=1,MXFAB
      K=(I-1)*12+4
320 FAB(I)=B(K)
      IF(IFV) 311,311,312
311 DO 321 I=1,MXSMI
      K=(I-1)*12+4
321 FAH(I)=H(K)
312 IF(IS-NCT) 323,322,322
322 DO 324 I=1,MFASB
      K=(I-1)*12+4
324 FASB (I)= SMLB(K)
323 IF (IS-NFLAP) 326,325,325
325 DU 327 I=1,MFASB
      K= (I-1)*12+4
327 FASD(I)=SMLD(K)
326 CONTINUE
      IF (IS-NCT) 340,328,340
328 NCCT=2
      DO 329 I=1,MXFAB
      K=(I-1)*12+3
329 CTB(I)=B(K)
      IF(IFV) 313,313,314
313 DO 330 I=1,MXSMI
      K=(I-1)*12+3
330 CTH(I)=H(K)
314 DO 331 I=1,MFASB
      K=(I-1)*12+4
331 CTSB(I)=SMLB(K)
      IF (IS-NFLAP) 333,332,332
332 DO 334 I=1,MFASB
      K=(I-1)*12+3
334 CTSD(I)=SMLD(K)
333 CONTINUE
340 IF (IS-NFLAP) 345,335,345
335 NCFLP=2
      DO 336 I=1,MXFAB
      K=(I-1)*12+11
336 FLB(I)=B(K)
      IF(IFV) 315,315,316
315 DO 337 I=1,MXSMI
      K=(I-1)*12+11
337 FLH(I)=H(K)
316 IF(IS-NCT) 339,338,338

```

```

338 DO 342 I=1,MFASB
      K=(I-1)*12+11
342 FLSB(I)=SMLB(K)
339 IF (IS-NFEA) 345,343,343
343 DO 344 I=1,MFASB
      K=(I-1)*12+11
344 FLSC(I)=SMLC(K)
345 CONTINUE
632 CONTINUE
346 GO TO 501
347 IB=1
      IF (NCT.GT.IS) IB=0
      IC=1
      IF (NFEA.GT.IS) IC=0
      ID=1
      IF (NFLAP.GT.IS) ID=0
      IF (MFP .NE. 0) GO TO 350
      IJ1=NF*MXCPM
      IJ2=NF*MXCSB
      IK1=NRIFC*NF+MXT2P1+(MS-1)*NRBD
      DO 348 IR=1,12
        K=IJ1+IR
        L=IJ2+IR
        SHAPE(IR)=B(K)-IB*SMLB(L)-IC*SMLC(L)-ID*SMLD(L)
354 DO 349 IP=1,6
        K1=K+12*IP
        L1=IK1+IP
349 SHAPE(IR)=SHAPE(IR)+B(K1)*EPS(L1)
        LPT=L+12
        SHAPE(IR)=SHAPE(IR)-IB*SMLB(LPT)*EPS(IK1+8)-
1 IC*SMLC(LPT)*EPS(IK1+7)
        IF (ID .EQ. 0) GO TO 348
        SHAPE(IR)=SHAPE(IR)-ID*SMLD(LPT)*EPS(IK1+9)
348 CONTINUE
        WRITE (6,961)
961 FORMAT(1H0,* VALUES OF SHAPE VECTOR*/)
        WRITE (6,900) (SHAPE(IR), IR=1,12)
        GO TO 501
350 IJ1=NF*72
      IJ2=NF*12
      IK1=NRIFC*NF+MXT2P1+ (MS-1)*NRBD
      DO 352 IR=1,12
        K=IJ1+IR
        L=IJ2+IR
        SHAPE(IR)=-IB*SMLB(L)*QU(IK1+8)-IC*SMLC(L)*QU(IK1+7)+H(L)
        IF (ID .EQ. 0) GO TO 351
        SHAPE(IR)=SHAPE(IR)-ID*SMLD(L)*QU(IK1+9)
351 DO 352 IP=1,6
        L1=IK1+IP
        K1=K+(IP-1)*12

```



```
352 SHAPE(IR)=SHAPE(IR)+B(K1)*QU(L1)
    WRITE (6,961)
    WRITE (6,900) (SHAPE(IR), IR=1,12)
501 CONTINUE
    RETURN
    END
```

```
SUBROUTINE MLRC1 (R,T)
REAL R(144)
COMPLEX T(12),THLD(12)
DO 50 I=1,12
50 THLD(I)=(0.,0.)
DO 100 M=1,12
MM1=(M-1)*12
DO 100 I=1,12
LM=MM1+I
100 THLD(M)=R(LM)*T(I)+THLD(M)
DO 200 I=1,12
200 T(I)=THLD(I)
RETURN
END
```

```
SUBROUTINE MLCC1 (R,T)
  COMPLEX R(144), T(12),THLD(12)
  DO 50 I=1,12
50 THLD(I)=(0.,0.)
  DO 100 M=1,12
  MM1=(M-1)*12
  DO 100 I=1,12
  LM=MM1+I
100 THLD(M)=R(LM)*T(I)+THLD(M)
  DO 200 I=1,12
200 T(I)=THLD(I)
  RETURN
  END
```

```

SUBROUTINE MLRC2(R,T,NCOLS)
REAL R(144)
COMPLEX T(84), THLD(84)
NCR=12*NCOLS
DO 50 I=1,NCR
50 THLD(I)=(0.,0.)
DO 100 N=1,NCOLS
NN1=(N-1)*12
DO 100 M=1,12
MM1=(M-1)*12
K=NN1+M
DO 100 I=1,12
LM=MM1+I
LN=NN1+I
100 THLD(K)=R(LM)*T(LN)+THLD(K)
DO 200 I=1,NCR
200 T(I)=THLD(I)
RETURN
END

```

```

SUBROUTINE MLCC2 (R,T,NCOLS)
COMPLEX R(144),T(84),THLD(84)
NCR=12*NCOLS
DO 50 I=1,NCR
50 THLD(I)=(0.,0.)
DO 100 N=1,NCOLS
NN1=(N-1)*12
DO 100 M=1,12
MM1=(M-1)*12
K=NN1+M
DO 100 I=1,12
LM=MM1+I
LN=NN1+I
100 THLD(K)=R(LM)*T(LN)+THLD(K)
DO 200 I=1,NCR
200 T(I)=THLD(I)
RETURN
END

```

```

SUBROUTINE STIFF (SK,CY5)
REAL Y(125)
COMPLEX SK(144)
COMPLEX CY5
COMMON /SUB/ Y
DO 5 I=1,144
5 SK(I)=(0.,0.)
IF (Y(111)) 198,199,198
198 SK(39)= Y(111)
GO TO 200
199 SK(28)= Y(105) / (1. + Y(108) * CY5)
SK(67)= Y(107) / (1. + Y(110) * CY5)
SK(119)= Y(106) / (1. + Y(109) * CY5)
200 DO 201 I = 1,144,13
201 SK(I)=(1.,0.)
RETURN
END

```

```

SUBROUTINE RIGID(R)
REAL Y(125)
REAL R(144)
COMMON/SUB/Y
DO 5 L=1,144
5 R(L)=0.
IF (Y(116)-1.) 80,79,80
79 Y(99)=-Y(99)
Y(100)=-Y(100)
Y(101)=-Y(101)
80 DO 10 L=1,144,13
10 R(L)= 1.
R(6)=-Y(100)
R(10) = Y(101)
R(39) = +(Y(101)* Y(104)+ Y(100)* Y(103))
R(42) = -Y(99)*Y(104)
R(44) = -Y(101)
R(46) = -Y(99)*Y(103)
R(48) = -Y(100)
R(51) = -Y(101)
R(54) = Y(99)
R(74) = Y(100)
R(75)=-Y(101)* Y(102)
R(78)= +(Y(100)* Y(103)+ Y(99)* Y(102))
R(80)= Y(99)
R(82)=-Y(101)* Y(103)
R(99)= -Y(100)
R(106)= Y(99)
R(122)= -Y(101)
R(123)=-Y(100) * Y(102)
R(126)=-Y(100) * Y(104)
R(130)= +(Y(99) * Y(102)+ Y(101)* Y(104))
R(132)= Y(99)
RETURN
END

```

```

SUBROUTINE ELAST (E)
REAL Y(125)
COMMON /SUB/ Y
COMPLEX E(144)
DO 5 I=1,144
5 E(I)=(0.,0.)
1590 DO 1600 K=1,144,13
1600 E(K) = 1.
E(28)= Y(76) / Y(77)
E(54)= Y(76) * Y(91)
E(55)= Y(76) * Y(76) / Y(78) * Y(94)
E(56)= Y(76) * Y(76) * Y(76) / Y(78) * Y(92)
E(66)= Y(93)
E(67)= Y(76) / Y(78) * Y(91)
E(68)= Y(76) * Y(76) / Y(78) * Y(94)
E(78)= Y(80) * Y(76) * Y(91)
E(79)= Y(93)
E(80)= Y(76) * Y(91)
E(106)= Y(76) * Y(95)
E(107)= Y(76) * Y(76) / Y(79) * Y(98)
E(108)= Y(76) * Y(76) * Y(76) / Y(79) * Y(96)
E(118)= Y(97)
E(119)= Y(76) / Y(79) * Y(95)
E(120)= Y(76) * Y(76) / Y(79) * Y(98)
E(130)= Y(80) * Y(76) * Y(95)
E(131)= Y(97)
E(132)= Y(76) * Y(95)
RETURN
END

```



```

SUBROUTINE MASSB(A,F)
REAL Y(125)
COMPLEX CY1,CY2,CY5,CY6
INTEGER CY18A,CY3
COMPLEX A(144)
COMPLEX F(12)
COMMON/SUB/ Y
COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1 CY16,CY17,CY20,CY39,CY3,CY18A
DO 5 I=1,144
5 A(I)=(0.,0.)
DO 11 I=1,144,13
11 A(I)=(1.,0.)
A(13) = Y(1) * (CY6 - CY7 * Y(18))
A(15) = Y(48) * (CY8 * Y(35) * CY5 - CY7 * Y(38))
A(17) = -Y(1) * (CY8 * Y(36) * CY5 + CY7 * Y(39))
A(18) = -Y(48) * (CY6-CY7 * Y(18))
A(21) = -Y(1) * (CY8 * Y(35) * CY5 - CY7 * Y(38))
A(37) = -Y(48) * (CY8 * Y(35) * CY5 + CY7 * Y(38))
A(39) = Y(50) * CY6 + (-Y(53) + Y(49)) * CY7 * Y(18)
1 * (Y(22) -Y(21)) - Y(48) * CY7 * Y(20) * Y(41)
2 + Y(48) * CY7 * Y(33) * Y(40)
A(41) = -Y(48) * (CY8 * Y(15) * CY5 - CY7 * Y(43))
A(42) = Y(56) * CY4 * Y(35) * CY5 + Y(54) * CY7 * Y(38)
A(45)=-Y(48)*(CY6-CY7*Y(44))
A(46) = Y(57) *CY4 * Y(36) * CY5 + Y(52) * CY7 * Y(39)
A(73) = -Y(48) * (CY6 - CY7 * Y(18))
A(75) = -Y(56) * CY4 * Y(35) *CY5 + Y(55) * CY7 * Y(38)
A(77) = Y(48) * ( CY8 * Y(36) * CY5 + CY7 * Y(39))
A(78) = (Y(7) + Y(49)) * CY6 + Y(54) * CY7 * Y(45) - Y(48)
1 * CY7 * Y(20) * Y(41) + Y(48) * CY7 * Y(33) * Y(40)
A(81) = Y(48) * ( CY8 * Y(35) * CY5 - CY7 * Y(38))
A(82) = -Y(58) * CY4 * Y(15) * CY5 + Y(52) * CY7 * Y(43)
A(85) = -Y(1) * (CY8 * Y(36) * CY5 - CY7 * Y(39))
A(87) = -Y(48) * ( CY8 * Y(15) * CY5 + CY7 * Y(43))
A(89) = -Y(1) * (CY6 - CY7 * Y(46))
A(90) = Y(48) * (CY8 * Y(36) * CY5 - CY7 * Y(39))
A(93) = Y(1) * ( CY8 * Y(15) * CY5 + CY7 * Y(43))
A(123)= -Y(57) * CY4 * Y(36) * CY5 - Y(55) * CY7 * Y(39)
1 -Y(48) * CY7 * Y(16) * Y(40)
A(126)= Y(58) * CY4 * Y(15) * CY5 + Y(54) * CY7* Y(43)
1 -Y(48) * CY7 * Y(19) * Y(41) - Y(48) * CY7
2 * Y(34) * Y(40)
A(130)= Y(6) * CY6 - Y(52) * CY7 * Y(47)
A(133)= -Y(1) * (CY8 * Y(35) * CY5 + CY7 * Y(38))
A(135)= Y(48) * ( CY6 - CY7 * Y(44))
A(137)= -Y(1) * (CY8 * Y(15) * CY5-CY7*Y(43))
A(138)= Y(48) * (CY8 * Y(35) * CY5 + CY7 * Y(38))
A(141)= -Y(1) * (CY6 - CY7 * Y(44))
DO 6 I=1,12

```

```

6 F(1)=(0.,0.)
  IF (CY18A) 81,8,81
81 IF (CY18A-1) 82,15,82
82 IF (CY18A+1) 100,20,100
8 CN1=Y(1)*CY11*CY16
  F(2) = -Y(1) * CY7 * Y(16) * Y(40) - Y(48) * CY7 * Y(39)
1-CN1*Y(15)
  F(4) = Y(55) * CY7 * Y(43) - Y(48) * CY7 * Y(19) * Y(41)
1 -Y(48) * CY7 * Y(34) * Y(40)
2 +Y(2)*CN1*Y(36)
  F(7) = Y(54) * CY7 * Y(39) + Y(48) * CY7 * Y(16) * Y(40)
1 +Y(2)*CN1*Y(15)
  F(8) = -Y(1) * CY7 * Y(20) * Y(41) + Y(1) * CY7 * Y(33)
1 * Y(40) + Y(48) * CY7 * Y(46)
2 -CN1*Y(35)
  F(11) = -Y(52) * CY7 * Y(38)
  F(12) = Y(48) * CY7 * Y(43) - Y(1) * CY7 * Y(19) * Y(41)
1 - Y(1) * CY7 * Y(34) * Y(40)
2 +CN1*Y(36)
  GO TO 100
20 CONTINUE
  S=1.
25 CN2=Y(1)*Y(11)*CY17*.5
  F(2)=-CN2*(Y(25)-S*CY2*Y(29))
  F(4)=-CN2*Y(2)*(Y(24)*Y(20)-Y(30)-S*CY2*(Y(26)+Y(28)*Y(20)))
  F(7)=CN2*Y(2)*(Y(25)-S*CY2*Y(29))
  F(8)=CN2*(Y(31)+Y(24)*Y(19)-S*CY2*(Y(28)*Y(19)-Y(27)))
  F(12)=-CN2*(Y(24)*Y(20)-Y(30)-S*CY2*(Y(26)+Y(28)*Y(20)))
  GO TO 100
15 CONTINUE
  CN2=Y(1)*Y(11)*CY17*.5
  S=-1.
  GO TO 25
100 CONTINUE
  RETURN
  END

```

```

SUBROUTINE BEND (B)
REAL Y(125)
REAL B(144)
DIMENSION SA(3,3),SAT(3,3),SB(3,3)
COMMON /SUB/ Y
SA(1,1) = Y(29)
SA(1,2) = Y(25)
SA(1,3) = -Y(15)
SA(2,1) = Y(19) * Y(28) -Y(27)
SA(2,2) = Y(33) * Y(11) + Y(31)
SA(2,3) = Y(35)
SA(3,1) = Y(34) * Y(12) + Y(26)
SA(3,2) = Y(34) * Y(11) -Y(30)
SA(3,3) = Y(36)
SAT(1,1) = Y(68)
SAT(1,2) = Y(63) * Y(67) - Y(66)
SAT(1,3) = Y(72) * Y(61) + Y(65)
SAT(2,1) = Y(64)
SAT(2,2) = Y(71) * Y(60) + Y(70)
SAT(2,3) = Y(72) * Y(60) - Y(69)
SAT(3,1) = -Y(62)
SAT(3,2) = Y(73)
SAT(3,3) = Y(74)
DO 20 I=1,3
DO 20 J=1,3
SB(I,J)=0.0
DO 20 K=1,3
20 SB(I,J)=SB(I,J)+SA(I,K)*SAT(K,J)
DO 5 I=1,144
5 B(I)=0.
B(1)=SB(1,1)
B(5) = SB(1,2)
B(9) =-SB(1,3)
B(14) = SB(1,1)
B(20) =-SB(1,2)
B(24) = SB(1,3)
B(27) = SB(1,1)
B(30) = SB(1,3)
B(34) = SB(1,2)
B(40) = SB(1,1)
B(43) = SB(1,3)
B(47) = SB(1,2)
B(49) = SB(2,1)
B(53) = SB(2,2)
B(57) =-SB(2,3)
B(63) = SB(3,1)
B(66) = SB(3,3)
B(70) = SB(3,2)
B(76) = SB(3,1)
B(79) = SB(3,3)

```

```
B(83) = SB(3,2)
B(86) = -SB(2,1)
B(92) = SB(2,2)
B(96) = -SB(2,3)
B(97) = -SB(3,1)
B(101) = -SB(3,2)
B(105) = SB(3,3)
B(111) = SB(2,1)
B(114) = SB(2,3)
B(118) = SB(2,2)
B(124) = SB(2,1)
B(127) = SB(2,3)
B(131) = SB(2,2)
B(144) = SB(3,3)
B(134) = SB(3,1)
B(140) = -SB(3,2)
RETURN
END
```

```

SUBROUTINE BLADE
C OMMON/IMSB/MS
INTEGER Q,ALP(6)
COMPLEX YKM
COMPLEX B(588),FAB(49),FLB(49),CTB(49)
COMPLEX SMLB(168),SMLC(168),SMLD(168)
COMPLEX FASB(14),FLSC(14),FLSD(14),FLSB(14),FASD(14),CTSB(14),
1 CTSD(14)
COMPLEX D(3276),C(56)
COMMON/ AKTAU/ AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
COMMON/DC/D,C
COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1 MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2 NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3 NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4 MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
COMMON/BTS/B,SMLB,SMLC,SMLD,FASB,FLSB,CTSB,FLSC,FLSD,FASD,CTSD,
1 FAB,FLB,CTB
DATA ALP/1,3,5,6,9,10/
MSM1=MS-1
MS1=MSM1*MZDM
NC1=NRBD*NCOLS
NC2=NRBD*(NCDLS+NCSB)
NC3=NRBD*(NCOLS+2*NCSB)
MS1P1=MS1+1
MS1P=MS*MZDM
DO 15 JJ=MS1P1,MS1P
15 D(JJ)=(0.,0.)
DO 22 I=1,MXSMI
IM1=I-1
I1=MXCPM*IM1
I2=NCOLS*IM1
I3=MXCSB*IM1
I5=NCSB*IM1
DO 4 J=1,NCOLS
JM1=J-1
J1=12*JM1
MS3=MS1+NEID*IM1+NRBD*JM1
DO 1 Q=1,6
IQALP=ALP(Q)
1 D(MS3+Q)=B(I1+J1+IQALP)
LL=I2+J
D(MS3+7)=FAB(LL)
D(MS3+8)=-SMLA(MS)*CTB(LL)*YKM(I,MS)
IF (MFLAP .EQ. 0) GO TO 4
D(MS3+9)=FLB(LL)
4 CONTINUE
DO 21 J=1,NCSB
JM1=J-1
J1=12*JM1

```

```

MS3=MS1+NEID*IM1+NRBD*JM1
DO 6 Q=1,6
  IQALP=ALP(Q)
6 D(MS3+NC1+Q)=-SMLC(I3+J1+IQALP)
  IF (MFLAP .EQ. 0) GO TO 8
  IF (NFLAP .LT. NFEA) GO TO 8
  D(MS3+NC1+9)=-FLSC(I5+J)
8 DO 9 Q=1,6
  IQALP=ALP(Q)
9 D(MS3+NC2+Q)=-SMLB(I3+J1+IQALP)
  LL=I5+J
  L=MS3+NC2+7
  D(L)=-FASB(LL)
  L=L+1
  D(L)=AKCI(MS)*CTSB(LL)
  IF (MFLAP .EQ. 0) GO TO 20
  IF (NFLAP .LT. NCT) GO TO 13
  D(L+1)=-FLSB(LL)
13 DO 14 Q=1,6
  LL=I3+J1+ALP(Q)
  L=MS3+NC3+Q
14 D(L)=-SMLD(LL)
  IF (NFLAP .GT. NFEA) GO TO 17
  LL=I5+J
  L=MS3+NC3+7
  D(L)=-FASD(LL)
17 IF (NFLAP .GT. NCT) GO TO 20
  D(MS3+NC3+8)=SMLA(MS)*SMLA(MS)*CTSD(I5+J)
20 C(MSM1*MCM+I5+J)=CTSB(I5+J)
21 CONTINUE
22 CONTINUE
  RETURN
  END
  COMPLEX FUNCTION YKM(I,MS)
  INTEGER CY18A,CY3
  COMPLEX CY1,CY2,CY5,CY6
  COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1 CY16,CY17,CY20,CY39,CY3,CY18A
  COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
  COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
  KSML=I-NFP1
  CY5=CY1-CY2*KSML*CY4
  YKM=SMLA(MS)*(1+CY5*TAU(MS))
  RETURN
  END

```

```

SUBROUTINE HBLOCK
COMMON/IMSB/MS
INTEGER ALP(6),Q
COMPLEX DD(252),H(84),CTH(7),FLH(7),FAH(7)
COMMON/DD1/DD
COMMON/RBTS/H,CTH,FLH,FAH
COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOU, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
DATA ALP/1,3,5,6,9,10/
MS1=(MS-1)*MZDDM
DO 5 I=1,MXSMI
MS2=MS1+(I-1)*NRBD
IM=(I-1)*12
DO 1 Q=1,6
IQALP=ALP(Q)
1 DD(MS2+Q)=-H(IM+IQALP)
DD(MS2+7)=-FAH(I)
DD(MS2+8)= SMLA(MS)*SMLA(MS)*CTH(I)
IF(MFLAP .EQ. 0) GO TO 5
DD(MS2+9)=-FLH(I)
5 CONTINUE
RETURN
END

```

```

SUBROUTINE SETUP
COMMON/BRIGD/EGNS
COMMON/IBRIG/MINPN,MAXPN,NEGNS,NPRCNT,MXITER,MXEROR,ITDET
INTEGER CY18A,CY3
COMPLEX EGNS(5),          ALM(287),EPS(287)
COMPLEX REM(9)
COMPLEX DETSV
COMPLEX CY1,CY2,CY5,CY6
REAL CS(4,5),SN(4,5),CS1(4,10),SN1(4,10)
REAL Y(125),SD(7500)
COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
COMMON/RNAME/CS,SN
COMMON/RNAME1/CS1,SN1
COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
COMMON/EP SA/EPS,REM
1  ,DETSV
COMMON/SAIN/SD
COMMON/SUB/Y
COMMON/CALM/ALM
COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1  CY16,CY17,CY20,CY39,CY3,CY18A
READ (5,902) NB,NSP,MAXN,NES
1  ,IFV,NF,NSIZEY,NOUT
READ (5,902) MXIT,NEXP,NCONV
NFP1=NF+1
MXSMI=2*NF+1
MXKQ=12*MXSMI
READ (5,902) MFLAP,NFEA,NCT,NFLAP,NS,NBS,NPS,NIG
IF (IFV) 57,57,58
57 NCOLS=6
NCSB=1
READ(5,902) MINPN,MAXPN
WRITE(6,927) MINPN,MAXPN
GO TO 59
58 NCCLS=7
NCSB=2
READ (5,902) NEGNS,MXITER,MXEROR,ITEREM,NORM,NREMS,NPRCNT
1  ,ITDET
READ(5,902) (IREM(I) , I=1,NREMS)
READ(5,901) (EGNS(I), I=1,NEGNS)
WRITE (6,912)
WRITE (6,913) NEGNS,MXITER,MXEROR,ITEREM,NORM,NREMS,NPRCNT
1  ,ITDET
WRITE(6,914) (I,IREM(I), I=1,NREMS)
WRITE(6,915) (I,EGNS(I), I=1,NEGNS)
59 NRBD=8+MFLAP

```



```

WRITE(6,925) NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT,MXIT,NEXP,NCONV,
1 MFLAP,NFEA,NCT,NFLAP,NS,NBS,NPS,NIG
NCBDB=NCOLS+(2+MFLAP)*NCSB
MXT2P1=(2*MAXN+1)*NSP
NCFV=(IFV+MXT2P1)*NSP
NEIA=MXT2P1*NCFV
NEID=NRBD*NCBDB
NEIB=MXT2P1*NCBDB
NEIC=NRBD*NCFV
MZDM=MXSMI*NEID
NRIFC=MXT2P1+NB*NRBD
NEIFC=NRIFC*NCFV
NEISC=NEIB+NB*NEID
MXTKN=NEIFC+NB*NEISC
MCM=NCSB*MXSMI
MZDDM=NRBD*MXSMI
MXQ=NRIFC*MXSMI
NSD=NS*NSIZEY
MXSD=NSD*NB
MXFAB=NCOLS*MXSMI
MXCPM=12*NCGLS
MXCPK=MXCPM*MXSMI
MXCSB=12*NCSB
MXSMB=MXCSB*MXSMI
MFASB=NCSB*MXSMI
READ(5,901) CY4,CY11,CY15
WRITE(6,911) CY4,CY11,CY15
IF(NSP.EQ.0) GO TO 30
READ(5,901) CY13,CY14,CY20,CY39
WRITE(6,923) CY13,CY14,CY20,CY39
CALL SUPPHA(NES,MAXN)
READ(5,901) (AK(MS), MS=1,NES)
READ(5,901) (AC(MS), MS=1,NES)
READ(5,901) CAPK,CAPC
30 CALL PHASE(NB,MAXN)
READ(5,901) (AKCI(MS), MS=1,NB)
READ(5,901) (TAU(MS), MS=1,NB)
READ(5,901) (SMLA(MS), MS=1,NB)
CY2=(0.,1.)
CY7=CY4*CY4
CY8=2.*CY4
CY12=3.1415927
CY16=SIN(CY15)
CY17=COS(CY15)
DO 40 I=1,NSIZEY
40 Y(I)=0.
DO 120 MS=1,NB
NSDMS=NSD*(MS-1)
DO 120 IS=1,NS
READ(5,909) M1,M2,M3,M4,M5,M6

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```

Y(112) = M1
Y(113) = M2
Y(114) = M3
Y(115) = M4
Y(116) = M5
Y(117) = M6
IF(M1 .EQ. 0) GO TO 2
CALL YA
2 IF(M2 .EQ. 0) GO TO 4
CALL BYB(MS,NS,IS,NSIZEY)
4 IF(M4 .EQ. 0) GO TO 5
CALL BYE (CY7,NSDMS,IS,NSIZEY)
5 IF(M5 .EQ. 0) GO TO 6
CALL YRIGID
6 IF (M6 .EQ. 0) GO TO 199
CALL YSK
199 DO 200 L=1,NSIZEY
M=(IS-1)*NSIZEY+L+NSDMS
200 SD(M)=Y(L)
DO 203 I=1,NSIZEY
203 Y(I)=0.
120 CONTINUE
901 FORMAT (8F10.6)
902 FORMAT (10I5)
909 FORMAT (6I1)
911 FORMAT(/18X,*CY4 = * ,F10.4,* CY11 = *,F10.4,* CY15 = *,F10.4)
912 FORMAT(1H1,42X,* NASA-5 FREE VIBRATION COMPUTATION*/)
913 FORMAT(15X,* NEGNS =*, I3,* MXITER =*, I3,* MXEROR =*, I3,* ITE
IREM =*, I3,* NORM =*, I3,* NREMS =*, I3/15X,*NPRCNT =*, I3
2,3X,* ITDET =*, I3)
914 FORMAT(12X,6(* IREM*, I2,* =*, I3)/)
915 FORMAT (8X,4(* EGNS*, I2,* =*, 2E11.4)/)
923 FORMAT(/17X,*CY13 =*, F10.4,*CY14 =*, F10.4,*CY20 =*, F10.4,*CY39 =*,
1 F10.4/)
925 FORMAT(/15X,* NB =*, I3,6X,*NSP =*, I3,5X,*MAXN =*, I3,6X,*NES =*
1 , I3,6X,*IFV =*, I3,7X,*NF =* I3/15X,*NSIZEY =*, I4,4X,*NOUT =*, I3,
2 5X,*MXIT =*, I3,5X,*NEXP =*, I3,4X,*NCONV =*, I3,4X,*MFLAP =*, I3/
3 17X,*NFEA "*, I3,6X,*NCT =*, I3,4X,*NFLAP =*, I3,7X,*NS =*, I3,
4 6X,*NBS =*, I3,6X,*NPS =* I3,6X,*NIG =* I3//)
927 FORMAT(/,5X,* MINPN= *, I5,* MAXPN= *, I5/)
REWIND 2
WRITE(2) SD
RETURN
END

```

```
SUBROUTINE PHASE (NB,MAXN)
REAL CS(4,5),SN(4,5),PHIM(4)
COMMON/RNAME/CS,SN
READ(5,700) (PHIM(MS), MS=1,NB)
700 FORMAT(8F10.6)
IF (MAXN .EQ. 0) GO TO 11
MAXNT2=2*MAXN
DO 10 MS=1,NB
DO 10 L=1,MAXNT2
ARG=L*PHIM(MS)
CS(MS,L)=COS(ARG)
10 SN(MS,L)=SIN(ARG)
11 RETURN
END
```

```
      SUBROUTINE SUPPHA(NES,MAXN)
      REAL CS1(4,10),SN1(4,10),CHI(4)
      COMMON/RNAME1/CS1,SN1
      READ(5,700) (CHI(J), J=1,NES)
700  FORMAT(8F10.6)
      IF (MAXN .EQ. 0) GO TO 13
      MXNT2=2*MAXN
      DO 12 J=1,NES
      DO 12 NL=1,MXNT2
      ARG1=NL*CHI(J)
      CS1(J,NL)=COS(ARG1)
12  SN1(J,NL)=SIN(ARG1)
13  RETURN
      END
```

```

SUBROUTINE YA
C MASS MATRIX FOR BLADE- ELEMENTS OF VECTOR -Y- TO BE CREATED.
REAL Y(125)
COMMON /SUB/Y
  READ (5,701) (Y(I),I=1,10)
701 FORMAT (8F10.6)
Y(1) = -Y(1)
Y(5) = -Y(5)
Y(6) = -Y(6)
Y(7) = -Y(7)
Y(11) = SIN(Y(8))
Y(12) = COS(Y(8))
Y(13) = Y(11) * Y(11)
Y(14) = Y(12) * Y(12)
Y(15) = SIN(Y(9))
Y(16) = COS(Y(9))
Y(17) = Y(15) * Y(15)
Y(18) = Y(16) * Y(16)
Y(19) = SIN(Y(10))
Y(20) = COS(Y(10))
Y(21) = Y(19) * Y(19)
Y(22) = Y(20) * Y(20)
Y(23) = Y(11) * Y(12)
Y(24) = Y(11) * Y(15)
Y(25) = Y(11) * Y(16)
Y(26) = Y(11) * Y(19)
Y(27) = Y(11) * Y(20)
Y(28) = Y(12) * Y(15)
Y(29) = Y(12) * Y(16)
Y(30) = Y(12) * Y(19)
Y(31) = Y(12) * Y(20)
Y(32) = Y(15) * Y(16)
Y(33) = Y(15) * Y(19)
Y(34) = Y(15) * Y(20)
Y(35) = Y(16) * Y(19)
Y(36) = Y(16) * Y(20)
Y(37) = Y(19) * Y(20)
Y(38) = Y(32) * Y(20)
Y(39) = Y(32) * Y(19)
Y(40) = Y(4) * Y(11) + Y(3) * Y(12)
Y(41) = Y(3) * Y(11) - Y(4) * Y(12)
Y(42) = Y(18) * (Y(22)-Y(21))
Y(43) = Y(18) * Y(37)
Y(44) = Y(18) * Y(21) + Y(17)
Y(45) = Y(17) - Y(18) * Y(21)
Y(46) = Y(18) * Y(22) +Y(17)
Y(47) = Y(18) * Y(22) - Y(17)
Y(48) = Y(1) * Y(2)
Y(49) = Y(1) * Y(2) * Y(2)
Y(50) = Y(5) + Y(49)

```

```
Y(51) = Y(5) - Y(6)
Y(52) = Y(5) - Y(7)
Y(53) = Y(6) - Y(7)
Y(54) = Y(51) + Y(49)
Y(55) = -Y(53) + Y(49)
Y(56) = Y(5) - Y(53) + (2. * Y(49))
Y(57) = -Y(52) - Y(6)
Y(58) = Y(7) - Y(51)
Y(80) = 0.
RETURN
END
```

```

SUBROUTINE BYE (CY7,NSDMS,IS,NSIZEY)
REAL SD(7500)
COMMON/SAIN/SD
REAL Y(125)
COMMON /SUB/Y
READ (5,701) (Y(I),I=75,80)
IF(Y(115)-1.) 650,648,650
648 Y(76)=-Y(76)
701 FORMAT (8F10.6)
650 CONTINUE
ISM1 = IS-1
Y(80) = 0.
IF(IS .EQ. 1) GO TO 2
DO 1 J=1,ISM1
NX = NSDMS + (J-1)*NSIZEY
1 Y(80) = Y(80) -SD(NX+1)*SD(NX+3)
Y(80) = Y(80)*CY7
2 CONTINUE
Y(81)= Y(76) *SQRT (Y(80)/ Y(78))
Y(82)= Y(76) *SQRT (Y(80)/Y(79))
Y(83)= SINH(Y(81))
Y(84)= COSH(Y(81))
Y(85)= SINH(Y(82))
Y(86)= COSH(Y(82))
Y(87)= Y(81) *Y(81)
Y(88)= Y(87) *Y(87)
Y(89)= Y(82) *Y(82)
Y(90)= Y(89) *Y(89)
IF (Y(81)-.01) 1570,1570,1550
1550 Y(91)= Y(83) / Y(81)
Y(92)= Y(83) - Y(81) / (Y(87) * Y(81))
Y(93)= Y(84)
Y(94)= (Y(84) -1.) / Y(87)
IF (Y(82) -.01) 1580,1580,1560
1560 Y(95)= Y(85) / Y(82)
Y(96)= (Y(85) - Y(82)) / (Y(82) * Y(89))
Y(97)= Y(86)
Y(98)= (Y(86) - 1.) / Y(89)
GO TO 1590
1570 Y(91)= 1. + Y(87) / 6. + Y(88) / 120.
Y(92)= .166666 + Y(87) / 120. + Y(88) / 5040.
Y(93)= 1. + Y(87) / 2. + Y(88) / 24.
Y(94)= .5 + Y(87) / 24. + Y(88) / 720.
IF (Y(82) - .01) 1580,1580,1560
1580 Y(95)= 1. + Y(89) / 6. + Y(90) / 120.
Y(96)= .166666 + Y(89) / 120. + Y(90) / 5040.
Y(97)= 1. + Y(89) / 2. + Y(90) / 24.
Y(98)= .5 + Y(89) / 24. + Y(90) / 720.
1590 CONTINUE
RETURN

```

END


```

SUBROUTINE YSK
REAL Y(125)
COMMON/SUB/Y
READ (5,701) (Y(I),I=105,111)
701 FORMAT (8F10.6)
IF (Y(117)-1.) 79,78,79
78 Y(105)= -Y(105)
Y(106)= -Y(106)
Y(107)= -Y(107)
Y(111)= -Y(111)
79 CONTINUE
RETURN
END
SUBROUTINE BYB(MS,NS,IS,NSIZEY)
REAL Y(125)
REAL SD(7500)
COMMON/SAIN/SD
COMMON /SUB/Y
READ(5,912) Y(8),Y(9),Y(10)
912 FORMAT (3F10.6)
NSD=NS*NSIZEY
IF (Y(112)) 30,30,35
30 Y(11)=SIN(Y(8))
Y(12) = COS(Y(8))
Y(15) = SIN(Y(9))
Y(16) = COS(Y(9))
Y(18) = Y(16) * Y(16)
Y(19) = SIN(Y(10))
Y(20) = COS(Y(10))
Y(21) = Y(19) * Y(19)
Y(22) = Y(20) * Y(20)
Y(23) = Y(11) * Y(12)
Y(24) = Y(11) * Y(15)
Y(25) = Y(11) * Y(16)
Y(26) = Y(11) * Y(19)
Y(27) = Y(11) * Y(20)
Y(28) = Y(12) * Y(15)
Y(29) = Y(12) * Y(16)
Y(30) = Y(12) * Y(19)
Y(31) = Y(12) * Y(20)
Y(33) = Y(15) * Y(19)
Y(34) = Y(15) * Y(20)
Y(35) = Y(16) * Y(19)
Y(36) = Y(16) * Y(20)
35 I=(IS-2)*NSIZEY+(MS-1)*NSD+11
IF(I) 741,741,739
739 Y(60)=SD(I)
I = I+1
Y(61)=SD(I)
I = I+3

```

```
Y(62)=SD(I)
I = I+4
Y(63)=SD(I)
I = I+6
Y(64)=SD(I)
K = I + 6
I=I+1
M = 65
DO 740 L=I,K
Y(M)=SD(L)
740 M=M+1
I=I+7
Y(71)=SD(I)
I=I+1
Y(72)=SD(I)
I=I+1
Y(73)=SD(I)
I=I+1
Y(74)=SD(I)
GO TO 742
741 Y(61)=1.
Y(68)=1.
Y(70)=1.
Y(74) = 1.
742 RETURN
END
```

```
SUBROUTINE YRIGID  
REAL Y(125)  
COMMON/SUB/Y  
READ (5,701) (Y(I),I=99,104)  
701 FORMAT (8F10.6)  
RETURN  
END
```

```

SUBROUTINE QSOLN
COMPLEX QOLD,QNEW,DET
COMPLEX QSAVE(287),A(41,41),QMULT(41),FTEMP(41),Y(41)
COMPLEX QU(287)
COMPLEX REM(9)
COMPLEX DETSV
COMMON /EPSA/ QU,REM
1  ,DETSV
COMPLEX TKN(2378)
COMMON /TKN1/ TKN
COMPLEX FKN(41)
COMMON /FKN1/ FKN
COMMON/INJ/I,J
COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
LQ=0.
NCONT=1
DO 30 KTC=1,MXQ
QSAVE(KTC)=(0.,0.)
30 QU(KTC)=(0.,0.)
35 NSGN=-1
DO 301 NEWI=1,MXSMI
NSGN=-NSGN
I=NSGN*(NEWI/2)+NFP1
KSML=I-NFP1
JJ=NP+NFP1
CALL FKNS(I,JJ)
ZERO=0.
DO 40 LL=1,NRIFC
CHECK=CABS(FKN(LL))
ZERO=CHECK+ZERO
40 FTEMP(LL)=FKN(LL)
WRITE(NOUT,925) I
WRITE (NOUT,906) (FTEMP(IL),IL=1,NRIFC)
IF(ZERO) 50,300,50
50 DO 250 J=1,MXSMI
IF (I-J) 100,250,100
100 LQC=(J-1)*NRIFC
DO 120 JJ=1,NRIFC
KTC=LQC+JJ
120 QMULT(JJ)=QU(KTC)
CALL TKNS(I,J)
DO 125 IQ=1,NRIFC
DO 125 IP=1,NRIFC
LL=(IQ-1)*NRIFC+IP
125 A(IP,IQ)=TKN(LL)
WRITE(NOUT,920) I,J

```

```

WRITE(NOUT,906) (TKN(LL), LL=1,MXTKN)
CALL MULTC(A,QMULT,NRIFC)
WRITE(NOUT,931)
WRITE(NOUT,906) (QMULT(L), L=1,NRIFC)
DO 130 LL=1,NRIFC
130 FTEMP(LL)=FTEMP(LL)-QMULT(LL)
250 CONTINUE
CALL TKNS(I,I)
WRITE(NOUT,920) I,I
WRITE(NOUT,900) (TKN(LL),LL=1,MXTKN)
DO 255 IQ=1,NRIFC
DO 255 IP=1,NRIFC
LL=(IQ-1)*NRIFC+IP
255 A(IP,IQ)=TKN(LL)
DO 260 LL=1,NRIFC
260 Y(LL)=FTEMP(LL)
CALL CMAT(A,NRIFC,Y,DET)
IF(CABS(DET)-.1E-6) 270,270,275
270 WRITE(NOUT,900) KSML
GO TO 300
275 CONTINUE
DO 287 LL=1,NRIFC
K=(I-1)*NRIFC+LL
287 QSAVE(K)=Y(LL)
IF(KSML) 291,288,291
288 K=(I-1)*NRIFC+NCONV
QOLD=QU(K)
QNEW=Y(NCONV)
QOLD1=CABS(QOLD)
QNEW1=CABS(QNEW)
IF(QOLD1+QNEW1) 290,290,289
289 DQ=(CABS(QNEW-QOLD))/(QOLD1+QNEW1)
290 CONTINUE
WRITE(NOUT,902) QOLD,QNEW
WRITE(NOUT,981) QOLD1,QNEW1
291 IF(MOD(NEWI,2)) 299,299,292
292 DO 293 K=1,MXQ
293 QU(K)=QSAVE(K)
299 WRITE(NOUT,927) I
WRITE(NOUT,906) (Y(L), L=1,NRIFC)
300 CONTINUE
301 CONTINUE
WRITE(NOUT,901) DQ
NCNT=NCNT+1
IF(NCNT-MXIT) 314,314,315
314 IF(DQ-.1**NEXP) 315,315,35
315 CONTINUE
WRITE(NOUT,930) NCNT
WRITE(NOUT,906) (QU(K), K=1,MXQ)
900 FORMAT(/5X,28HT MATRIX IS SINGULAR FOR K=,I4/)

```

```
901 FORMAT(//10X,20HCONVERGENCE NUMBER=,1E15.6)
902 FORMAT(*O*,* QOLD - *,2E15.6,* QNEW - *,2E15.6,/)
905 FORMAT(50X,3HP= I4/(3X,14F8.4))
906 FORMAT(10(1PE12.4))
920 FORMAT(//44X,*I= *,I4,4X,*J= *,I4,6X,*T MATRIX */)
925 FORMAT(//49X,*I= *,I4,7X,8HF COLUMN/)
927 FORMAT(//46X,*SOLUTION VECTOR FOR I= *I4/)
930 FORMAT(//37X,*ITERATION NUMBER *,I4,5X,*FULL SOLUTION VECTOR */)
931 FORMAT(//53X,*PRODUCT VECTOR */)
981 FORMAT(*O*,*QOLD1 - *, E15.6,*QNEW1 - *, E15.6,/)
  RETURN
  END
```

```

SUBROUTINE FKNS(I,J)
  COMPLEX DD(252),FKN(41)
  COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1  MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2  NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3  NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4  MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
  COMMON/FKN1/FKN
  COMMON/DD1/DD
  DO 15 LL=1,NRIFC
15  FKN(LL)={0.,0.}
  IF(I .NE. J) GO TO 18
  DO 17 MS=1,NB
  DO 16 JJ=1,NRBD
  L=(MS-1)*MZDDM+(I-1)*NRBD+JJ
  LL=MXT2P1+(MS-1)*NRBD+JJ
16  FKN(LL)=DD(L)
17  CONTINUE
18  CONTINUE
  RETURN
  END

```

```
      SUBROUTINE MULTC(A,Q,NRIFC)
      COMPLEX A(41,41),Q(41),QSAVE(41)
      DO 20 I=1,NRIFC
20    QSAVE(I)=(0.,0.)
      DO 100 I=1,NRIFC
      DO 100 J=1,NRIFC
100   QSAVE(I)=QSAVE(I)+A(I,J)*Q(J)
      DO 200 I=1,NRIFC
200   Q(I)=QSAVE(I)
      RETURN
      END
```



```

SUBROUTINE CMAT(A,N,Y,DET)
COMPLEX A,Y,DET,AMX,TEMP,ONE
DIMENSION A(41,41),Y(41)
DIMENSION ICHG(41)
DET=(1.0,0.0)
ONE=(1.0,0.0)
DO 118 K=1,N
AMX = A(K,K)
IMX=K
DO 100 I=K,N
IF(CABS(A(I,K)).LE.CABS(AMX)) GO TO 100
AMX = A(I,K)
IMX=I
100 CONTINUE
IF(CABS(AMX).GT.0.1E-70) GO TO 102
DET=(0.0,0.0)
GO TO 124
102 IF (IMX.EQ.K) GO TO 106
DO 104 J=1,N
TEMP=A(K,J)
A(K,J)=A(IMX,J)
104 A(IMX,J)=TEMP
ICHG(K)=IMX
TEMP=Y(K)
Y(K)= Y(IMX)
Y(IMX)= TEMP
DET=-DET
GO TO 108
106 ICHG(K)=K
108 DET=DET*A(K,K)
A(K,K)=ONE/A(K,K)
DO 110 J=1,N
IF (J.NE.K) A(K,J)=A(K,J)*A(K,K)
110 CONTINUE
Y(K) = Y(K)*A(K,K)
DO 114 I=1,N
DO 112 J=1,N
IF (I.EQ.K) GO TO 114
IF (K.NE.J) A(I,J)=A(I,J)-A(I,K)*A(K,J)
112 CONTINUE
Y(I) = Y(I)-A(I,K)*Y(K)
114 CONTINUE
DO 116 I=1,N
IF (I.NE.K) A(I,K)=-A(I,K)*A(K,K)
116 CONTINUE
118 CONTINUE
DO 122 K=1,N
L=N+1-K
KI=ICHG(L)
IF (L.EQ.KI) GO TO 122

```

```
DO 120 I=1,N
  TEMP = A(I,L)
  A(I,L) = A(I,KI)
120 A(I,KI) = TEMP
122 CONTINUE
124 RETURN
  END
```

```

SUBROUTINE TKNS(I,J)
  INTEGER P,Q,QS
  COMPLEX TKN(2378),D(3276),C(56)
  COMPLEX ALM(287)
  COMPLEX XNLQ
  COMPLEX ZLN
  COMPLEX YKM
  COMPLEX EXPON
  COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
  1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
  2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
  3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
  4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
  COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
  COMMON/CALM/ALM
  COMMON/TKN1/TKN
  COMMON/DC/D,C
  DO 15 L=1,MXTKN
15 TKN(L) = (0.,0.)
  IF (I .NE. J) GO TO 30
C THE I=J TERMS ARE THE SMALL K=SMALL N TERMS.
  DO 16 MS=1,NB
  DO 16 Q=1,NCBDB
  DO 16 P=1,NRBD
  JJ=NRBD*(Q-1)+P
  L=(MS-1)*MZDM+(I-1)*NEID+JJ
  LL=NEIFC+(MS-1)*NEISC+(Q-1)*NRIFC+MXT2P1+(MS-1)*NRBD+P
16 TKN(LL)=D(L)
  IF (NSP .EQ. 0) GO TO 50
  DO 17 L=1,MXT2P1
  LS=L-MAXN-1
  LL=IFV*NRIFC+(L-1)*NRIFC+L
17 TKN(LL)=ZLN(LS,I)
19 DO 20 MS=1,NB
  DO 20 L=1,MXT2P1
  LS=L-MAXN-1
  LL=NRIFC*IFV+(L-1)*NRIFC+MXT2P1+(MS-1)*NRBD+8
20 TKN(LL)=YKM(I,MS)*EXPON(LS,MS)
  IF (NBS .EQ. 0) GO TO 13
  IF(NPS .GT. MAXN) GO TO 23
  DO 14 Q=1,NCSB
  L= (I-1)*NCSB+Q
  L1= NEIFC+NRIFC*(NCOLS+NCSB)+(Q-1)*NRIFC+MAXN+1
  QS=NPS
  LL=L1+QS
  TKN(LL)=TKN(LL)-C(L)*NBS*.5/SMLA(1)
  QS=-NPS
  LL=L1+QS
14 TKN(LL)=TKN(LL)-C(L)*NBS*.5/SMLA(1)
  GO TO 23

```

```

13 DO 21 MS=1,NB
    DO 21 Q=1,NCSB
    DO 21 P=1,MXT2P1
    QS=P-MAXN-1
    L=(MS-1)*MCM+(I-1)*NCSB+Q
    LL=NEIFC+(MS-1)*NEISC +NRIFC*(NCOLS+NCSB)+(Q-1)*NRIFC+P
21 TKN(LL)=-C(L)*EXPON(-QS,MS)/SMLA(MS)
    GO TO 23
30 IMJ=I-J
    DO 18 L=1,MXT2P1
    DO 18 Q=1,MXT2P1
    IF(L .EQ. Q) GO TO 18
    LMQ=L-Q
    IF(IMJ.NE.LMQ)GO TO 18
    LS = L-MAXN-1
    QS=Q-MAXN-1
    LL= IFV*NRIFC+(L-1)*NRIFC+Q
    TKN(LL)=XNLQ(J,LS,QS)
18 CONTINUE
23 CONTINUE
    IF (IFV) 50,50,35
35 JMI=(J-1)*NRIFC
    IF (I .NE. J) GO TO 40
    DO 38 LP=1,MXT2P1
    LP1= LP+NRIFC
    DO 38 LQ=1,MXT2P1
    LL=LP1+(LQ-1)*NRIFC
    L1=JMI+LQ
38 TKN(LP)=TKN(LP)+TKN(LL)*ALM(L1)
40 DO 48 MS=1,NB
    LP=MXT2P1+(MS-1)*NRBD+8
    LP2=LP+NRIFC
    DO 48 LQ=1,MXT2P1
    LL=(LQ-1)*NRIFC+LP2
    L1=JMI+LQ
48 TKN(LP)= TKN(LP)+TKN(LL)*ALM(L1)
50 CONTINUE
    RETURN
    END
    COMPLEX FUNCTION YKM(I,MS)
    INTEGER CY18A,CY3
    COMPLEX CY1,CY2,CY5,CY6
    COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1 CY16,CY17,CY20,CY39,CY3,CY18A
    COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOU, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
    COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC

```

```

KSML=I-NFP1
CY5=CY1-CY2*KSML*CY4
YKM=SMLA(MS)*(1+CY5*TAU(MS))
RETURN
END
COMPLEX FUNCTION ZLN(LS,I)
COMPLEX C1,C2,C5,C6,C7,C8
COMPLEX EXCHI
INTEGER CY18A,CY3
COMPLEX CY1,CY2,CY5,CY6
COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1 CY16,CY17,CY20,CY39,CY3,CY18A
COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
R=CY39
KSML=I-NFP1
CY5=CY1-CY2*KSML*CY4
CY6=CY5*CY5
C1=CY20*(CY6-CY8*LS*CY2*CY5-LS*LS*CY7)
C2=(0.,0.)
DO 10 J=1,NES
10 C2=AK(J)+CY5*AC(J)+C2-CY2*LS*CY4*AC(J)
IF (NIG .EQ. 0) GO TO 11
C5=CAPK+CAPC*(CY5-CY2*LS*CY4)
C6=(0.,0.)
C7=(0.,0.)
DO 8 J=1,NES
C8=AK(J)+CY5*AC(J)-CY2*LS*CY4*AC(J)
C6=C6+C8*EXCHI(LS,0,J)
8 C7=C7+C8*EXCHI(0,LS,J)
C2=C2-C7*C6/(C5+C2)
11 IF (MAXN .EQ. 1) GO TO 12
KX=1-LS*LS
C3=2.*CY12*LS*LS*KX*KX
C4=R*R*R*(1./CY13+LS*LS/CY14)
C3=C3/C4
ZLN=C1+C2+CMPLX(C3,0.)
GO TO 13
12 ZLN=C1+C2
13 CONTINUE
RETURN
END
COMPLEX FUNCTION EXPON(L,MS)
C CREATE EXP(I*L*PHIM)
DIMENSION CS(4,5),SN(4,5)
COMMON/RNAME/CS,SN

```

```

      IL=IABS(L)
      IF(L) 16,15,17
15  EXPON=(1.,0.)
      GO TO 18
16  A=CS(MS,IL)
      B=SN(MS,IL)
      EXPON=CMPLX(A,-B)
      GO TO 18
17  A=CS(MS,L)
      B=SN(MS,L)
      EXPON=CMPLX(A,B)
18  CONTINUE
      RETURN
      END
      COMPLEX FUNCTION EXCHI(L,Q,J)
C  CREATE EXP(I*(L-Q)*CHI(J))
      INTEGER Q
      DIMENSION CS1(4,10),SN1(4,10)
      COMMON/RNAME1/CS1,SN1
      LQ=L-Q
      ILQ=IABS(LQ)
      IF(LQ) 16,15,17
15  EXCHI=(1.,0.)
      GO TO 18
16  A= CS1(J,ILQ)
      B=SN1(J,ILQ)
      EXCHI= CMPLX(A,-B)
      GO TO 18
17  A=CS1(J,ILQ)
      B=SN1(J,ILQ)
      EXCHI=CMPLX(A,B)
18  CONTINUE
      RETURN
      END
      COMPLEX FUNCTION XNLQ(I,LS,QS)
      INTEGER CY18A,CY3
      INTEGER QS
      COMPLEX CY1,CY2,CY5,CY6,C5,C6,XN1,XN2,XN3,XN
      COMPLEX EXCHI
      COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1  MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2  NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3  NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4  MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
      COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1  CY16,CY17,CY20,CY39,CY3,CY18A
      COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
      KSML=I-NFP1
      CY5=CY1-CY2*KSML*CY4
      IF(QS .EQ. LS) GO TO 15

```

```

XNLQ=(0.,0.)
DO 10 J=1,NES
10 XNLQ=XNLQ+(AK(J)+(CY5-CY2*QS*CY4)*AC(J))*EXCHI(LS,QS,J)
   IF(NIG .EQ. 0) GO TO 16
   C5=CAPK+CAPC*(CY5-CY2*QS*CY4)
   XN1=(0.,0.)
   XN2=(0.,0.)
   XN3=(0.,0.)
   DO 12 J=1,NES
   XN=AK(J)+(CY5-CY2*QS*CY4)*AC(J)
   XN1=XN1+XN
   XN2=XN2+XN*EXCHI(LS,0,J)
12 XN3=XN3+XN*EXCHI(0,QS,J)
   XNLQ=XNLQ-XN3*XN2/(C5+XN1)
   GO TO 16
15 XNLQ=(0.,0.)
16 CONTINUE
   RETURN
   END

```

```

SUBROUTINE EPSOLN
COMPLEX FTEMP(41),EPMULT(41),Y(41),EPSAV(287)
COMPLEX EPS(287),RW(41),FTREMK,ZERO
COMPLEX A(41,41)
COMPLEX REM(9)
COMPLEX DETSV
COMPLEX TKN(2378)
COMMON /TKN1/TKN
COMPLEX DET,QOLD,QNEW,XREMK,YREMK,RWMK
COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT,MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS,MFLAP,NFEA,NCT,NFLAP,NS,
2NCLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
COMMON /EPSA/EPS,REM
1  ,DETSV
FTREMK=(0.,0.)
DO 10 L=1,NREMS
10 REM(L)= (0.,0.)
NFCM1=NRIFC-1
DO 30 L=1,MXQ
EPS(L)= (0.,0.)
30 EPSAV(L)= (0.,0.)
NCGNT=1
35 NSGN=-1
DO 400 NEWI=1,MXSMI
NSGN=-NSGN
I=NSGN * (NEWI/2)+NFP1
C INITIALIZE FTEMP (LL) LL=1,NRIFC
DO 40 LL=1,NRIFC
40 FTEMP(LL)= (0.,0.)
50 DO 250 J=1,MXSMI
IF (I-J) 100,250,100
100 LQC=(J-1)*NRIFC
DO 120 JJ=1,NRIFC
KTC=LQC+JJ
120 EPMULT(JJ)= EPS(KTC)
CALL TKNS(I,J)
CALL FTFTKN(FTEMP)
CALL AFTKN(A)
CALL MULTC (A,EPMULT,NRIFC)
DO 130 LL=1,NRIFC
130 FTEMP (LL)= FTEMP(LL)-EPMULT(LL)
250 CONTINUE
IF (I .EQ.NFP1) GO TO 300
C FOR I=J SMALL K NOT = 0
CALL TKNS(I,I)
CALL FTFTKN(FTEMP)
CALL AFTKN(A)
DO 260 LL=1,NRIFC

```



```

260 Y(LL)=FTEMP(LL)
    CALL CMAT (A,NRIFC,Y,DET)
    IF(CABS(DET)-.1E-25) 270,270,275
270 KSML= I-NFP1
    WRITE (NOUT,900) KSML
    GO TO 300
275 CONTINUE
285 DO 287 LL=1,NRIFC
    K=(I-1) * NRIFC+LL
287 EPSAV(K)= Y(LL)
290 CONTINUE
291 IF (MOD(NEWI,2)) 299,299,292
292 DO 293 K=1,MXQ
293 EPS(K)= EPSAV(K)
299 CONTINUE
    GO TO 400
300 CONTINUE
    J=I
    CALL TKNS(I,J)
    DO 305 ITEMP=1,NRIFC
305 Y(ITEMP)=(0.,0.)
    CALL AFTKN(A)
    CALL CMAT (A,NRIFC,Y,DETSV)
    CALL FTFTKN(FTEMP)
    DO 380 K=1,NREMS
        CALL AFTKN(A)
    CALL EXCOL(NRIFC,NORM,A)
    IREMK=IREM (K)
    CALL EXROW (IREMK,NRIFC,A,RW)
    CALL EXRFFT(IREMK,FTEMP,FTREMK,NRIFC)
    DO 340 LL=1,NFCM1
340 Y(LL)= FTEMP(LL)
903 FORMAT (* *,3(/),28X,I5,* VALUES OF F COLUMN*/ )
    CALL CMAT (A,NFCM1,Y,DET)
    IF(CABS(DET)-.1E-25) 342,342,345
342 KSML=I-NFP1
    WRITE (NOUT,900) KSML
    GO TO 415
345 CONTINUE
    ZERO =(0.,0.)
    CALL INRIFT (NORM,Y,ZERO,NRIFC)
    XREMK= Y(IREMK)
    IF (IREMK-NORM) 420,421,421
420 RWMK=RW(IREMK)
    GO TO 425
421 RWMK=RW(IREMK-1)
425 IF (CABS(RWMK)-.1E-20) 346,346,347
346 WRITE (NOUT,910) IREMK
    GO TO 360
C    SUMMATION TO SOLVE FOR YREMK

```

```

347 YREMK=FTREMK
    DO 355 L=1,NRIFC
    IF (L.EQ.IREMK) GO TO 355
    IF (L-NORM) 348,349,349
348 LL=L
    GO TO 350
349 LL=L-1
350 YREMK= YREMK-RW(LL)*Y(L)
355 CONTINUE
    YREMK= YREMK/RWMK
    REM(K) = (XREMK-YREMK)/2.
    IF (K-ITEREM) 360,356,360
356 Y(IREMK)= (YREMK +XREMK)/2.
360 CALL INRIFT (IREMK,FTEMP,FTREMK,NRIFC)
    DO 357 LL=1,NRIFC
    KK= (I-1)*NRIFC+LL
357 EPSAV(KK)=Y(LL)
380 CONTINUE
    DO 381 K=1,NREMS
    LREMK=IREM(K)
381 WRITE(NOUT,912) LREMK,REM(K),Y(LREMK)
    KK=(I-1)*NRIFC +NCONV
    QOLD= EPS(KK)
    QNEW= EPSAV(KK)
    QOLD1= CABS(QOLD)
    QNEW1= CABS(QNEW)
    WRITE (NOUT,915) QOLD,QNEW,QOLD1,QNEW1
    IF (QOLD1 + QNEW1) 390,390,389
389 DQ= CABS(QNEW-QOLD)/(QOLD1+QNEW1)
390 CONTINUE
391 IF (MOD(NEWI,2)) 399,399,392
392 DO 393 K=1,MXQ
393 EPS(K)=EPSAV(K)
399 WRITE (NOUT,927) I
    WRITE (NOUT,906) (Y(L),L=1,NRIFC)
400 CONTINUE
    WRITE (NOUT,901) DQ
    NCONT=NCONT+1
    IF (NCONT-MXIT) 414,414,415
414 IF (DQ-.1**NEXP) 415,415,35
415 CONTINUE
900 FORMAT(//5X,28HT MATRIX IS SINGULAR FOR K=,I4//)
901 FORMAT(//10X,20HCONVERGENCE NUMBER==,2E15.6)
953 FORMAT(3(/),28X,I5,* VALUES OF F COLUMN*/)
906 FORMAT(10(1PE12.4))
910 FORMAT(//20X,* REMAINDER WAS NOT COMPUTED FOR IREMK = *,I3,
1 * BECAUSE OF IMPENDING DIVISION BY ZERO*//)
912 FORMAT (//27X,* REMAINDERS*,40X,*EPSILONS*/{15X,I4,2E20.6,6X,
1 2E20.6/})
915 FORMAT (/3X,* QOLD = *,2E15.6,3X,* QNEW = *,2E15.6,3X,*QOLD1 = *,

```

```

1   E15.6,3X,*QNEW1= *,E15.6/)
927 FORMAT(/ /46X,*SOLUTION VECTOR FOR I= *I4/)
   RETURN
   END
   COMPLEX FUNCTION YKM(I,MS)
   INTEGER CY18A,CY3
   COMPLEX CY1,CY2,CY5,CY6
   COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1   CY16,CY17,CY20,CY39,CY3,CY18A
   COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IEM(9)
   COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
   KSML=I-NFP1
   CY5=CY1-CY2*KSML*CY4
   YKM=SMLA(MS)*(1+CY5*TAU(MS))
   RETURN
   END

```

```
SUBROUTINE MULTC(A,Q,NRIFC)
COMPLEX A(41,41),Q(41),QSAVE(41)
DO 20 I=1,NRIFC
20 QSAVE(I)=(0.,0.)
DO 100 I=1,NRIFC
DO 100 J=1,NRIFC
100 QSAVE(I)=QSAVE(I)+A(I,J)*Q(J)
DO 200 I=1,NRIFC
200 Q(I)=QSAVE(I)
RETURN
END
```

```

SUBROUTINE CMAT(A,N,Y,DET)
COMPLEX A,Y,DET,AMX,TEMP,ONE
DIMENSION A(41,41),Y(41)
DIMENSION ICHG(41)
DET=(1.0,0.0)
ONE=(1.0,0.0)
DO 118 K=1,N
AMX = A(K,K)
IMX=K
DO 100 I=K,N
IF(CABS(A(I,K)).LE.CABS(AMX)) GO TO 100
AMX = A(I,K)
IMX=I
100 CONTINUE
IF(CABS(AMX).GT.0.1E-70) GO TO 102
DET=(0.0,0.0)
GO TO 124
102 IF (IMX.EQ.K) GO TO 106
DO 104 J=1,N
TEMP=A(K,J)
A(K,J)=A(IMX,J)
104 A(IMX,J)=TEMP
ICHG(K)=IMX
TEMP=Y(K)
Y(K)= Y(IMX)
Y(IMX)= TEMP
DET=-DET
GO TO 108
106 ICHG(K)=K
108 DET=DET*A(K,K)
A(K,K)=ONE/A(K,K)
DO 110 J=1,N
IF (J.NE.K) A(K,J)=A(K,J)*A(K,K)
110 CONTINUE
Y(K) = Y(K)*A(K,K)
DO 114 I=1,N
DO 112 J=1,N
IF (I.EQ.K) GO TO 114
IF (K.NE.J) A(I,J)=A(I,J)-A(I,K)*A(K,J)
112 CONTINUE
Y(I) = Y(I)-A(I,K)*Y(K)
114 CONTINUE
DO 116 I=1,N
IF (I.NE.K) A(I,K)=-A(I,K)*A(K,K)
116 CONTINUE
118 CONTINUE
DO 122 K=1,N
L=N+1-K
KI= ICHG(L)
IF (L.EQ.KI) GO TO 122

```

```
DO 120 I=1,N
  TEMP = A(I,L)
  A(I,L) = A(I,KI)
120 A(I,KI) = TEMP
122 CONTINUE
124 RETURN
  END
```

```
SUBROUTINE EXCOL (NRIFC,NORM,A)
COMPLEX A(41,41)
NFCM1=NRIFC-1
DO 6 IQ=NORM,NFCM1
DO 6 IP=1,NRIFC
IQP1=IQ+1
6 A(IP,IQ)=A(IP,IQP1)
RETURN
END
```

```
SUBROUTINE EXROW(IEMK,NRIFC,A,RW)
  COMPLEX A(41,41)
  COMPLEX RW(41)
  NFCM1=NRIFC-1
  DO 7 IQ=1,NFCM1
7  RW(IQ)=A(IEMK,IQ)
  IF(IEMK.EQ.NRIFC) GO TO 9
  DO 8 IP=IEMK,NFCM1
  DO 8 IQ=1,NFCM1
  IPP1=IP+1
8  A(IP,IQ)=A(IPP1,IQ)
9  CONTINUE
  RETURN
  END
```



```
C      SUBROUTINE EXRFFT(IREMK,FTEMP,FTREMK,NRIFC)
      EXTRACTS ROW FROM FTEMP AND SAVES ELEMENT.
      COMPLEX FTEMP(41),FTREMK
      NFCMI=NRIFC-1
      FTREMK=FTEMP(IREMK)
      IF(IREMK .EQ. NRIFC) GO TO 9
      DO 8 IP=IREMK,NFCMI
      IPP1=IP+1
      8 FTEMP(IP)=FTEMP(IPP1)
      9 RETURN
      END
```

```
C      SUBROUTINE INRIFT (IREMK,FTEMP,FTREMK,NRIFC)
      INSERTS ELEMENT INTO FTEMP
      COMPLEX FTEMP(41),FTREMK
      NFCM1=NRIFC-1
      IP=NFCM1
10     IPP1=IP+1
      FTEMP(IPP1)=FTEMP(IP)
      IP=IP-1
      IF (IP-IREMK) 11,10,10
11     FTEMP (IREMK)=FTREMK
      RETURN
      END
```

```

SUBROUTINE TKNS(I,J)
  INTEGER P,Q,QS
  COMPLEX TKN(2378),D(3276),C(56)
  COMPLEX ALM(287)
  COMPLEX XNLQ
  COMPLEX ZLN
  COMPLEX YKM
  COMPLEX EXPON
  COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
  1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
  2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
  3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
  4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
  COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
  COMMON/CALM/ALM
  COMMON/TKN1/TKN
  COMMON/DC/D,C
  DO 15 L=1,MXTKN
15 TKN(L) = (0.,0.)
  IF (I .NE. J) GO TO 30
C THE I=J TERMS ARE THE SMALL K=SMALL N TERMS.
  DO 16 MS=1,NB
  DO 16 Q=1,NCBDB
  DO 16 P=1,NRBD
  JJ=NRBD*(Q-1)+P
  L=(MS-1)*MZDM+(I-1)*NEID+JJ
  LL=NEIFC+(MS-1)*NEISC+(Q-1)*NRIFC+MXT2P1+(MS-1)*NRBD+P
16 TKN(LL)=D(L)
  IF (NSP .EQ. 0) GO TO 50
  DO 17 L=1,MXT2P1
  LS=L-MAXN-1
  LL=IFV*NRIFC+(L-1)*NRIFC+L
17 TKN(LL)=ZLN(LS,I)
19 DO 20 MS=1,NB
  DO 20 L=1,MXT2P1
  LS=L-MAXN-1
  LL=NRIFC*IFV+(L-1)*NRIFC+MXT2P1+(MS-1)*NRBD+8
20 TKN(LL)=YKM(I,MS)*EXPON(LS,MS)
  IF (NBS .EQ. 0) GO TO 13
  IF (NPS .GT. MAXN) GO TO 23
  DO 14 Q=1,NCSB
  L= (I-1)*NCSB+Q
  L1= NEIFC+NRIFC*(NCOLS+NCSB)+(Q-1)*NRIFC+MAXN+1
  QS=NPS
  LL=L1+QS
  TKN(LL)=TKN(LL)-C(L)*NBS*.5/SMLA(1)
  QS=-NPS
  LL=L1+QS
14 TKN(LL)=TKN(LL)-C(L)*NBS*.5/SMLA(1)
  GO TO 23

```

```

13 DO 21 MS=1,NB
    DO 21 Q=1,NCSB
    DO 21 P=1,MXT2P1
    QS=P-MAXN-1
    L=(MS-1)*MCM+(I-1)*NCSB+Q
    LL=NEIFC+(MS-1)*NEISC +NRIFC*(NCOLS+NCSB)+(Q-1)*NRIFC+P
21 TKN(LL)=-C(L)*EXPON(-QS,MS)/SMLA(MS)
    GO TO 23
30 IMJ=I-J
    DO 18 L=1,MXT2P1
    DO 18 Q=1,MXT2P1
    IF(L .EQ. Q) GO TO 18
    LMQ=L-Q
    IF(IMJ.NE.LMQ)GO TO 18
    LS = L-MAXN-1
    QS=Q-MAXN-1
    LL= IFV*NRIFC+(L-1)*NRIFC+Q
    TKN(LL)=XNLQ(J,LS,QS)
18 CONTINUE
23 CONTINUE
    IF (IFV) 50,50,35
35 JM1=(J-1)*NRIFC
    IF (I .NE. J) GO TO 40
    DO 38 LP=1,MXT2P1
    LP1= LP+NRIFC
    DO 38 LQ=1,MXT2P1
    LL=LP1+(LQ-1)*NRIFC
    L1=JM1+LQ
38 TKN(LP)=TKN(LP)+TKN(LL)*ALM(L1)
40 DO 48 MS=1,NB
    LP=MXT2P1+(MS-1)*NRBD+8
    LP2=LP+NRIFC
    DO 48 LQ=1,MXT2P1
    LL=(LQ-1)*NRIFC+LP2
    L1=JM1+LQ
48 TKN(LP)= TKN(LP)+TKN(LL)*ALM(L1)
50 CONTINUE
    RETURN
    END
    COMPLEX FUNCTION ZLN(LS,I)
    COMPLEX C1,C2,C5,C6,C7,C8
    COMPLEX EXCHI
    INTEGER CY18A,CY3
    COMPLEX CY1,CY2,CY5,CY6
    COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1 CY16,CY17,CY20,CY39,CY3,CY18A
    COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,

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4MXFAB, MXCPM, MXCPK, MXCSB, MXSMB, MFASB, NBS, NPS, NIG, IREM(9)
COMMON/ AKTAU/ AKCI(4), TAU(4), SMLA(4), AK(4), AC(4), CAPK, CAPC
R=CY39
KSML=I-NFPI
CY5=CY1-CY2*KSML*CY4
CY6=CY5*CY5
C1=CY20*(CY6-CY8*LS*CY2*CY5-LS*LS*CY7)
C2=(0.,0.)
DO 10 J=1,NES
10 C2=AK(J)+CY5*AC(J)+C2-CY2*LS*CY4*AC(J)
IF (NIG .EQ. 0) GO TO 11
C5=CAPK+CAPC*(CY5-CY2*LS*CY4)
C6=(0.,0.)
C7=(0.,0.)
DO 8 J=1,NES
C8=AK(J)+CY5*AC(J)-CY2*LS*CY4*AC(J)
C6=C6+C8*EXCHI(LS,0,J)
8 C7=C7+C8*EXCHI(0,LS,J)
C2=C2-C7*C6/(C5+C2)
11 IF (MAXN .EQ. 1) GO TO 12
KX=1-LS*LS
C3=2.*CY12*LS*LS*KX*KX
C4=R*R*R*(1./CY13+LS*LS/CY14)
C3=C3/C4
ZLN=C1+C2+CMPLX(C3,0.)
GO TO 13
12 ZLN=C1+C2
13 CONTINUE
RETURN
END
COMPLEX FUNCTION EXPON(L,MS)
C CREATE EXP(I*L*PHIM)
DIMENSION CS(4,5),SN(4,5)
COMMON/RNAME/CS,SN
IL=IABS(L)
IF(L) 16,15,17
15 EXPON=(1.,0.)
GO TO 18
16 A=CS(MS,IL)
B=SN(MS,IL)
EXPON=CMPLX(A,-B)
GO TO 18
17 A=CS(MS,L)
B=SN(MS,L)
EXPON=CMPLX(A,B)
18 CONTINUE
RETURN
END
COMPLEX FUNCTION EXCHI(L,Q,J)
C CREATE EXP(I*(L-Q)*CHI(J))

```

```

INTEGER Q
DIMENSION CS1(4,10),SN1(4,10)
COMMON/RNAME1/CS1,SN1
LQ=L-Q
ILQ=IABS(LQ)
IF(LQ) 16,15,17
15 EXCHI=(1.,0.)
GO TO 18
16 A= CS1(J,ILQ)
B=SN1(J,ILQ)
EXCHI= CMPLX(A,-B)
GO TO 18
17 A=CS1(J,ILQ)
B=SN1(J,ILQ)
EXCHI=CMPLX(A,B)
18 CONTINUE
RETURN
END
COMPLEX FUNCTION XNLQ(I,LS,QS)
INTEGER CY18A,CY3
INTEGER QS
COMPLEX CY1,CY2,CY5,CY6,C5,C6,XN1,XN2,XN3,XN
COMPLEX EXCHI
COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
COMMON/CY/ CY1,CY2,CY5,CY6,CY4,CY7,CY8,CY11,CY12,CY13,CY14,CY15,
1 CY16,CY17,CY20,CY39,CY3,CY18A
COMMON/AKTAU/AKCI(4),TAU(4),SMLA(4),AK(4),AC(4),CAPK,CAPC
KSML=I-NFP1
CY5=CY1-CY2*KSML*CY4
IF(QS .EQ. LS) GO TO 15
XNLQ=(0.,0.)
DO 10 J=1,NES
10 XNLQ=XNLQ+(AK(J)+(CY5-CY2*QS*CY4)*AC(J))*EXCHI(LS,QS,J)
IF(NIG .EQ. 0) GO TO 16
C5=CAPK+CAPC*(CY5-CY2*QS*CY4)
XN1=(0.,0.)
XN2=(0.,0.)
XN3=(0.,0.)
DO 12 J=1,NES
XN=XN+(CY5-CY2*QS*CY4)*AC(J)
XN1=XN1+XN
XN2=XN2+XN*EXCHI(LS,0,J)
12 XN3=XN3+XN*EXCHI(0,QS,J)
XNLQ=XNLQ-XN3*XN2/(C5+XN1)
GO TO 16
15 XNLQ=(0.,0.)

```

16 CONTINUE
RETURN
END

```

SUBROUTINE FTFTKN(FTEMP)
  COMPLEX FTEMP(41), TKN(2378)
  COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT,MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS,MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
  COMMON/TKN1/TKN
  N1=NCOLS*NRIFC
  N2=NCSB*NRIFC
  DO 40 IP=1,NRIFC
  DO 35 MS=1,NB
  L1=NEIFC+(MS-1)*NEISC+IP
  L2=L1+N1
  L3=L2+N2
  FTEMP(IP)=FTEMP(IP)-TKN(L1)-TKN(L2)-TKN(L3)
  IF (MFLAP .EQ. 0) GO TO 35
  L4=L3+N2
  FTEMP(IP)=FTEMP(IP)-TKN(L4)
35 CONTINUE
  IF (NSP .EQ. 0) GO TO 40
  FTEMP(IP)=FTEMP(IP)-TKN(IP)
40 CONTINUE
  RETURN
  END

```



```

SUBROUTINE AFTKN(A)
C   CREATES MATRIX A (IP,IQ) FROM TKN(LL)
      INTEGER Q
      COMPLEX A(41,41)
      COMPLEX TKN(2378)
      COMMON/IQVAR/ NB,NSP,MAXN,NES,IFV,NF,NSIZEY,NOUT, MODE,MFP,NP,
1MXIT,NEXP,NCONV,ITEREM,NORM,NREMS, MFLAP,NFEA,NCT,NFLAP,NS,
2NCOLS,NCSB,NFP1,MXSMI,MXKQ,NRBD,NCBDB,MXT2P1,NCFV,NEIA,NEIB,
3NEIC,NEID,MZDM,NRIFC,NEIFC,NEISC,MXTKN,MCM,MZDDM,MXQ,NSD,MXSD,
4MXFAB,MXCPM,MXCPK,MXCSB,MXSMB,MFASB,NBS,NPS,NIG,IREM(9)
      COMMON /TKN1/TKN
      IF (NSP .EQ. 0) GO TO 6
      DO 12 IQ=1,MXT2P1
      DO 12 IP=1,NRIFC
      LL=IQ*NRIFC+IP
12  A(IP,IQ)=TKN(LL)
6   DO 17 MS=1,NB
      DO 13 Q=1,6
      DO 13 IP=1,NRIFC
      IQ=MXT2P1+(MS-1)*NRBD+Q
      LL=NEIFC+(MS-1)*NEISC+Q*NRIFC+IP
13  A(IP,IQ)=TKN(LL)
      DO 14 IP=1,NRIFC
      IQ=MXT2P1+(MS-1)*NRBD+6+1
      LL=NEIFC+(MS-1)*NEISC+(NCOLS+1)
1*NRIFC+IP
14  A (IP,IQ)=TKN(LL)
      DO 15 IP=1,NRIFC
      IQ=MXT2P1+(MS-1)*NRBD+6+2
      LL=NEIFC+(MS-1)*NEISC+(NCOLS+3)
1*NRIFC+IP
15  A(IP,IQ)=TKN(LL)
      IF(MFLAP.EQ.0) GO TO 17
      DO 16 IP=1,NRIFC
      IQ=MXT2P1+(MS-1)*NRBD+6+3
      LL=NEIFC+(MS-1)*NEISC+(NCOLS+5)
1*NRIFC+IP
16  A(IP,IQ)=TKN(LL)
17  CONTINUE
      RETURN
      END

```