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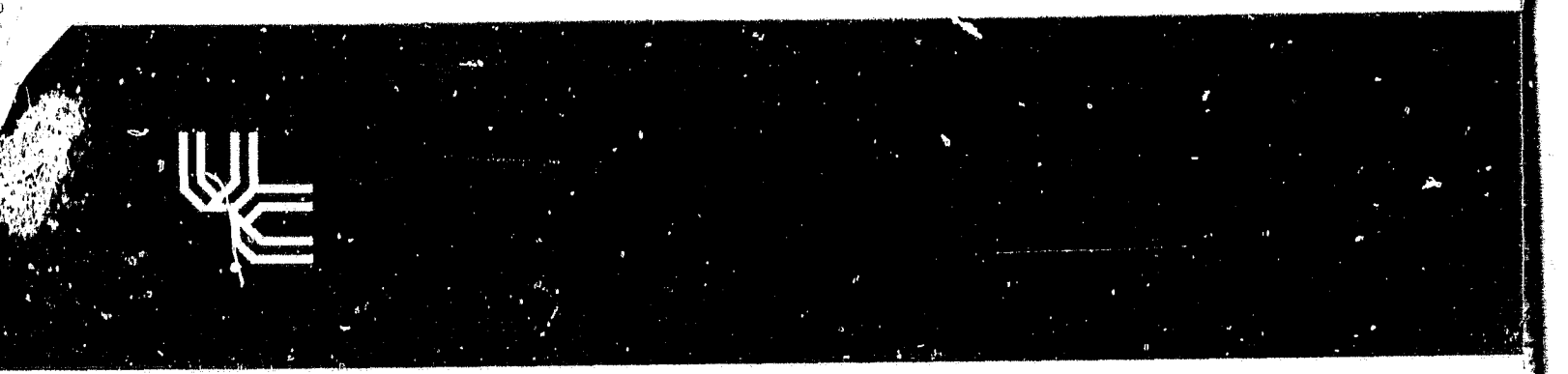

CINCINNATI, OHIO 45221

(NASA-CR-169159) FLAP-LAG-TORSIONAL DYNAMICS OF EXTENSIONAL AND INEXTENSIONAL ROTOR BLADES IN HOVER AND IN FORWARD FLIGHT Semiannual Progress Report, Jan. - Jun. 1982 (Cincinnati Univ.) 72 p HC A04/MF A01 G3/05 28509

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FLAP-LAG-TORSIONAL DYNAMICS OF EXTENSIONAL AND INEXTENSIONAL ROTOR BLADES IN HOVER AND IN FORWARD FLIGHT

SEMI-ANNUAL PROGRESS REPORT

JAN-JUNE 1982

NASA GRANT NAG 2-38

PRINCIPAL INVESTIGATOR: M.R.M. CRESPO DA SILVA
PROFESSOR

NASA TECHNICAL OFFICER FOR THIS GRANT: DR. DEWEY H. HODGES
AEROMECHANICS LABORATORY
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MOFFETT FIELD, CALIFORNIA
94035

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The reduction of the $O(\varepsilon^3)$ integro differential equations derived in [1] to ordinary differential equations using a set of orthogonal functions was described in [2]. Attention was focused on the hover flight condition.

Since the writing of [2], we have also decided to evaluate the set of Galerkin integrals that appear in the reduced equations by making use of nonrotating beam modes. Although a large amount of computer time was needed to accomplish this task, the Galerkin integrals so evaluated were stored on tape on a permanent basis for future use. Several of the coefficients were also obtained in closed form in order to check the accuracy of the numerical computations.

The equilibrium solution to the set of 3n equations obtained as described in [2] was determined as the solution to a minimization problem as follows. Let the 3n equilibrium equations be written in general form as

$$f_{vi}(x_1,x_2,\ldots,x_m) = 0 \tag{1}$$

$$f_{wi}(x_1,x_2,\ldots,x_m) = 0 \tag{2}$$

$$f_{\theta i}(x_1,x_2,\ldots,x_m) = 0 \tag{3}$$

for $i = 1,2,\ldots,n$. Here $[x_1,x_2,\ldots,x_m]$ denote the components of the vector of equilibrium deflections

$$[v_{e1},v_{e2},\ldots;w_{e1},w_{e2},\ldots;\theta_{e1},\theta_{e2},\ldots,\theta_{en}].$$

When non-rotating normal modes are used, the boundary conditions at $x = 0$ are automatically satisfied and, thus, $m = 3n$. When Legendre polynomials are used, satisfaction of the boundary conditions at $x = 0$ require four constraint equations to be satisfied (two for the lead-lag deflections and two for the flap deflections), and the

number of unconstrained variables in equations (1) to (3) is then $m = 3n-4$.

The solution to the equations was obtained by finding the vector $[x_1, x_2, \ldots, x_k]$ that minimizes the function

$$f \triangleq \sum_{i=1}^{n} (f_{vi}^2 + f_{wi}^2 + f_{\theta i}^2) \qquad (4)$$

A listing of the computer program written to solve this problem is included in this report. The Galerkin coefficients (using either non-rotating normal modes or Legendre coefficients) were read from the appropriate files of the tape where they were stored. A copy of the computer programs written to evaluate the Galerkin coefficients are also included here (programs COEFFREE, where non-rotating normal modes were used, and COEFFPOL, where Legendre polynomials were used).

The vector $\underline{x} \triangleq [x_1, x_2, \ldots, x_m]$, corresponding to the minimum of f, was obtained by making use of "standard" subroutine packages. Convergence problems when using the IMSL package ZXMIN were encountered for a number of the cases tried. The IBM SSP packages DFMCG and DFMFP have given the "best" results so far. They are the ones being used in the program listings enclosed. For several of the test cases, one of these packages take f to about 10^{-8}. It was observed that when the vector $\underline{x}$, corresponding to such value of f, is used as an initial "guess" for the other package, the value of f is then decreased to about 10^{-20}. The tip deflections were then calculated and found to agree well with test cases taken from [3].

In order to use the above subroutine packages, the gradient components of f needed to be determined. Two different approaches were used to determine them, and both were programmed in the enclosed listings. One such approach, which may present numerical difficulties

for some cases, was to approximate $\partial f/\partial x_j$ $(j = 1,2,\ldots,k)$ as

$$\partial f/\partial x_j = [f(x_1,\ldots,x_j-\Delta,\ldots,x_m) - f(x_1,\ldots,x_j+\Delta,\ldots,x_m)]/2(\Delta)$$

for a sufficiently small value of Δ. The other approach was to use an analytical expression for $\partial f/\partial x_j$.

The functions f_{vi}, f_{wi} and $f_{\theta i}$ are of the following form, with summation in j and k implied:

$$\begin{aligned} f_{\alpha i} &= (VJ)_j\, v_{ej} + (WJ)_j\, w_{ej} + (TJ)_j\, \theta_{ej} \\ &+ v_{ej}[(VV)_{jk}\, v_{ek} + (VW)_j\, w_{ek} + (VT)_j\, \theta_{ek}] \\ &+ w_{ej}[(WW)_j\, w_{ek} + (WT)_j\, \theta_{ek}] + (TT)_j\, \theta_{ej}\, \theta_{ek} \\ &+ v_{ej}\, v_{ek}[(VVV)_{jkL}\, v_{eL} + (VVW)_{jkL}\, w_{eL} + (VVT)_{jkL}\, \theta_{eL}] \\ &+ v_{ej}\, v_{ek}[(VWW)_{jkL}\, w_{eL} + (VWT)_{jkL}\, \theta_{eL}] \\ &+ w_{ej}\, w_{ek}[(WWW)_{jkL}\, w_{eL} + (WWT)_{jkL}\, \theta_{eL}] \\ &+ [(VTT)_{jkL}\, v_{ej} + (WTT)_{jkL}\, w_{ej} + (TTT)_{jkL}\, \theta_{ej}]\theta_{ek}\, \theta_{eL} \end{aligned} \quad (5)$$

(for $\alpha = v,w,\theta$), where $(VJ)_j$, $(VV)_{jk}$, etc., denote the respective coefficients of the terms v_{ej}, $v_{ej}\, v_{ek}$, etc. These coefficients are functions of the Galerkin coefficients, of problem parameters such as collective pitch and pre-cone angle, and of the inflow ratio λ. These coefficients would be independent of the elastic deflections if λ were not dependent on these same deflections. For these cases, $\partial f_{\alpha i}/\partial x_j$ would have a relatively simple form that can be easy expressed in algorithm form. For example,

$$\partial f_{\alpha i}/\partial v_{ej} = (VJ)_j + [(VV)_{jk} + (VV)_{kj}]v_{ek} + (VW)_{jk}\, w_{ek} + (VT)_{jk}\, \theta_{ek}$$

$$+ [(VVV)_{jkL} + (VVV)_{kjL} + (VVV)_{Lkj}]\, v_{ek}\, v_{eL} + [(VVW)_{jkL}$$

$$+ (VVW)_{kjL}]\, v_{ek}\, w_{eL} + [(VVT)_{jkL} + (VVT)_{kjL}]\, v_{ek}\, \theta_{eL}$$

$$+ w_{ek}[(VWW)_{jkL}\, w_{eL} + (VWT)_{jkL}\, \theta_{eL}] + (VTT)_{jkL}\, \theta_{ek}\, \theta_{eL}$$

(6)

The algorithm developed on the basis of such expressions was incorporated in the subroutine used by the minimization package. The statements corresponding to this algorithm were included in subroutine FUNCTIN as "comment statements C," which can be converted to executable statements when appropriate. The program developed can also be useful on a study of the influence of the inflow modelling on the blade dynamics.

REFERENCES

1. Crespo da Silva, M.R.M., "Flap-Lag-Torsional Dynamic Modelling of Rotor Blades in Hover and in Forward Flight, Including the Effect of Cubic Non-linearities." NASA CR-166194, July 1981.

2. Crespo da Silva, M.R.M., "Semi-Annual Progress Report, July-December 1981, NASA grant NAG 2-38.

3. Hodges, D.H. and Ormiston, R.A., "Stability of Elastic Bending and Torsion of Uniform Cantilever Rotor Blades in Hover with Variable Structural Coupling." NASA TN D-8192, April 1976.

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```
//XXXXXXXL JOB (0,XXXXXX),'CRESPO',TIME=(0,44)
/*JOBPARM LINES=200
/*ROUTE PRINT RMT41
//STEP1 EXEC FORTGCLG,REGION=(256K,768K)
//FORT.SYSIN DD *
      CALL HOVER(0,0.05D0,0.05D0,1,0.D0,0.1D0,1)
      STOP
      END
      SUBROUTINE HOVER(ILGDRE,BETAL,DBETA,NBETA,THETAL,DTHETA,NTHETA)
C ***************************************************************
C *                                                             *
C * PROGRAM TO DETERMINE THE EQUILIBRIUM DEFLECTIONS            *
C *    OF A ROTOR BLADE IN HOVER                                *
C *                                                             *
C * ILGDRE=0 IF NON-ROTATING NORMAL MODES ARE USED              *
C * ILGDRE=1  IF LEGENDRE POLYNOMIALS ARE USED                  *
C *                                                             *
C ***************************************************************
      IMPLICIT REAL*8(A-H,O-Z)
      INTEGER EPS2,EPS3,EPS3JB
      DIMENSION X(24),GRAD(24),W(60),FI1(8),ALPHA(8),BBETA(8),XG(8),
     1U(8,8),U1(8,8),FSQ(10,10,10),IER(10,10,10)
      DIMENSION DELTA(8,8),A(8),B(8),C(8),D(8,8),E(8,8),F(8,8,8),G(8,8,8
     1),H(8,8,8),XI(8,8),XJ(8,8),XK(8,8,8),XM(8,8),XN(8,8),O(8,8),P(8,8)
     2,Q(8),R(8,8),S(8),A3(8,8,8),B3(8,8,8,8),C3(8,8,8,8),D3(8,8),
     3E3(8,8,8,8),F3(8,8,8,8),G3(8,8),H3(8,8,8,8),XI3(8,8,8,8),XJ3(8,8),
     4XK3(8,8),XL3(8,8),XM3(8,8),XN3(8,8),O3(8,8,8),P3(8,8,8),Q3(8,8,8
     5),R3(8,8,8,8),S3(8,8,8,8),T3(8,8,8),DEL(8,8),DELF(8,8)
      DIMENSION U3(8,8,8),V3(8,8,8),W3(8,8),X3(8,8,8),Y3(8,8,8),Z3(8,8,8.
     1),A4(8,8,8,8),B4(8,8,8,8),C4(8,8,8,8),D4(8,8,8,8),E4(8,8,8,8),
     2F4(8,8,8,8),G4(8,8,8,8),H4(8),XI4(8,8,8,8),XJ4(8,8,8),XK4(8,8),
     3XL4(8,8,8,8),XM4(8,8,8),XN4(8,8),O4(8,8),P4(8,8,8),Q4(8,8,8,8),
     4R4(8,8,8,8),S4(8,8,8,8),T4(8,8),U4(8),V4(8,8,8,8),W4(8,8,8),X41(8,8)
     5,VETIP(8,4,6),WETIP(8,4,6),THETIP(8,4,6),PHIE(8,4,6)
      COMMON/VAR1/EPS2,EPS3,EPS3JB,NFUNCT,NF
      COMMON/VAR2/X1,X2,XX3,X4,X5,X6,X7,X8,X9,X10,X11,X12,X13,X14,X15,
     1X16,X17,X18,X19,X20,X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,X31,
     2X32,X33,X34,X35,X36,X37,X38,X39,X40,X41,Y1,Y2,YY3,Y4,Y5,Y6,Y7,Y8,
     3Y9,Y10,Y11,Y12,Y13,Y14,Y15,Y16,Y17,Y18,Y19,Y20,Y21,Y22,Y23,Y24,Z1,
     4Z2,ZZ3,Z4,Z5,Z7,A11,A12,A21,A22,DCSI,CHORD,SINB,COSB,S2B,C2B,SBCB,
     5COSPC,C2BOEA,SQRT2,S3C,SCCC,COS2C,SIN2C,VEN1,VEN,WEN1,WEN,THETAC
      COMMON/VAR3/CDOOPI,SINPC,C2C,S2C,DEL,DELF,DELTA,A,B,C,D,E,F,G,H,XI
     1,XJ,XK,XM,XN,O,P,Q,R,S,A3,B3,C3,D3,E3,F3,G3,H3,XI3,XJ3,XK3,XL3,XM3
     2,XN3,O3,P3,Q3,R3,S3,T3,U3,V3,W3,X3,Y3,Z3,A4,B4,C4,D4,E4,F4,G4,H4,
     3XI4,XJ4,XK4,XL4,XM4,XN4,O4,P4,Q4,R4,S4,T4,U4,V4,W4,FI1
      COMMON/VAR5/SIGMA,XG,U
      EXTERNAL FUNCTB,FUNCTL
   29 FORMAT(' ***********************************************************')
   30 FORMAT(' *****  PRE-CONE ANGLE :  BETA= ',D14.7)
   31 FORMAT(' COLLECTIVE PITCH :  THETAC= ',D14.7)
   32 FORMAT(' NFUNCT     VE(X-1)          WE(X-1)          THETAE(X-1)
     1     PHIE(X-1)',9X,'FSQ',10X,'IER')
   33 FORMAT(' ',I1,5(3X,D14.7),3X,I2)
      CALL UNDFLW
C ****************    INPUT    DATA    ************************
      PI=3.141592654D0
      DETA=0.0146D0
      DZETA=0.1654D0
C       DCSI=0.00089D0
      DCSI=0.0056D0
      EICSI=DETA+DZETA
      XJETA=0.D0
      XJZETA=0.000625D0
      XJCSI=XJETA+XJZETA
      EA=128.D0
      GAMA=5.D0
      SIGMA=0.1D0
      CHORD=PI/40
      CDO=0.01D0
      EPS2=1
      EPS3=1
      EPS3JB=1
C ***************************************************************
C *                                                             *
C * THE ROTOR INFLOW RATIO LAMBDA (DENOTED BY XLMBDA IN         *
C * THIS PROGRAM) IS CALCULATED EITHER IN FUNCTION              *
C * SUBPROGRAM FUNCTN (IF NON-ROTATING NORMAL MODES ARE         *
C * USED) OR IN FUNCTION SUBPROGRAM FUNCT (IF LEGENDRE          *
C * POLYNOMIALS ARE USED).                                      *
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C   *                                                                   *
C   * NFUNCT  IS THE NUMBER OF NON-ROTATING NORMAL MODES                *
C   * (OR LEGENDRE POLYNOMIALS) USED.                                   *
C   *                                                                   *
C   * NFUNCT MUST BE AT LEAST 3 IF LEGENDRE POLYNOMIALS                 *
C   * ARE USED.                                                         *
C   *                                                                   *
C   *********************************************************************
      DO 400 I=1,8
      READ(50) A(I),B(I),C(I),Q(I),S(I),H4(I),U4(I)
  400 CONTINUE
      DO 411 I=1,8
      DO 420 J=1,8
      READ(50) DEL(I,J),DELTA(I,J),D(I,J),E(I,J),XI(I,J),XJ(I,J)
      READ(50) XM(I,J),XN(I,J),O(I,J),P(I,J),R(I,J),B3(I,J)
      READ(50) G3(I,J),XJ3(I,J),XK3(I,J),XL3(I,J),XM3(I,J),W3(I,J)
      READ(50) XK4(I,J),XN4(I,J),O4(I,J),T4(I,J)
  420 CONTINUE
  411 CONTINUE
      DO 430 I=1,8
      DO 440 J=1,8
      DO 450 K=1,8
      READ(50) F(I,J,K),G(I,J,K),H(I,J,K),XK(I,J,K),A3(I,J,K)
     1,XN3(I,J,K)
      READ(50) O3(I,J,K),P3(I,J,K),Q3(I,J,K),T3(I,J,K),U3(I,J,K)
     1,V3(I,J,K)
      READ(50) X3(I,J,K),Y3(I,J,K),Z3(I,J,K),XJ4(I,J,K),XM4(I,J,K)
     1,F4(I,J,K)
      READ(50) S4(I,J,K),W4(I,J,K)
  450 CONTINUE
  440 CONTINUE
  430 CONTINUE
      DO 460 I=1,8
      DO 470 J=1,8
      DO 480 K=1,8
      DO 490 L=1,8
      READ(50) B3(I,J,K,L),C3(I,J,K,L),E3(I,J,K,L),F3(I,J,K,L)
     1,H3(I,J,K,L),XI3(I,J,K,L)
      READ(50) R3(I,J,K,L),S3(I,J,K,L),A4(I,J,K,L),B4(I,J,K,L)
     1,C4(I,J,K,L),D4(I,J,K,L)
      READ(50) E4(I,J,K,L),F4(I,J,K,L),G4(I,J,K,L),XI4(I,J,K,L)
     1,XL4(I,J,K,L),Q4(I,J,K,L)
      READ(50) R4(I,J,K,L),V4(I,J,K,L)
  490 CONTINUE
  480 CONTINUE
  470 CONTINUE
  460 CONTINUE
C
C   *********************************************************************
C   *                                                                   *
C   *   THE COEFFICIENTS   DELF(I,J)                                    *
      DO 500 I=1,8
      DO 501 J=1,8
      DELF(I,J)=DEL(I,J)
      IF(I.EQ.1.AND.ILGDRE.EQ.1) DELF(I,J)=0.D0
  501 CONTINUE
  500 CONTINUE
C   *                                                                   *
C   *********************************************************************
C
C   * THE COEFFS. XG(I) TO CALCULATE THE INFLOW RATIO                   *
      XG(1)=1.30656296500
      XG(2)=-0.54119610010D0
      XG(3)=XG(2)
      XG(4)=XG(1)
      XG(5)=-XG(1)
      XG(6)=-XG(2)
      XG(7)=XG(6)
      XG(8)=XG(5)
C
C   *********************************************************************
      NMIN=3
      IF(ILGDRE.EQ.1) GO TO 1111
      NMIN=1
C   *********************************************************************
C   *                                                                   *
C   *   THE COEFFICIENTS U1(I,J) AND U(I,J) TO CALCULATE                *
C   *   THE EQUILIBRIUM ELASTIC DEFLECTION PHIE AT X=1 AND              *
C   *   THE INFLOW RATIO, RESPECTIVELY, WHEN NON-ROTATING               *
C   *   NORMAL MODES ARE USED                                           *
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      C  *
            BBETA(1)=0.187510406870D1
            BBETA(2)=0.469409113300D1
            BBETA(3)=0.785475743820D1
            BBETA(4)=0.109955407350D2
            BBETA(5)=0.141371683910D2
            BBETA(6)=0.172787599320D2
            BBETA(7)=0.204203522510D2
            BBETA(8)=0.235619449020D2
            ALPHA(1)=0.734095513760D0
            ALPHA(2)=0.101846731870D1
            ALPHA(3)=0.999224496520D0
            ALPHA(4)=0.100003305330D1
            ALPHA(5)=0.999998550110D0
            ALPHA(6)=0.100000006260D1
            ALPHA(7)=0.999999997290D0
            ALPHA(8)=1.D0
            NI=1
            DO 3111 I=1,8
            AUX1=ALPHA(I)*BBETA(I)
            U1(I,I)=2*AUX1**2
            AUX2=BBETA(I)**2
            AUX3=AUX2**2
            NJ=1
            DO 3112 J=1,8
            IF(J.EQ.I) GO TO 3113
            U1(I,J)=4*AUX1*AUX2*ALPHA(J)*BBETA(J)*(BBETA(J)**2-NI*NJ*AUX2)
           1/(BBETA(J)**4-AUX3)
     3113   NJ=-NJ
     3112   CONTINUE
            NI=-NI
     3111   CONTINUE
            U(1,1)=0.3629246D1
            U(1,2)=0.5505781D1
            U(1,3)=0.1744958D1
            U(1,4)=-0.2134544D1
            U(1,5)=0.1564799D1
            U(1,6)=0.3704012D0
            U(1,7)=0.1934753D1
            U(1,8)=0.8247060D-1
            U(2,1)=-0.2647601D2
            U(2,2)=0.3029180D2
            U(2,3)=0.1014811D3
            U(2,4)=0.2160570D2
            U(2,5)=0.2871452D2
            U(2,6)=0.4369674D2
            U(2,7)=-0.6868077D1
            U(2,8)=0.3987049D2
            U(3,1)=0.1261884D2
            U(3,2)=-0.1429789D3
            U(3,3)=0.1421241D2
            U(3,4)=0.4318519D3
            U(3,5)=0.1174606D3
            U(3,6)=0.3621580D2
            U(3,7)=0.2377329D3
            U(3,8)=-0.4042645D2
            U(4,1)=0.1199459D2
            U(4,2)=-0.6242567D2
            U(4,3)=-0.4038911D3
            U(4,4)=0.1375219D2
            U(4,5)=-0.9834033D3
            U(4,6)=0.4199045D3
            U(4,7)=0.1383665D2
            U(4,8)=0.5320940D3
            U(5,1)=-0.5021859D2
            U(5,2)=0.1118483D3
            U(5,3)=-0.2137421D3
            U(5,4)=-0.1078111D4
            U(5,5)=0.1630623D3
            U(5,6)=-0.1855181D4
            U(5,7)=0.8054312D3
            U(5,8)=0.1908673D3
            U(6,1)=0.5983286D2
            U(6,2)=-0.2176271D3
            U(6,3)=-0.8292016D2
            U(6,4)=-0.3027167D3
            U(6,5)=-0.2258734D4
            U(6,6)=-0.2496686D3
            U(6,7)=-0.3445534D4
            U(6,8)=-0.1113894D4
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      U(7,1)=-0.3137553D2
      U(7,2)=0.9192193D2
      U(7,3)=-0.2959916D3
      U(7,4)=-0.7115023D2
      U(7,5)=-0.6080909D3
      U(7,6)=-0.3689485D4
      U(7,7)=0.5970872D2
      U(7,8)=0.5750219D4
      U(8,1)=-0.3461307D2
      U(8,2)=0.5988959D2
      U(8,3)=-0.2790705D2
      U(8,4)=-0.5993094D3
      U(8,5)=0.405925[illegible]
      U(8,6)=-0.14002[illegible]D4
      U(8,7)=-0.5610158D4
      U(8,8)=0.8213839D2
      GO TO 1113
 1111 DO 2 I=1,8
      DO 3 J=I,8
      CALL FX41(X41(I,J),I,J)
      X41(J,I)=X41(I,J)
    3 CONTINUE
    2 CONTINUE
      DO 444 NI=1,8
      FI1(NI)=DSQRT(2.DO*NI-1.DO)
  444  CONTINUE
C
C    ****************************************************************
C    *                                                              *
C    *  THE COEFFICIENTS U1(I,J) AND U(I,J) WHEN LEGENDRE           *
C    *  POLYNOMIALS ARE USED                                        *
C    *                                                              *
      DO 1001 I=3,8
      DO 1002 J=2,8
      CALL FUU1(U1(I,J),U(I,J),I,J)
 1002 CONTINUE
      U1(I,1)=0.DO
      U(I,1)=0.DO
 1001 CONTINUE
      DO 1003 J=1,8
      U1(1,J)=0.DO
      U(1,J)=0.DO
      U1(2,J)=0.DO
      U(2,J)=0.DO
 1003 CONTINUE
C    *                                                              *
C    ****************************************************************
 1113 SQRT2=DSQRT(2.DO)
      CDOOPI=EPS2*CDO/(2.DO*PI)
      Z7=DETA-DZETA
      DO 4 IBETA=1,NBETA
      BETA=BETAL+DBETA*(IBETA-1)
      WRITE(6,29)
      WRITE(6,30) BETA
      COSB=DCOS(BETA)
      SINB=DSIN(BETA)
      S2B=SINB**2
      C2B=COSB**2
      C2BOEA=EPS3*C2B/EA
      Z4=EICSI*C2BOEA
      SBCB=SINB*COSB
      X1=GAMA*COSB/6.DO
      X9=CHORD*COSB/2
      X15=C2BOEA*C2B/4
      X16=EPS2*X1*SINB
      X28=X1*COSB
      DO 5 ITHETA=1,NTHETA
      THETAC=THETAL+DTHETA*(ITHETA-1)
      WRITE(6,31) THETAC
      WRITE(6,32)
      COSPC=DCOS(THETAC)
      SINPC=DSIN(THETAC)
      SCCC=SINPC*COSPC
      C2C=COSPC**2
      S2C=1-C2C
      S3C=S2C*SINPC
      COS2C=2*C2C-1
      SIN2C=2*SCCC
C**      X2=XLMBDA*(EPS2*XLMBDA*COSB*COSPC-EPS3*CHORD*SINB/2)
C**       XX3=XLMBDA*C2B*SINPC*(1+EPS3*CDOOPI*C2C)
```

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```
      X4=CDOOPI*COSB*COSPC
      X5=EPS3JB*(XJETA-XJZETA)*SCCC*SBCB
      X7=-Z7*SCCC
      X10=SINPC*SINB
      X11=X10*C2C
      X12=DETA*S2C+DZETA*C2C
      X14=X12*C2BOEA
C**      X17=EPS3*XLMBDA*S2C*COSPC
C**      X18=EPS3*XLMBDA*SINPC
      X20=EPS3*2*CDOOPI*COSB*SINPC*C2C
      X21=EPS3*CHORD*SINB*S2C/2
      X22=C2BOEA*COSB*SINPC*COS2C/2
      X38=1+2*S2C
      X23=EPS3*X16*X38*COSPC
      X24=-Z7*COS2C
      X25=EPS3*X1*SINPC
      X26=SINB*COS2C
      X27=X9*SINPC
C**      X29=EPS3*XLMBDA*COSPC
      X31=X28*SINPC
      X33=2*C2C
C**      X34=EPS3*XLMBDA*(C2C-3*S2C)
      X36=C2C-S2C/2
      X37=X28*COSPC
      X39=X31*(2*C2C/3-S2C/2)
      X40=C2B*SINPC*COS2C/2
      Y1=XJETA*S2C+XJZETA*C2C-XJCSI
C**      Y2=SBCB+X37*XLMBDA+X1*CDOOPI*X30*COSB-X16*CHORD/2
      YY3=EPS3JB*Y1*SBCB
C**      Y4=C2BOEA*(SBCB+X37*XLMBDA)/2
      Y5=EPS2*X31*C2B/EA
      Y6=DETA*C2C+DZETA*S2C
      Y7=-EPS3JB*Y1*C2B
      Y10=EPS2*2*X10
      Y11=X16*COSPC
C**      Y12=XLMBDA*SCCC
      Y13=(1+EPS3*2*CDOOPI*S2C)*COSB*COSPC
      Y15=C2BOEA*COSB*COSPC*C2C
      Y16=EPS3*2*Y11*COSPC*S2C
      Y17=EPS3*X1*COSPC
      Y18=2*SINB*C2C
      Y19=SINPC*C2C/2
      Y22=(1-C2C/3+S2C)/2
      Y23=C2B*C2C*COSPC
      Y24=X37*C2C
      Z1=EPS2*(XJZETA-XJETA)*C2B*SCCC
      Z2=EPS3*GAMA*COSPC*(CHORD**2)/96
      Z5=Z2*C2B
      Z2=Z2*SBCB
      ZZ3=EPS3*(XJZETA-XJETA)*COS2C*C2B
      DO 1 NFUNCT=NMIN,5
      NX=3*NFUNCT
      IF(ILGDRE.EQ.0) GO TO 1112
      NX=NX-4
C ***************************************************************
C                                                               *
      NA=-1
      IF(NFUNCT.EQ.3.OR.NFUNCT.EQ.5.OR.NFUNCT.EQ.7) NA=1
C   NA=(-1)**(NFUNCT+1)
      A1=FI1(NFUNCT)
      A2=FI1(NFUNCT-1)
      A11=NA*NFUNCT/(2*A2)
      A12=NA/(2*(NFUNCT-1)*A2)
      A21=NA*(NFUNCT-2)/(2*A1)
      A22=NA/(2*(NFUNCT-1)*A1)
C** A11,A12,A21,A22 ARE USED IN SUBROUTINE FUNCT TO CALCULATE
C** VE(NFUNCT-1),VE(NFUNCT),WE(NFUNCT-1) AND WE(NFUNCT)
C                                                               *
C ***************************************************************
C  THE VECTOR X(I) USED IN THE OPTIMIZATION ROUTINE IS DEFINED AS
C      [X(1),X(2),...X(3*NFUNCT-4)]=
C      [VE(1),VE(2),...,VE(NFUNCT-2);WE(1),WE(2),...,WE(NFUNCT-2);
C       THETAE(1),THETAE(2),...,THETAE(NFUNCT)].
C ** NOTE THAT VE(NFUNCT-1),VE(NFUNCT),WE(NFUNCT-1) AND WE(NFUNCT)
C     ARE CALCULATED SO THAT THE CANTILEVER BOUNDARY CONDITIONS AT X=0
C     ARE SATISFIED. THESE QUANTITIES, DENOTED HERE IN THE PROGRAM BY
C   VEN1,VEN,WEN1 AND WEN, RESPECTIVELY, ARE CALCULATED IN THE
C   SUBROUTINE FUNCT AND RETURNED AS A COMMON VARIABLE TO THIS
C   PART OF THE PROGRAM.
C ** INITIAL GUESS FOR THE VECTOR X(I) ******
```

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```
 1112 DO 6 K=1,NX
      X(K)=0.D0
  6   CONTINUE
C *************************************************
      NUMBER=0
      EST=0
      EPS=1.D-6
      LIMIT=500
      IF(ILGDRE.EQ.1) GO TO 2111
 8000 CALL DFMCG(FUNCTB,NX,X,FSQ(IBETA,ITHETA,NFUNCT),GRAD,EST,EPS,LIMIT
     1,IER(IBETA,ITHETA,NFUNCT),W)
C       IF(FSQ(IBETA,ITHETA,NFUNCT).LE.1.D-20) GO TO 2112
      NUMBER=NUMBER+1
      IF(NUMBER.LT.1) GO TO 8000
      CALL DFMFP(FUNCTB,NX,X,FSQ(IBETA,ITHETA,NFUNCT),GRAD,EST,EPS,
     1LIMIT,IER(IBETA,ITHETA,NFUNCT),W)
      GO TO 2112
 2111 CALL DFMCG(FUNCTL,NX,X,FSQ(IBETA,ITHETA,NFUNCT),GRAD,EST,EPS,LIMIT
     1,IER(IBETA,ITHETA,NFUNCT),W)
C       WRITE(6,*) NFUNCT,FSQ(IBETA,ITHETA,NFUNCT),IER(IBETA,ITHETA,NFUNC
C      1T)
C       DO 888 I=1,NX
C       WRITE(6,*) X(I)
C  888 CONTINUE
      GO TO 1114
C  ** TIP DEFLECTIONS WHEN NON-ROTATING NORMAL MODES ARE USED **
 2112 VETIPA=0.D0
      WETIPA=0.D0
      THETPA=0.D0
      NVE1=2*NFUNCT
      NA=1
      PHI=0.D0
      DO 777 I=1,NFUNCT
      VETIPA=VETIPA+2*NA*X(I)
      WETIPA=WETIPA+2*NA*X(NFUNCT+I)
      THETPA=THETPA+NA*X(NVE1+I)
      DO 778 J=1,NFUNCT
      AUX=U1(I,J)*X(NFUNCT+J)
  778 CONTINUE
      PHI=PHI+AUX*X(I)
      NA=-NA
  777 CONTINUE
      VETIP(IBETA,ITHETA,NFUNCT)=VETIPA
      WETIP(IBETA,ITHETA,NFUNCT)=WETIPA
      THETPA=SQRT2*THETPA
      THETIP(IBETA,ITHETA,NFUNCT)=THETPA
      PHIE(IBETA,ITHETA,NFUNCT)=THETAC+THETPA+PHI
      GO TO 3333
C
CC   ***************************************************************
CC   *                                                             *
CC   *    TIP DEFLECTIONS WHEN LEGENDRE POLYNOMIALS ARE USED       *
CC   *                                                             *
CC   *   VETIP=VE(1)+VE(2)*SQRT(3)+VE(3)*SQRT(5)+...               *
CC   *   WETIP=WE(1)+WE(2)*SQRT(3)+WE(3)*SQRT(5)+...               *
CC   *   THETAETIP=SQRT(2)*(THETAE(1)-THETAE(2)+THETAE(3)-...)     *
CC   *                                                             *
C    ***************************************************************
 1114 NN=NFUNCT-2
      NVE1=2*NFUNCT
      DO 7 I=1,NN
      W(I)=X(I)
      I1=NN+I
      I2=NFUNCT+I
      W(I2)=X(I1)
      I1=NVE1-4
      I2=NVE1+I
      W(I2)=X(I1)
    7 CONTINUE
      W(NFUNCT-1)=VEN1
      W(NFUNCT)=VEN
      W(NVE1-1)=WEN1
      W(NVE1)=WEN
      I1=3*NFUNCT
      W(I1-1)=X(I1-5)
      W(I1)=X(I1-4)
      VETIPA=0.D0
      WETIPA=0.D0
      THETPA=0.D0
      NA=1
```

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```
      PHI=0.DO
      DO 877 I=1,NFUNCT
      I1=NFUNCT+I
      I2=NVE1+I
      VETIPA=VETIPA+FI1(I)*W(I)
      WETIPA=WETIPA+FI1(I)*W(I1)
      THETPA=THETPA+NA*W(I2)
      DO 878 J=1,NFUNCT
      I1=NFUNCT+J
      AUX=U1(I,J)*W(I1)
  878 CONTINUE
      PHI=PHI+AUX*W(I)
      NA=-NA
  877 CONTINUE
      VETIP(IBETA,ITHETA,NFUNCT)=VETIPA
      WETIP(IBETA,ITHETA,NFUNCT)=WETIPA
      THETPA=SQRT2*THETPA
      THETIP(IBETA,ITHETA,NFUNCT)=THETPA
      PHIE(IBETA,ITHETA,NFUNCT)=THETAC+THETPA+PHI
 3333 WRITE(6,33) NFUNCT,VETIP(IBETA,ITHETA,NFUNCT),WETIP(IBETA,ITHETA
     1,NFUNCT),THETIP(IBETA,ITHETA,NFUNCT),PHIE(IBETA,ITHETA,NFUNCT),
     2FSQ(IBETA,ITHETA,NFUNCT),IER(IBETA,ITHETA,NFUNCT)
      WRITE(6,*)
    1 CONTINUE
    5 CONTINUE
    4 CONTINUE
      WRITE(6,29)
      RETURN
      END
C     ******************************************************************
      SUBROUTINE DDFMCG(FUNCTB,NX,X,FSQ,GRAD,EST,EPS,LIMIT,IER,W)
      IMPLICIT REAL*8(A-H,O-Z)
      INTEGER EPS2,EPS3,EPS3JB
      DIMENSION X(24),GRAD(24),W(2),XY(24)
      COMMON/VAR1/EPS2,EPS3,EPS3JB,NFUNCT,NF
      COMMON/VAR4/XY
      TOL=1.D-7
      ICOUNT=0
      IER=0
    9 CALL FUNCTB(NX,X,FSQ1,GRAD)
      XA=0.DO
      DO 50 K=1,NX
      XA=XA+GRAD(K)**2
   50 CONTINUE
      STEP=FSQ1/XA
   10 DO 1 K=1,NX
      XY(K)=X(K)-STEP*GRAD(K)
    1 CONTINUE
      AUX=XY(1)
      NF=1
      FSQ2=FUNCTN(AUX)
      WRITE(6,*) ICOUNT,FSQ1,FSQ2
      IF(FSQ2.LT.FSQ1) GO TO 11
      IF(FSQ1.LE.TOL) GO TO 12
      STEP=STEP/2.DO
      ICOUNT=ICOUNT+1
      IF(ICOUNT.LE.LIMIT) GO TO 10
      IER=1
   12 FSQ=FSQ1
      GO TO 13
   11 RATIO=FSQ1/FSQ2-1.DO
      DO 2 K=1,NX
      X(K)=XY(K)
    2 CONTINUE
      IF(FSQ2.GT.TOL) GO TO 9
      FSQ=FSQ2
   13 RETURN
      END
      SUBROUTINE FUNCTB(NX,X,FSQ,GRAD)
      INTEGER EPS2,EPS3,EPS3JB
      REAL*8 X,FSQ,GRAD,XY,FUNCTN,XA,XA2,REPS,DSQRT,F1,F2,GRAD1
      DIMENSION X(24),GRAD(24),XY(24),GRAD1(24)
      COMMON/VAR1/EPS2,EPS3,EPS3JB,NFUNCT,NF
      DATA REPS/Z3410000000000000/
      XA=1.D-6
C      XA=DSQRT(REPS)
      DO 1 I=1,NX
      XY(I)=X(I)
    1 CONTINUE
      CALL FUNCTN(NX,X,FSQ,GRAD)
```

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```
      XA2=2*XA
      DO 2 NF=1,NX
      XY(NF)=X(NF)+XA
      CALL FUNCTN(NX,XY,F2,GRAD1)
      XY(NF)=X(NF)-XA
      CALL FUNCTN(NX,XY,F1,GRAD1)
       XY(NF)=X(NF)
      GRAD(NF)=(F2-F1)/XA2
    2 CONTINUE
      RETURN
      END
      SUBROUTINE FUNCTL(NX,X,FSQ,GRAD)
      INTEGER EPS2,EPS3,EPS3JB
      REAL*8 X,FSQ,GRAD,XY,FUNCT,DER,XA,REPS,DSQRT
      DIMENSION X(24),GRAD(24),XY(24)
      COMMON/VAR1/EPS2,EPS3,EPS3JB,NFUNCT,NF
      COMMON/VAR4/XY
      DATA REPS/Z3410000000000000/
      XA=1.D-6
C      XA=DSQRT(REPS)
      DO 1 I=1,NX
      XY(I)=X(I)
    1 CONTINUE
      NF=1
      FSQ=FUNCT(X(NF))
      DO 2 NF=1,NX
C      H=0.001
C      IH=1
C      CALL DDCAR(X(NF),H,IH,FUNCT,DER)
C      GRAD(NF)=DER
      GRAD(NF)=(FUNCT(X(NF)+XA)-FUNCT(X(NF)-XA))/(XA+XA)
      XY(NF)=X(NF)
    2 CONTINUE
      RETURN
      END
C   *** SUBROUTINES TO EVALUATE THE COEFFICIENTS
C   *** X41(I,J),U1(I,J), AND U(I,J)
      SUBROUTINE FX41(X41,I,J)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C2,I2,I)
      CALL FIP(C3,I3,J)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      C2(1)=0.D0
      CALL PINT(C1,I1,C2,I2)
      X41=0.D0
      IF(I1.EQ.1) GO TO 2
      DO 1 I=2,I1
      X41=X41+C1(I)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)
      IF(DABS(X41).LT.1.D-7) X41=0.D0
      X41=X41*DSQRT(XX)
    2 RETURN
      END
      SUBROUTINE FUU1(U1,U,I,J)
      REAL*8 U1,U,XX,DSQRT,DABS,C1,C2,C3
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIPP(C1,I1,I)
      CALL FIP(C2,I2,J)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      U1=0.D0
      U=0.D0
      DO 1 N=2,I1
      U1=U1+C1(N)
      U=U+C1(N)*0.75D0**(N-1)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)
      IF(DABS(U1).LT.1.D-7) U1=0.D0
      IF(DABS(U).LT.1.D-7) U=0.D0
      XX=DSQRT(XX)
      U1=U1*XX
      U=U*XX
      RETURN
      END
C   *** SUBROUTINES FI,FIP AND FIPP DEFINING THE SHIFTED
C   *** LEGENDRE POLYNOMIALS AND THEIR FIRST DERIVATIVES
      SUBROUTINE FI(COEFF,I)
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```
640.            REAL*8 COEFF
641.            DIMENSION COEFF(8)
642.            IF(I.EQ.1) GO TO 1
643.            IF(I.EQ.2) GO TO 2
644.            IF(I.EQ.3) GO TO 3
645.            IF(I.EQ.4) GO TO 4
646.            IF(I.EQ.5) GO TO 5
647.            IF(I.EQ.6) GO TO 6
648.            IF(I.EQ.7) GO TO 7
649.            COEFF(1)=-1.D0
650.            COEFF(2)=56.D0
651.            COEFF(3)=-756.D0
652.            COEFF(4)=4200.D0
653.            COEFF(5)=-11500.D0
654.            COEFF(6)=16632.D0
655.            COEFF(7)=-12012.D0
656.            COEFF(8)=3432.D0
657.            GO TO 50
658.        7   COEFF(1)=1.D0
659.            COEFF(2)=-42.D0
660.            COEFF(3)=420.D0
661.            COEFF(4)=-1680.D0
662.            COEFF(5)=3150.D0
663.            COEFF(6)=-2772.D0
664.            COEFF(7)=924.D0
665.            GO TO 50
666.        6   COEFF(1)=-1.D0
667.            COEFF(2)=30.D0
668.            COEFF(3)=-210.D0
669.            COEFF(4)=560.D0
670.            COEFF(5)=-630.D0
671.            COEFF(6)=252.D0
672.            GO TO 50
673.        5   COEFF(1)=1.D0
674.            COEFF(2)=-20.D0
675.            COEFF(3)=90.D0
676.            COEFF(4)=-140.D0
677.            COEFF(5)=70.D0
678.            GO TO 50
679.        4   COEFF(1)=-1.D0
680.            COEFF(2)=12.D0
681.            COEFF(3)=-30.D0
682.            COEFF(4)=20.D0
683.            GO TO 50
684.        3   COEFF(1)=1.D0
685.            COEFF(2)=-6.D0
686.            COEFF(3)=6.D0
687.            GO TO 50
688.        2   COEFF(1)=-1.D0
689.            COEFF(2)=2.D0
690.            GO TO 50
691.        1   COEFF(1)=1.D0
692.        50  RETURN
693.            END
694.            SUBROUTINE FIF(COEFF,IF,I)
695.            REAL*8 COEFF,C1
696.            DIMENSION COEFF(100),C1(100)
697.            CALL FI(C1,I)
698.            CALL PDER(COEFF,IF,C1,I)
699.             RETURN
700.            END
701.            SUBROUTINE FIPP(COEFF,IPP,I)
702.            REAL*8 COEFF,C1
703.            DIMENSION COEFF(100),C1(100)
704.            CALL FI(COEFF,I)
705.            CALL PDER(C1,IP,COEFF,I)
706.            CALL PDER(COEFF,IPP,C1,IP)
707.            RETURN
708.            END
709.      C  ***    SSP SUBROUTINES PMPY,PDER AND PINT    ***
710.            SUBROUTINE PMPY(Z,IDIMZ,X,IDIMX,Y,IDIMY)
711.            REAL*8 Z,X,Y
712.            DIMENSION Z(1),X(1),Y(1)
713.            IF(IDIMX*IDIMY) 10,10,20
714.        10  IDIMZ=0
715.            GO TO 50
716.        20  IDIMZ=IDIMX+IDIMY-1
717.            DO 30 I=1,IDIMZ
718.        30  Z(I)=0.D0
719.            DO 40 I=1,IDIMX
```

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```
      DO 40 J=1,IDIMY
      K=I+J-1
   40 Z(K)=X(I)*Y(J)+Z(K)
   50 RETURN
      END
      SUBROUTINE PDER(Y,IDIMY,X,IDIMX)
      REAL*8 Y,X,EXPT
      DIMENSION X(1),Y(1)
      IF(IDIMX-1) 3,3,1
    1 IDIMY=IDIMX-1
      EXPT=0.D0
      DO 2 I=1,IDIMY
      EXPT=EXPT+1.D0
    2 Y(I)=X(I+1)*EXPT
      GO TO 4
    3 IDIMY=1
      Y(1)=0.D0
    4 RETURN
      END
      SUBROUTINE PINT(Y,IDIMY,X,IDIMX)
      REAL*8 Y,X,EXPT
      DIMENSION X(1),Y(1)
      IDIMY=IDIMX+1
      Y(1)=0.D0
      IF(IDIMX) 1,1,2
    1 RETURN
    2 EXPT=1.D0
      DO 3 I=2,IDIMY
      Y(I)=X(I-1)/EXPT
    3 EXPT=EXPT+1.D0
      GO TO 1
      END
C  **** END OF THE SUBROUTINES NEEDED TO EVALUATE X41(I,J) **
C  ***********************************************************
      FUNCTION FUNCT(X)
      IMPLICIT REAL*8(A-H,O-Z)
      INTEGER EPS2,EPS3,EPS3JB
      DIMENSION VE(8),WE(8),THETAE(8),FV(8),FW(8),FTHETA(8),FI1(8),
     1XY(24)
      DIMENSION DELTA(8,8),A(8),B(8),C(8),D(8,8),E(8,8),F(8,8,8),G(8,8,8
     1),H(8,8,8),XI(8,8),XJ(8,8),XK(8,8,8),XM(8,8),XN(8,8),O(8,8),P(8,8,
     2,Q(8),R(8,8),S(8),A3(8,8,8),B3(8,8,8,8),C3(8,8,8,8),D3(8,8),
     3E3(8,8,8,8),F3(8,8,8,8),G3(8,8),H3(8,8,8,8),XI3(8,8,8,8),XJ3(8,8),
     4XK3(8,8),XL3(8,8),XM3(8,8),XN3(8,8,8),O3(8,8,8),P3(8,8,8),Q3(8,8,8
     5),R3(8,8,8,8),S3(8,8,8,8),T3(8,8,8),DEL(8,8),DELF(8,8)
      DIMENSION U3(8,8,8),V3(8,8,8),W3(8,8),X3(8,8,8),Y3(8,8,8),Z3(8,8,8
     1),A4(8,8,8,8),B4(8,8,8,8),C4(8,8,8,8),D4(8,8,8,8),E4(8,8,8,8),
     2F4(8,8,8,8),G4(8,8,8,8),H4(8),XI4(8,8,8,8),XJ4(8,8,8),XK4(8,8),
     3XL4(8,8,8,8),XM4(8,8,8),XN4(8,8),O4(8,8),P4(8,8,8),Q4(8,8,8,8),
     4R4(8,8,8,8),S4(8,8,8),T4(8,8),U4(8),V4(8,8,8,8),W4(8,8,8),X41(8,8
      COMMON/VAR1/EPS2,EPS3,EPS3JB,NFUNCT,NF
      COMMON/VAR4/XY
      COMMON/VAR2/X1,X2,XX3,X4,X5,X6,X7,X8,X9,X10,X11,X12,X13,X14,X15,
     1X16,X17,X18,X19,X20,X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,X31,
     2X32,X33,X34,X35,X36,X37,X38,X39,X40,X41,Y1,Y2,YY3,Y4,Y5,Y6,Y7,Y8,
     3Y9,Y10,Y11,Y12,Y13,Y14,Y15,Y16,Y17,Y18,Y19,Y20,Y21,Y22,Y23,Y24,Z1,
     4Z2,ZZ3,Z4,Z5,Z7,A11,A12,A21,A22,DCSI,CHORD,SINB,COSB,S2B,C2B,SBCB,
     5CCOSPC,C2BOEA,SQRT2,S3C,SCCC,COS2C,SIN2C,VEN1,VEN,WEN1,WEN,THETAC
      COMMON/VAR3/CDOOPI,SINPC,C2C,S2C,DEL,DELF,DELTA,A,B,C,D,E,F,G,H,XI
     1,XJ,XK,XM,XN,O,P,Q,R,S,A3,B3,C3,D3,E3,F3,G3,H3,XI3,XJ3,XK3,XL3,XM3
     2,XN3,O3,P3,Q3,R3,S3,T3,U3,V3,W3,X3,Y3,Z3,A4,B4,C4,D4,E4,F4,G4,H4,
     3XI4,XJ4,XK4,XL4,XM4,XN4,O4,P4,Q4,R4,S4,T4,U4,V4,W4,FI1
C  ***************************************************
C  DEFINITION OF THE VECTOR [X(1),X(2),...,X(3*N-4)] =
C  [VE(1),VE(2),...,VE(N-2);WE(1),WE(2),...,WE(N-2);THETAE(1),
C   THETAE(2),...,THETAE(N)] USED IN THE OPTIMIZATION ROUTINE.
      XY(NF)=X
      NN=NFUNCT-2
      DO 3 I=1,NN
      VE(I)=XY(I)
      I1=NN+I
      WE(I)=XY(I1)
      I2=2*NN+I
      THETAE(I)=XY(I2)
    3 CONTINUE
      I1=3*NFUNCT-5
      I2=NFUNCT-1
      THETAE(I2)=XY(I1)
      I1=I1+1
      THETAE(NFUNCT)=XY(I1)
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      C   ***********************************************
      C
      C   CALCULATION OF VE(NFUNCT-1),VE(NFUNCT),WE(NFUNCT-1) AND WE(NFUNCT)
      C   ACCORDING TO THE EQUATIONS ON PAGE 39 OF THE NOTES.
          AUX1=VE(1)
          N1=1
          AUX2=0
          AUX3=WE(1)
          AUX4=0
          N2=NFUNCT-2
          IF(N2.EQ.1) GO TO 55
          DO 5 I=2,N2
          SS=DSQRT(2.DO*I-1.DO)
          AUX1=AUX1-N1*SS*VE(I)
          AUX2=AUX2+N1*I*(I-1)*SS*VE(I)
          AUX3=AUX3-N1*SS*WE(I)
          AUX4=AUX4+N1*I*(I-1)*SS*WE(I)
          N1=-N1
        5 CONTINUE
       55 N1=NFUNCT-1
          VE(N1)=A11*AUX1+A12*AUX2
          VE(NFUNCT)=A21*AUX1+A22*AUX2
          WE(N1)=A11*AUX3+A12*AUX4
          WE(NFUNCT)=A21*AUX3+A22*AUX4
          VEN1=VE(N1)
          VEN=VE(NFUNCT)
          WEN1=WE(N1)
          WEN=WE(NFUNCT)
      C   ***********************************************************
      CC  *                                                         *
      CC  **       CALCULATION OF THE INFLOW RATIO LAMBDA           **
      CC  *        (XLMBDA IN THE PROGRAM)                          *
      CC  *                                                         *
      CC* *       CALL XLBDA(XLMBDA)
      C   *                                                         *
          XLMBDA=0.03927DO*(DSQRT(1.DO+38.1972DO*THETAC)-1.DO)
      C   *                                                         *
      C   ***********************************************************
          X2=XLMBDA*(EPS2*XLMBDA*COSB*COSPC-EPS3*CHORD*SINB/2)
          XX3=XLMBDA*C2B*SINPC*(1+EPS3*CDOOPI*C2C)
          X8=EPS3*X1*XLMBDA
          X6=X8*C2BOEA*COSB*SINPC/2
          X13=1+2*X8*SINB*COSPC
          X17=EPS3*XLMBDA*S2C*COSPC
          X18=EPS3*XLMBDA*SINPC
          X19=EPS2*XLMBDA*COSB
          X29=EPS3*XLMBDA*COSPC
          X30=X29*(1+S2C)
          X32=EPS3*XLMBDA/2
          X34=EPS3*XLMBDA*(C2C-3*S2C)
          X35=EPS3*X31*XLMBDA/2
          Y2=SBCB+X37*XLMBDA+X1*CDOOPI*X30*COSB-X16*CHORD/2
          Y4=C2BOEA*(SBCB+X37*XLMBDA)/2
          Y8=X29*SINB
          Y9=EPS2*X9+X29*SINB*C2C
          Y12=EPS3*XLMBDA*SCCC
          Y14=SINPC*(X19-EPS3*CHORD*SINB*COSPC/2)
          Y20=X29*C2C
          Y21=EPS3*XLMBDA*X31*SCCC/2
          II=1
          DO 6 I=1,NFUNCT
          FI10=(1-II)*FI1(I)
          FV(I)=-X1*(X2*A(I)-XX3*B(I)-X4*C(I))+X5*FI10+X6*H4(I)
          FW(I)=-X31*C(I)+Y2*B(I)+YY3*FI10+Y4*H4(I)-Y5*U4(I)
          FTHETA(I)=Z1*Q(I)+Z2*S(I)
          Z6A=(1-2*I)/SQRT2
          IJ=1
          DO 7 J=1,NFUNCT
          Z6B=J*(J-1)*FI1(J)
          FV(I)=FV(I)+(X7*(DELTA(I,J)+C2BOEA*D3(I,J))+X8*(X9*W3(I,J)-X10*DEL
         1F(I,J)+X11*O(I,J)))*WE(J)+(X12*DELTA(I,J)-X13*DELF(I,J)+C2B*D(I,J
         2)+X14*D3(I,J)+X15*(XJ3(I,J)-G3(I,J)/6)+X16*(E(I,J)-X17*O(I,J)))*VE
         3(J)+X1*((COSPC*XI(I,J)+X18*O4(I,J))*X19-X20*XJ(I,J)-X21*XI(I,J)
         4+X22*XK4(I,J))*THETAE(J)
           FW(I)=FW(I)+(Y6*(DELTA(I,J)+C2BOEA*D3(I,J))+C2B*D(I,J)+X15*(XJ3(I
         1J)-G3(I,J)/6)+Y7*XK3(I,J)-EPS3*S2B*DELF(I,J)-X1*(Y8*DELF(I,J)+Y9*
         2(I,J)-Y10*E(I,J)))*WE(J)-(X7*(DELTA(I,J)+C2BOEA*D3(I,J))-Y11*(Y12
         30(I,J)+E(I,J)))*VE(J)-X1*(Y13*XJ(I,J)+Y14*XI(I,J)+Y15*XK4(I,J))*
         4THETAE(J)
           FTHETA(I)=FTHETA(I)+(ZZ3*DEL(I,J)-DCSI*(P(I,J)+2*C2BOEA*XN(I,J))+
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880.              1Z4*XN(I,J))*THETAE(J)+Z5*R(I,J)*WE(J)
881.               IF(EPS2.EQ.0) GO TO 77
882.               IK=1
883.               DO 8 K=1,NFUNCT
884.               Z6C=K*(K-1)*FI1(K)
885.               Z8A=Z6B*Z6C
886.               Z6=IJ*IK*Z6A*Z8A
887.               Z8=-NAI*Z8A*(J-2)*(J+1)/SQRT2
888.               Z8A=NAI*Z8A*(K-2)*(K+1)
889.               FV(I)=FV(I)+(X23*G(I,K,J)-2*X7*XK(J,K,I))*THETAE(J)*VE(K)+
890.              1(DCSI*A3(I,J,K)+X24*XK(J,K,I)-X25*(X26*G(I,K,J)+X27*Y3(I,K,J)
891.              2))*THETAE(J)*WE(K)-(EPS3*SBCB*(F(I,J,K)+X41(I,J)*IK*FI1(K))-X28*
892.              3(C2C*(X29*P3(I,J,K)-SINPC*Q3(I,J,K))+T3(I,J,K)-S3C*O3(I,J,K)+X30*
893.              4XN3(I,J,K)+2*X29*Z3(I,J,K)))*VE(J)*WE(K)
894.               FV(I)=FV(I)-X31*(X32*(X33*P3(I,J,K)+32C*XN3(I,J,K)
895.              1+F(J,K,I)-2*Z3(I,J,K))-SCCC*(Q3(I,J,K)-O3(I,J,K)/2))*VE(J)*VE(K)
896.              2-X31*(SCCC*U3(I,J,K)-X34*X3(I,J,K))*THETAE(J)*THETAE(K)/2
897.              3+X35*(C2C*XN3(I,J,K)-F(J,K,I))*WE(J)*WE(K)
898.               FW(I)=FW(I)+(X24*XK(J,K,I)-DCSI*P4(I,J,K)-Y16*G(I,K,J))*THETA
899.              1E(J)*VE(K)-X37*(SINPC*(X29*P3(I,K,J)-SINPC*Q3(I,K,J))-T3(I,J,K)+
900.              203(I,J,K))*VE(J)*WE(K)+(2*X7*XK(J,K,I)+Y17*(Y18*G(I,J,K)+X27*Y3(I
901.              3,J,K)))*WE(J)*THETAE(K)-(EPS3*SBCB*(F(I,J,K)+F(J,K,I)/2+X41(I,J)*
902.              4IK*FI1(K))-X28*(C2C*(X29*P3(I,J,K)-SINPC*Q3(I,J,K))+Y19*O3(I,J,K)-
903.              5Y20*XN3(I,J,K)+SINPC*S4(I,J,K)-X29*F(J,K,I)/2))*WE(J)*WE(K)
904.               FW(I)=FW(I)-(EPS3*SBCB*F(J,K,I)/2-X26*(SINPC*(O3(I,J,K)-
905.              12*T3(I,J,K)+X29*(Z3(I,J,K)-XN3(I,J,K)/2-F(J,K,I)/2))+SINPC*S4(I,
906.              2J,K))*VE(J)*VE(K)+Y21*X3(I,J,K)*THETAE(J)*THETAE(K)
907.               FTHETA(I)=FTHETA(I)+DCSI*(A3(J,I,K)+Z6)*VE(J)*WE(K)+Z7*(XK(I
908.              1,J,K)+Z8)*((VE(J)*VE(K)-WE(J)*WE(K))*SCCC-VE(J)*WE(K)*C0S2C)
909.               IF(EPS3.EQ.0) GO TO 88
910.               DO 9 L=1,NFUNCT
911.               NAL=1
912.               IF(L.EQ.3.OR.L.EQ.5.OR.L.EQ.7) NAL=-1
913.               Z9=NAL*Z8A
914.               FV(I)=FV(I)+Z7*(THETAE(J)*THETAE(K)*(WE(L)*SIN2C+VE(L)*COS2C)*B3(I
915.              1,J,K,L)-SCCC*WE(J)*(VE(K)*VE(L)+WE(K)*WE(L))*C3(I,J,K,L))+(X12*
916.              2E3(I,J,K,L)-C2B*(H3(I,J,K,L)+XI3(I,J,K,L)/2))*VE(J)*VE(K)*VE(L)/2+
917.              3(X12*E3(I,J,K,L)/2+DCSI*F3(I,J,K,L)-C2B*(H3(I,J,K,L)+XI3(I,J,K,L)/
918.              42)/2)*VE(J)*WE(K)*WE(L)+X31*(C2C*R3(I,J,K,L)+C0S2C*A4(I,J,K,L)-
919.              5X36*C4(I,J,K,L)-C0S2C*XI4(I,J,K,L)/2)*VE(J)*VE(K)*THETAE(L)
920.               FV(I)=FV(I)-X37*(C2C*R3(I,J,K,L)-X38*A4(I,J,K,L)+3*S2C*C4(I,J,K,L)
921.              1)*VE(J)*WE(K)*THETAE(L)-X39*B4(I,J,K,L)*THETAE(J)*THETAE(K)*
922.              2THETAE(L)-X40*WE(J)*WE(K)*THETAE(L)*XI4(I,J,K,L)
923.               FW(I)=FW(I)+Z7*THETAE(J)*THETAE(K)*(VE(L)*SIN2C-WE(L)*COS2C)*B3(I,
924.              1J,K,L)-2*X7*(C3(I,J,K,L)+F3(I,K,J,L)/4+F3(I,J,K,L)/2)*WE(J)*WE(K)*
925.              2WE(L)-X7*F3(I,J,K,L)*VE(J)*VE(K)*VE(L)/2+(X12*Q4(I,J,K,L)-DCSI*
926.              3R4(I,J,K,L)-C2B*(H3(I,J,K,L)+XI3(I,J,K,L)/2)/2)*WE(J)*VE(K)*VE(L)+
927.              4(Y6*Q4(I,J,K,L)-C2B*(H3(I,J,K,L)+XI3(I,J,K,L)/2)/2)*WE(J)*WE(K)*
928.              5WE(L)
929.               FW(I)=FW(I)+X37*(SCCC*(R3(I,J,K,L)+2*(C4(I,J,K,L)-A4(I,K,J,L)))*
930.              1WE(J)*VE(K)*THETAE(L)-C2C*(R3(I,J,K,L)-C4(I,J,K,L)/2)*WE(J)*WE(K)
931.              2*THETAE(L)-Y22*B4(I,J,K,L)*THETAE(J)*THETAE(K)*THETAE(L))
932.              3-Y23*(2*A4(I,J,K,L)-C4(I,J,K,L))*VE(J)*VE(K)*THETAE(L)
933.              4+Y24*XI4(I,J,K,L)*(VE(J)*VE(K)+WE(J)*WE(K))*THETAE(L)
934.               FTHETA(I)=FTHETA(I)+Z7*(B3(J,I,L,K)+Z9)*((VE(J)*VE(K)-WE(J)*WE(K))
935.              1*C0S2C+2*VE(J)*WE(K)*SIN2C)*THETAE(L)
936.         9     CONTINUE
937.        88     IK=-IK
938.         8     CONTINUE
939.        77     IJ=-IJ
940.         7     CONTINUE
941.               II=-II
942.         6     CONTINUE
943.               FUNCT=0
944.               DO 10 I=1,NFUNCT
945.               FUNCT=FUNCT+FV(I)**2+FW(I)**2+FTHETA(I)**2
946.         C      FUNCT=FUNCT+DABS(FV(I))+DABS(FW(I))+DABS(FTHETA(I))
947.         CC     FUNCT=FUNCT+DEXP(FV(I))+DEXP(FTHETA(I))-3.DO
948.         C      FUNCT=FUNCT+DSQRT(FV(I)**2)+DSQRT(FW(I)**2)+DSQRT(FTHETA(I)**2)
949.        10     CONTINUE
950.               RETURN
951.               END
952.               SUBROUTINE FUNCTN(NX,X,FSQ,GRAD)
953.               IMPLICIT REAL*8(A-H,O-Z)
954.               INTEGER EPS2,EPS3,EPS3JB
955.               DIMENSION VE(8),WE(8),THETAE(8),FV(8),FW(8),FTHETA(8),FI1(8)
956.              1,X(24),XG(8),U(8,8),GRAD(24),GV(8,24),GW(8,24),GT(8,24)
957.               DIMENSION DELTA(8,8),A(8),B(8),C(8),D(8,8),E(8,8),F(8,8,8),G(8,8,8
958.              1),H(8,8,8),XI(8,8),XJ(8,8),XK(8,8,8),XM(8,8),XN(8,8),O(8,8),P(8,8)
959.              2,Q(8),R(8,8),S(8),A3(8,8,8),B3(8,8,8,8),C3(8,8,8,8),D3(8,8),
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```
     3E3(8,8,8,8),F3(8,8,8,8),G3(8,8),H3(8,8,8,8),XI3(8,8,8,8),XJ3(8,8),
     4XK3(8,8),XL3(8,8),XM3(8,8),XN3(8,8),O3(8,8,8),P3(8,8,8),Q3(8,8,8
     5),R3(8,8,8,8),S3(8,8,8,8),T3(8,8,8),DEL(8,8),DELF(8,8)
      DIMENSION U3(8,8,8),V3(8,8,8),W3(8,8),X3(8,8,8),Y3(8,8,8),Z3(8,8,8
     1),A4(8,8,8,8),B4(8,8,8,8),C4(8,8,8,8),D4(8,8,8,8),E4(8,8,8,8),
     2F4(8,8,8,8),G4(8,8,8,8),H4(8),XI4(8,8,8,8),XJ4(8,8,8),XK4(8,8),
     3XL4(8,8,8,8),XM4(8,8,8),XN4(8,8),O4(8,8),P4(8,8,8),Q4(8,8,8,8),
     4R4(8,8,8,8),S4(8,8,8,8),T4(8,8),U4(8),V4(8,8,8,8),W4(8,8,8),X41(8,8)
      COMMON/VAR1/EPS2,EPS3,EPS3JB,NFUNCT,NF
      COMMON/VAR2/X1,X2,XX3,X4,X5,X6,X7,X8,X9,X10,X11,X12,X13,X14,X15,
     1X16,X17,X18,X19,X20,X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,X31,
     2X32,X33,X34,X35,X36,X37,X38,X39,X40,X41,Y1,Y2,Y3,Y4,Y5,Y6,Y7,Y8,
     3Y9,Y10,Y11,Y12,Y13,Y14,Y15,Y16,Y17,Y18,Y19,Y20,Y21,Y22,Y23,Y24,Z1,
     4Z2,ZZ3,Z4,Z5,Z7,A11,A12,A21,A22,DCSI,CHORD,SINB,COSB,S2B,C2B,SBCB,
     5COSPC,C2BOEA,SQRT2,S3C,SCCC,COS2C,SIN2C,VEN1,VEN,WEN1,WEN,THETAC
      COMMON/VAR3/CDOOPI,SINPC,C2C,S2C,DEL,DELF,DELTA,A,B,C,D,E,F,G,H,XI
     1,XJ,XK,XM,XN,O,P,Q,R,S,A3,B3,C3,D3,E3,F3,G3,H3,XI3,XJ3,XK3,XL3,XM3
     2,XN3,O3,P3,Q3,R3,S3,T3,U3,V3,W3,X3,Y3,Z3,A4,B4,C4,D4,E4,F4,G4,H4,
     3XI4,XJ4,XK4,XL4,XM4,XN4,O4,P4,Q4,R4,S4,T4,U4,V4,W4,FII
      COMMON/VAR5/SIGMA,XG,U
      N2=2*NFUNCT
      DO 3 I=1,NFUNCT
      J1=NFUNCT+I
      J2=N2+I
      VE(I)=X(I)
      WE(I)=X(J1)
      THETAE(I)=X(J2)
    3 CONTINUE
C  ***************************************************************
C  *                                                             *
C  **       CALCULATION OF THE INFLOW RATIO LAMBDA              *
C  *         (XLMBDA IN THE PROGRAM)                             *
C  *                                                             *
      PHIE=0.DO
      DO 1 I=1,NFUNCT
      PHIE=PHIE+XG(I)*THETAE(I)
      AUX=0.DO
      DO 2 J=1,NFUNCT
      AUX=AUX+U(I,J)*WE(J)
    2 CONTINUE
      PHIE=PHIE+AUX*VE(I)
    1 CONTINUE
      PHIE=PHIE+THETAC
      IF(PHIE.NE.0.DO) GO TO 100
      XLMBDA=0.DO
      GO TO 101
  100 AUX=SIGMA*0.3927DO
      ABSPHI=DABS(PHIE)
      II=1
      IF(PHIE.LT.0.DO) II=-1
      XLMBDA=AUX*II*(DSQRT(1.DO+3.8197ZDO*ABSPHI/SIGMA)-1.DO)
C     1-1.DO)
C  *                                                             *
C  ***************************************************************
  101 X2=XLMBDA*(EPS2*XLMBDA*COSB*COSPC-EPS3*CHORD*SINB/2)
      XX3=XLMBDA*C2B*SINPC*(1+EPS3*CDOOPI*C2C)
      X8=EPS3*X1*XLMBDA
      X6=X8*C2BOEA*COSB*SINPC/2
      X13=1+2*X8*SINB*COSPC
      X17=EPS3*XLMBDA*S2C*COSPC
      X18=EPS3*XLMBDA*SINPC
      X19=EPS2*XLMBDA*COSB
      X29=EPS3*XLMBDA*COSPC
      X30=X29*(1+S2C)
      X32=EPS3*XLMBDA/2
      X34=EPS3*XLMBDA*(C2C-3*S2C)
      X35=EPS3*X31*XLMBDA/2
      Y2=SBCB+X37*XLMBDA+X1*CDOOPI*X30*COSB-X16*CHORD/2
      Y4=C2BOEA*(SBCB+X37*XLMBDA)/2
      Y8=X29*SINB
      Y9=EPS2*X9+X29*SINB*C2C
      Y12=EPS3*XLMBDA*SCCC
      Y14=SINPC*(X19-EPS3*CHORD*SINB*COSPC/2)
      Y20=X29*C2C
      Y21=EPS3*XLMBDA*X31*SCCC/2
C      DO 66 I=1,NFUNCT
C      DO 67 J=1,NX
C      GV(I,J)=0.DO
C      GW(I,J)=0.DO
C      GT(I,J)=0.DO
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1040.      C  67   CONTINUE
1041.        66   CONTINUE
1042.             II=1
1043.             DO 6 I=1,NFUNCT
1044.             FI10=2*II
1045.             FV(I)=-X1*(X2*A(I)-X3*B(I)-X4*C(I))+X5*FI10+X6*H4(I)
1046.             FW(I)=-X31*C(I)+Y2*B(I)+YY3*FI10+Y4*H4(I)-Y5*U4(I)
1047.             FTHETA(I)=Z1*Q(I)+Z2*S(I)
1048.             DO 7 J=1,NFUNCT
1049.             J1=NFUNCT+J
1050.             J2=N2+J
1051.             GVIJ=X12*DELTA(I,J)-X13*DELF(I,J)+C2B*D(I,J)+X14*D3(I,J)
1052.            1+X15*(XJ3(I,J)-G3(I,J)/6)+X16*(E(I,J)-X17*Q(I,J))
1053.             GVIJ1=X7*(DELTA(I,J)+C2BOEA*D3(I,J))+X8*(X9*W3(I,J)-X10*DELF(I,J)
1054.            1+X11*Q(I,J))
1055.             GVIJ2=X1*((COSPC*XI(I,J)+X18*Q4(I,J))*X19-X20*XJ(I,J)
1056.            1-X21*XI(I,J)+X22*XK4(I,J))
1057.             GWIJ=Y11*(Y12*Q(I,J)+E(I,J))-X7*(DELTA(I,J)+C2BOEA*D3(I,J))
1058.             GWIJ1=Y6*(DELTA(I,J)+C2BOEA*D3(I,J))+C2B*D(I,J)+X15*(XJ3(I,J)
1059.            1-G3(I,J)/6)+Y7*XK3(I,J)-EPS3*S2B*DELF(I,J)-X1*(Y8*DELF(I,J)
1060.            2+Y9*Q(I,J)-Y10*E(I,J))
1061.             GWIJ2=-X1*(Y13*XJ(I,J)+Y14*XI(I,J)+Y15*XK4(I,J))
1062.      C       GT(I,J)=0.D0
1063.             GTIJ1=Z5*R(I,J)
1064.             GTIJ2=ZZ3*DEL(I,J)-DCSI*(F(I,J)+2*C2BOEA*XN(I,J))+Z4*XN(I,J)
1065.             FV(I)=FV(I)+GVIJ*VE(J)+GVIJ1*WE(J)+GVIJ2*THETAE(J)
1066.             FW(I)=FW(I)+GWIJ*VE(J)+GWIJ1*WE(J)+GWIJ2*THETAE(J)
1067.             FTHETA(I)=FTHETA(I)+GTIJ1*WE(J)+GTIJ2*THETAE(J)
1068.      C       GV(I,J)=GV(I,J)+GVIJ
1069.      CCCCC   GV(I,J1)=GV(I,J1)+GVIJ1
1070.      CCCCC   GV(I,J2)=GV(I,J2)+GVIJ2
1071.      CCCCC   GW(I,J)=GW(I,J)+GWIJ
1072.      CCCCC   GW(I,J1)=GW(I,J1)+GWIJ1
1073.      CCCCC   GW(I,J2)=GW(I,J2)+GWIJ2
1074.      CCCCC   GT(I,J1)=GT(I,J1)+GTIJ1
1075.      CCCCC   GT(I,J2)=GT(I,J2)+GTIJ2
1076.             IF(EPS2.EQ.0) GO TO 7
1077.             DO 8 K=1,NFUNCT
1078.             K1=NFUNCT+K
1079.             K2=N2+K
1080.             VVFV=X31*(SCCC*(Q3(I,J,K)-Q3(I,J,K)/2)-X32*(X33*P3(I,J,K)+S2C*XN3(
1081.            1I,J,K)+F(J,K,I)-2*Z3(I,J,K)))
1082.             VWFV=-EPS3*SBCB*F(I,J,K)+X28*(C2C*(X29*P3(I,J,K)-SINPC*Q3(I,J,K)
1083.            1)+T3(I,J,K)-S3C*Q3(I,J,K)+X30*XN3(I,J,K)+2*X29*Z3(I,J,K))
1084.             VTFV=X23*G(I,J,K)-2*X7*XK(K,J,I)
1085.             WWFV=X35*(C2C*XN3(I,J,K)-F(J,K,I))
1086.             WTFV=DCSI*A3(I,K,J)+X24*XK(K,J,I)-X25*(X26*G(I,J,K)+X27*Y3(I,J,K))
1087.             TTFV=X31*(X34*X3(I,J,K)-SCCC*U3(I,J,K))/2
1088.             VVFW=X28*(SINPC*(Q3(I,J,K)-2*T3(I,J,K))+X29*(Z3(I,J,K)
1089.            1-XN3(I,J,K)/2-F(J,K,I)/2)+SINPC*S4(I,J,K))-EPS3*SBCB*F(J,K,I)/2
1090.             VWFW=X37*(T3(I,J,K)-Q3(I,J,K)-SINPC*(X29*P3(I,K,J)-SINPC*Q3(I,K,J)
1091.            1))
1092.             VTFW=X24*XK(K,J,I)-DCSI*P4(I,K,J)-Y16*G(I,J,K)
1093.             WWFW=X28*(C2C*(X29*P3(I,J,K)-SINPC*Q3(I,J,K))+Y19*Q3(I,J,K)-
1094.            1Y20*XN3(I,J,K)+SINPC*S4(I,J,K)-X29*F(J,K,I)/2)
1095.            2-EPS3*SBCB*(F(I,J,K)+F(J,K,I)/2)
1096.             WTFW=2*X7*XK(J,K,I)+Y17*(Y18*G(I,J,K)+X27*Y3(I,J,K))
1097.             TTFW=Y21*X3(I,J,K)
1098.             VVFT=Z7*XK(I,J,K)
1099.             VWFT=DCSI*A3(J,I,K)-VVFT*COS2C
1100.             VVFT=VVFT*SCCC
1101.             WWFT=-VVFT
1102.             AUX1=VVFV*VE(K)+VWFV*WE(K)+VTFV*THETAE(K)
1103.             AUX2=WWFV*WE(K)+WTFV*THETAE(K)
1104.             AUX3=TTFV*THETAE(K)
1105.             FV(I)=FV(I)+VE(J)*AUX1+WE(J)*AUX2+THETAE(J)*AUX3
1106.      CCCCC   GV(I,J)=GV(I,J)+AUX1
1107.      CCCCC   GV(I,K)=GV(I,K)+VVFV*VE(J)
1108.      CCCCC   GV(I,J1)=GV(I,J1)+AUX2
1109.      CCCCC   GV(I,K1)=GV(I,K1)+VWFV*VE(J)+WWFV*WE(J)
1110.      CCCCC   GV(I,J2)=GV(I,J2)+AUX3
1111.      CCCCC   GV(I,K2)=GV(I,K2)+VTFV*VE(J)+WTFV*WE(J)+TTFV*THETAE(J)
1112.             AUX1=VVFW*VE(K)+VWFW*WE(K)+VTFW*THETAE(K)
1113.             AUX2=WWFW*WE(K)+WTFW*THETAE(K)
1114.             AUX3=TTFW*THETAE(K)
1115.             FW(I)=FW(I)+VE(J)*AUX1+WE(J)*AUX2+THETAE(J)*AUX3
1116.      CCCCC   GW(I,J)=GW(I,J)+AUX1
1117.      CCCCC   GW(I,K)=GW(I,K)+VVFW*VE(J)
1118.      CCCCC   GW(I,J1)=GW(I,J1)+AUX2
1119.      CCCCC   GW(I,K1)=GW(I,K1)+VWFW*VE(J)+WWFW*WE(J)
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      GW(I,J2)=GW(I,J2)+AUX3
      GW(I,K2)=GW(I,K2)+VTFW*VE(J)+WTFW*WE(J)+TTFW*THETAE(J)
     AUX1=VVFT*VE(K)+VWFT*WE(K)
     AUX2=WWFT*WE(K)
      GT(I,J)=GT(I,J)+AUX1
      GT(I,K)=GT(I,K)+VVFT*VE(J)
      GT(I,J1)=GT(I,J1)+AUX2
      GT(I,K1)=GT(I,K1)+VWFT*VE(J)+WWFT*WE(J)
     FTHETA(I)=FTHETA(I)+VE(J)*AUX1+WE(J)*AUX2
     IF(EPS3.EQ.0) GO TO 8
     DO 9 L=1,NFUNCT
     L1=NFUNCT+L
     L2=N2+L
     VVVFV=(X12*E3(I,J,K,L)-C2B*(H3(I,J,K,L)+XI3(I,J,K,L)/2))/2
     VVWFV=-Z7*SCCC*C3(I,L,K,J)
     VVTFV=X31*(C2C*R3(I,J,K,L)+COS2C*(A4(I,J,K,L)-XI4(I,J,K,L)/2)
    1-X36*C4(I,J,K,L))
     VWWFV=VVVFV+DCSI*F3(I,J,K,L)
     VWTFV=X37*(X38*A4(I,J,K,L)-C2C*R3(I,J,K,L)-3*S2C*C4(I,J,K,L))
     VTTFV=Z7*COS2C*B3(I,L,K,J)
     WWWFV=-Z7*SCCC*C3(I,J,K,L)
     WWTFV=-X40*XI4(I,J,K,L)
     WTTFV=Z7*SIN2C*B3(I,L,K,J)
     TTTFV=-X39*B4(I,J,K,L)
     VVVFW=-X7*F3(I,J,K,L)/2
     VVWFW=X12*Q4(I,L,K,J)-DCSI*R4(I,L,K,J)-C2B*(H3(I,L,K,J)
    J+XI3(I,L,K,J)/2)/2
     VVTFW=Y23*(C4(I,J,K,L)-2*A4(I,J,K,L))+Y24*XI4(I,J,K,L)
     VWTFW=X37*SCCC*(R3(I,K,J,L)-2*A4(I,J,K,L)+2*C4(I,K,J,L))
     VTTFW=WTTFV
     WWWFW=Y6*Q4(I,J,K,L)-C2B*(H3(I,J,K,L)+XI3(I,J,K,L)/2)/2
    1-2*X7*(C3(I,J,K,L)+F3(I,K,J,L)/4+F3(I,J,K,L)/2)
     WWTFW=X37*C2C*(C4(I,J,K,L)/2-R3(I,J,K,L))+Y24*XI4(I,J,K,L)
     WTTFW=-VTTFV
     TTTFW=-X37*Y22*B4(I,J,K,L)
     AUX1=Z7*B3(J,I,L,K)
     VVTFT=AUX1*COS2C
     WWTFT=-VVTFT
     VWTFT=2*SIN2C*AUX1
     AUX=THETAE(K)*THETAE(L)
     AUX4=VVVFV*VE(L)+VVWFV*WE(L)+VVTFV*THETAE(L)
     AUX5=VWWFV*WE(L)+VWTFV*THETAE(L)
     AUX6=WWWFV*WE(L)+WWTFV*THETAE(L)
     AUX1=AUX4*VE(K)+AUX5*WE(K)+VTTFV*AUX
     AUX2=AUX6*WE(K)+WTTFV*AUX
     AUX3=TTTFV*AUX
      GV(I,J)=GV(I,J)+AUX1
      GV(I,K)=GV(I,K)+AUX4*VE(J)
      GV(I,L)=GV(I,L)+VVVFV*VE(J)*VE(K)
      GV(I,J1)=GV(I,J1)+AUX2
      GV(I,K1)=GV(I,K1)+AUX5*VE(J)+AUX6*WE(J)
      GV(I,L1)=GV(I,L1)+VE(J)*(VVWFV*VE(K)+VWWFV*WE(K))+WWWFV*WE(J)*
    1WE(K)
      GV(I,J2)=GV(I,J2)+AUX3
      GV(I,K2)=GV(I,K2)+(VTTFV*VE(J)+WTTFV*WE(J)+TTTFV*THETAE(J))*
    1THETAE(L)
      GV(I,L2)=GV(I,L2)+(VVTFV*VE(K)+VWTFV*WE(K)+VTTFV*THETAE(K))*VE(J)
    1+(WWTFV*WE(K)+WTTFV*THETAE(K))*WE(J)+TTTFV*THETAE(J)*THETAE(K)
     FV(I)=FV(I)+VE(J)*AUX1+WE(J)*AUX2+THETAE(J)*AUX3
     AUX4=VVVFW*VE(L)+VVWFW*WE(L)+VVTFW*THETAE(L)
     AUX5=VWWFW*WE(L)+VWTFW*THETAE(L)
     AUX6=WWWFW*WE(L)+WWTFW*THETAE(L)
     AUX1=AUX4*VE(K)+AUX5*WE(K)+VTTFW*AUX
     AUX2=AUX6*WE(K)+WTTFW*AUX
     AUX3=TTTFW*AUX
      GW(I,J)=GW(I,J)+AUX1
      GW(I,K)=GW(I,K)+AUX4*VE(J)
      GW(I,L)=GW(I,L)+VVVFW*VE(J)*VE(K)
      GW(I,J1)=GW(I,J1)+AUX2
      GW(I,K1)=GW(I,K1)+AUX5*VE(J)+AUX6*WE(J)
      GW(I,L1)=GW(I,L1)+VE(J)*(VVWFW*VE(K)+VWWFW*WE(K))+WWWFW*WE(J)*
    1WE(K)
      GW(I,J2)=GW(I,J2)+AUX3
      GW(I,K2)=GW(I,K2)+(VTTFW*VE(J)+WTTFW*WE(J)+TTTFW*THETAE(J))*
    1THETAE(L)
      GW(I,L2)=GW(I,L2)+(VVTFW*VE(K)+VWTFW*WE(K)+VTTFW*THETAE(K))*VE(J)
    1+(WWTFW*WE(K)+WTTFW*THETAE(K))*WE(J)+TTTFW*THETAE(J)*THETAE(K)
     FW(I)=FW(I)+VE(J)*AUX1+WE(J)*AUX2+THETAE(J)*AUX3
     AUX1=VVTFT*VE(K)+VWTFT*WE(K)
     AUX2=WWTFT*WE(K)
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C          GT(I,J)=GT(I,J)+AUX1*THETAE(L)
C          GT(I,K)=GT(I,K)+VVTFT*VE(J)*THETAE(L)
C          GT(I,J1)=GT(I,J1)+AUX2*THETAE(L)
C          GT(I,K1)=GT(I,K1)+(VWTFT*VE(J)+WWTFT*WE(J))*THETAE(L)
C          GT(I,L2)=GT(I,L2)+VE(J)*AUX1+WE(J)*AUX2
        FTHETA(I)=FTHETA(I)+(VE(J)*AUX1+WE(J)*AUX2)*THETAE(L)
     9  CONTINUE
     8  CONTINUE
     7  CONTINUE
        II=-II
     6  CONTINUE
        FSQ=0.DO
        DO 10 I=1,NFUNCT
        FSQ=FSQ+FV(I)**2+FW(I)**2+FTHETA(I)**2
    10  CONTINUE
        FSQ=FSQ/2
        DO 4 J=1,NX
        GRAD(J)=0
C         DO 5 I=1,NFUNCT
C         GRAD(J)=GRAD(J)+FV(I)*GV(I,J)+FW(I)*GW(I,J)+FTHETA(I)*GT(I,J)
C    5    CONTINUE
     4  CONTINUE
        RETURN
        END
//GO.FT50F001 DD UNIT=3400-3,VOL=SER=XXXXXX,
//   DISP=(OLD,KEEP),
//   DSN=GALERKIN.NONROTAT.HOVER.COEFFS,LABEL=(4,SL)
//GO.SYSIN DD *
/*
//
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C     ***********************************
C     *                                 *
C     *          COEFFREE               *
C     *                                 *
C     ***********************************
C
C**   CALCULATION OF THE GALERKIN COEFFICIENTS FOR THE FLAP-LAG-
C     TORSIONAL MOTION OF A ROTOR BLADE IN HOVER USING THE NON-ROTATING
C     NORMAL MODES OF A CLAMPED-FREE BEAM.
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION AUX(100),NN(4),Y(11),ALPHA(8),BETA(8)
      DIMENSION DELTA(8,8),A(8),B(8),C(8),D(8,8),E(8,8),F(8,8,8),
     1G(8,8,8),H(8,8,8),XI(8,8),XJ(8,8),XK(8,8,8),XM(8,8),XN(8,8),O(8,8)
     2,P(8,8),Q(8),R(8,8),S(8),A3(8,8,8),B3(8,8,8,8),C3(8,8,8,8),
     3D3(8,8),E3(8,8,8,8),F3(8,8,8,8),G3(8,8),H3(8,8,8,8),XI3(8,8,8,8)
     4,XJ3(8,8),XK3(8,8),XL3(8,8),XM3(8,8),XN3(8,8),O3(8,8,8),
     5P3(8,8,8),Q3(8,8,8),R3(8,8,8,8),S3(8,8,8,8),T3(8,8,8),DEL(8,8)
      DIMENSION U3(8,8,8),V3(8,8,8),W3(8,8),X3(8,8,8),Y3(8,8,8),Z3(8,8,8
     1),A4(8,8,8,8),B4(8,8,8,8),C4(8,8,8,8),D4(8,8,8,8),E4(8,8,8,8),
     2F4(8,8,8,8),G4(8,8,8,8),H4(8),XI4(8,8,8,8),XJ4(8,8,8),XK4(8,8),
     3XL4(8,8,8,8),XM4(8,8,8),XN4(8,8),O4(8,8),P4(8,8,8),Q4(8,8,8,8),
     4R4(8,8,8,8),S4(8,8,8),T4(8,8),U4(8),V4(8,8,8,8),W4(8,8,8)
      COMMON ALPHA,BETA
      EXTERNAL FI3,FCT1,FCT2,FCT3,FCT4,FCT5,FCT6,FCT7,FCT8,FCT9,
     1FCT10,FCT11
C  66   FORMAT(' ',6(D14.7,2X))
C  67   FORMAT(' ',2(D14.7,2X))
C  68   FORMAT(' ',//)
C  69   FORMAT(' ',3(D14.7,2X))
   65   FORMAT('1')
   66   FORMAT(' ',7(D14.7,2X))
   67   FORMAT(' ',5(D14.7,2X))
   68   FORMAT(' ')
   69   FORMAT(' ',/)
C  70   FORMAT(' IER1 TO IER20 : ',20(I2,2X))
   71   FORMAT(' ALL THE GALERKIN-NONROTAT HOVER COEFFICIENTS WERE PUT ON
     1TAPE NUMBER T07316 (A PRIVATE TAPE)')
 6666 FORMAT('                I',11X,'BETA(I)',22X,'ALPHA(I)',22X,'CH. EQN.')
 6667 FORMAT(' ',10X,I2,3X,D25.18,6X,D25.18,6X,D25.18)
C      DO 1 I=1,8
C      FO(I)=FUNF(0.D0,I)
C      FO(I)=0.D0
C    1   CONTINUE
C
C     ***********************************************
C     *                                             *
C     *  THE CONSTANTS ALPHA(I) AND BETA(I)         *
C     *                                             *
      BETA(1)=1.87510406871196111D0
      BETA(2)=4.69409113297417457D0
      BETA(3)=7.85475743823761263D0
      BETA(4)=10.99554073487546700
      BETA(5)=14.13716839104647230
      BETA(6)=17.27875953208823390
      BETA(7)=20.42035225104124760
      BETA(8)=23.56194490180644510
C**   CALCULATION OF THE ALPHA(I) CONSTANTS
C**   AND REFINEMENT OF THE B(I)'S BY A MODIFIED EWTON'S METHOD.
      WRITE(6,6666)
      ERROR=1.D-10
      DO 1111 I=1,8
      X=BETA(I)
 1112 X1=DCOSH(X)
      X2=DCOS(X)
      FBETA=1.D0+X1*X2
      XX=X-.2D0*FBETA/(DSINH(X)*X2-X1*DSIN(X))
      TEST=X/XX-1.D0
      IF(DABS(TEST).LE.ERROR) GO TO 1113
      X=XX
      GO TO 1112
 1113 X=XX
      BETA(I)=X
      X1=DCOSH(X)
      X2=DCOS(X)
```

```
      ALPHA(I)=(X1+X2)/(DSINH(X)+DSIN(X))
      FBETA=1.D0+X1*X2
      WRITE(6,6667) I,X,ALPHA(I),FBETA
 1111 CONTINUE
      WRITE(6,69)
      WRITE(6,69)
C *                                                    *
C ******************************************************
C
      ERROR=1.D-4
      NERROR=100
C
C ***************************************
C  *** CALCULATION OF THE IJKL-SYMMETRIC I3 COEFFICIENTS
      IR1=0
      IR2=0
      DO 110 I=1,6
      DO 111 J=1,6
      IF(J.GE.I) GO TO 112
      IR1=1
  112 DO 113 K=1,6
      IF(K.GE.J) GO TO 114
      IR2=1
  114 DO 115 L=1,6
      IF(L.LT.K) GO TO 141
      IF(IR1.EQ.0.AND.IR2.EQ.0) GO TO 119
      GO TO 141
  119 Y(1)=0.D0
      NI=1
      HH=0.01D0
      NCALL=1
      CALL DASCRU(0.D0,1.D0,HH,NI,FI3,Y,IERJ,AUX,I,J,K,L,NCALL,ERROR,
     1NERROR)
      XI3(I,J,K,L)=Y(1)
      IF(DABS(XI3(I,J,K,L)).LE.1.D-4) XI3(I,J,K,L)=0.D0
      GO TO 115
C ---- PUT IJKL IN INCREASING ORDER
  141 NN(1)=I
      NN(2)=J
      NN(3)=K
      NN(4)=L
      IG=I
      DO 130 M=2,4
      IF(NN(M).GE.IG) GO TO 131
      KK=M-1
      DO 132 N=1,KK
      IF(NN(M).GE.NN(N)) GO TO 132
      ITX=NN(N)
      NN(N)=NN(M)
      NN(M)=ITX
  132 CONTINUE
  131 IG=NN(M)
  130 CONTINUE
      M1=NN(1)
      M2=NN(2)
      M3=NN(3)
      M4=NN(4)
      XI3(I,J,K,L)=XI3(M1,M2,M3,M4)
  115 CONTINUE
      IR2=0
  113 CONTINUE
  111 IR1=0
  110 CONTINUE
C
C  ***** CALCULATION OF THE --(I,J,K,L) COEFFICIENTS WITH IJ-SYMMETRY
C ** M,N,J3,E,K3,DELTA,D,F,G3,N4 : SUBROUTINE FCT1 IS USED
C ** Q8,F,G,H,P3,T3,V3,Z8,K      : SUBROUTINE FCT2 IS USED
C ** R3,S8,Q4,A4                 : SUBROUTINE FCT3 IS USED
C
      DO 5 I=1,6
      DO 6 J=I,6
      NCALL=2
      NI=10
      Y(1)=0.D0
      Y(2)=0.D0
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      Y(3)=0.D0
      Y(4)=0.D0
      Y(5)=0.D0
      Y(6)=0.D0
      Y(7)=0.D0
      Y(8)=0.D0
      Y(9)=0.D0
      Y(10)=0.D0
      HH=0.01D0
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT1,Y,IER2,AUX,I,J,K,L,NCALL,ERROR,
     1NERROR)
      DO 991 IA=1,10
      IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
  991 CONTINUE
      XM(I,J)=Y(1)
      XN(I,J)=Y(2)
      XJ3(I,J)=Y(3)
      E(I,J)=Y(4)
      XK3(I,J)=Y(5)
      DELTA(I,J)=Y(6)
      IF(I.NE.J) DELTA(I,J)=0.D0
      D(I,J)=Y(7)
      P(I,J)=Y(8)
      IF(I.NE.J) P(I,J)=0.D0
      G3(I,J)=Y(9)
      XN4(I,J)=Y(10)
      DO 7 K=1,8
      NCALL=3
      NI=10
      HH=0.01D0
      DO 992 IA=1,10
      Y(IA)=0.D0
  992 CONTINUE
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT2,Y,IER3,AUX,I,J,K,L,NCALL,ERROR,
     1NERROR)
      DO 993 IA=1,10
      IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
  993 CONTINUE
      Q3(I,J,K)=Y(1)
      F(I,J,K)=Y(3)/BETA(K)**4
      G(I,J,K)=Y(4)
      H(I,J,K)=Y(5)
      P3(I,J,K)=Y(6)
      T3(I,J,K)=Y(7)
      V3(I,J,K)=Y(8)
      Z3(I,J,K)=Y(9)
      XK(I,J,K)=Y(10)
      DO 8 L=1,8
      NCALL=4
      NI=5
      HH=0.01D0
      Y(1)=0.D0
      Y(2)=0.D0
      Y(3)=0.D0
      Y(4)=0.D0
      Y(5)=0.D0
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT3,Y,IER4,AUX,I,J,K,L,NCALL,ERROR,
     1NERROR)
      DO 904 IA=1,5
      IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
  904 CONTINUE
      R3(I,J,K,L)=Y(1)
      S3(I,J,K,L)=Y(3)
      Q4(I,J,K,L)=Y(4)
      A4(I,J,K,L)=Y(5)
      R3(J,I,K,L)=Y(1)
      S3(J,I,K,L)=Y(3)
      Q4(J,I,K,L)=Y(4)
      A4(J,I,K,L)=Y(5)
    8 CONTINUE
      Q3(J,I,K)=Q3(I,J,K)
      F(J,I,K)=F(I,J,K)
      G(J,I,K)=G(I,J,K)
      H(J,I,K)=H(I,J,K)
      P3(J,I,K)=P3(I,J,K)
```

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```
      T3(J,I,K)=T3(I,J,K)
      V3(J,I,K)=V3(I,J,K)
      Z3(J,I,K)=Z3(I,J,K)
      XK(J,I,K)=XK(I,J,K)
    7 CONTINUE
      XM(J,I)=XM(I,J)
      XN(J,I)=XN(I,J)
      XJ3(J,I)=XJ3(I,J)
      E(J,I)=E(I,J)
      XK3(J,I)=XK3(I,J)
      DELTA(J,I)=DELTA(I,J)
      D(J,I)=D(I,J)
      P(J,I)=P(I,J)
      G3(J,I)=G3(I,J)
      XN4(J,I)=XN4(I,J)
    6 CONTINUE
    5 CONTINUE
C
C  *** CALCULATION OF THE --(I,J,K,L) COEFFICIENTS WITH JK-SYMMETRY
C  **       D3,U3,N3,X3,S4  : SUBROUTINE FCT4 IS USED
C  **       I4,C4           : SUBROUTINE FCT5 IS USED
C
      DO 9 I=1,8
      DO 10 J=1,8
      DO 11 K=J,8
      NCALL=5
      NI=6
      HH=0.01D0
      DO 994 IA=1,6
      Y(IA)=0.D0
  994 CONTINUE
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT4,Y,IER5,AUX,I,J,K,L,NCALL,ERROR,
     1NERROR)
      DO 995 IA=1,6
      IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
  995 CONTINUE
      D3(I,J,K)=Y(1)
      U3(I,J,K)=Y(2)
      XN3(I,J,K)=Y(3)
      X3(I,J,K)=Y(4)
      S4(I,J,K)=Y(5)
      DO 12 L=1,8
      NCALL=6
      NI=3
      HH=0.01D0
      Y(1)=0.D0
      Y(2)=0.D0
      Y(3)=0.D0
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT5,Y,IER6,AUX,I,J,K,L,NCALL,ERROR,
     1NERROR)
      IF(DABS(Y(1)).LE.1.D-4) Y(1)=0.D0
      IF(DABS(Y(2)).LE.1.D-4) Y(2)=0.D0
      IF(DABS(Y(3)).LE.1.D-4) Y(3)=0.D0
      XI4(I,J,K,L)=Y(1)
      C4(I,J,K,L)=Y(3)
      XI4(I,K,J,L)=Y(1)
      C4(I,K,J,L)=Y(3)
C**       V4(I,J,K,L)=S3(J,K,L,I)-F0(I)*S3(J,K,L,1)
   12 CONTINUE
      D3(I,K,J)=D3(I,J,K)
      U3(I,K,J)=U3(I,J,K)
      XN3(I,K,J)=XN3(I,J,K)
      X3(I,K,J)=X3(I,J,K)
      S4(I,K,J)=S4(I,J,K)
   11 CONTINUE
   10 CONTINUE
    9 CONTINUE
C
C  **** CALCULATION OF THE COEFFICIENTS WITH (IJ-KL)-SYMMETRY
C
C  ** D4(I,J,K,L),B3(I,K,L,J),F3(I,J,K,L),G4(I,J,K,L),L4(I,J,K,L)
C  ** E3(I,J,K,L),H3(I,J,K,L)  ARE CALCULATED USING SUBROUTINE FCT6
C
      DO 13 I=1,8
      DO 14 J=I,8
```

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```
      DO 15 K=1,8
      DO 16 L=K,8
      NCALL=7
      NI=9
      HH=0.01D0
      DO 998 IA=1,9
      Y(IA)=0.D0
  998 CONTINUE
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT6,Y,IER7,AUX,I,J,K,L,NCALL,ERROR,
     1IERROR)
      DO 999 IA=1,8
      IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
  999 CONTINUE
      D4(I,J,K,L)=Y(1).
      B3(I,K,L,J)=Y(2).
      F3(I,J,K,L)=Y(3)
      G4(I,J,K,L)=Y(4)
      XL4(I,J,K,L)=Y(5)
      E3(I,J,K,L)=Y(7).
      H3(I,J,K,L)=Y(8)
C *********************
      D4(I,J,L,K)=Y(1).
      B3(I,L,K,J)=Y(2)
      F3(I,J,L,K)=Y(3)
      G4(I,J,L,K)=Y(4)
      XL4(I,J,L,K)=Y(5)
      E3(I,J,L,K)=Y(7).
      H3(I,J,L,K)=Y(8)
C *********************
      D4(J,I,K,L)=Y(1)
      B3(J,K,L,I)=Y(2).
      F3(J,I,K,L)=Y(3)
      G4(J,I,K,L)=Y(4)
      XL4(J,I,K,L)=Y(5)
      E3(J,I,K,L)=Y(7).
      H3(J,I,K,L)=Y(8)
   16 CONTINUE
   15 CONTINUE
   14 CONTINUE
   13 CONTINUE
C
C  **,   CALCULATION OF THE COEFFICIENTS WITH JKL-SYMMETRY
C
C  **   B4(I,J,K,L),C3(J,I,K,L),E4(J,K,L,I),F4(J,I,K,L) ARE CALCULATED
C  **    USING SUBROUTINE FCT7
C
      IR=0
      DO 210 I=1,8
      DO 211 J=1,8
      DO 212 K=1,8
      IF(K.GE.J) GO TO 213
      IR=1
  213 DO 214 L=1,8
      IF(L.LT.K) GO TO 241
      IF(IR.EQ.0) GO TO 215
      GO TO 241
  215 NCALL=8
      NI=4
      HH=0.01D0
      Y(1)=0.D0
      Y(2)=0.D0
      Y(3)=0.D0
      Y(4)=0.D0
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT7,Y,IER8,AUX,I,J,K,L,NCALL,ERROR,
     1IERROR)
      IF(DABS(Y(1)).LE.1.D-4) Y(1)=0.D0
      IF(DABS(Y(2)).LE.1.D-4) Y(2)=0.D0
      IF(DABS(Y(3)).LE.1.D-4) Y(3)=0.D0
      IF(DABS(Y(4)).LE.1.D-4) Y(4)=0.D0
      B4(I,J,K,L)=Y(1)
      C3(J,I,K,L)=Y(2)
      E4(J,K,L,I)=Y(3)
      F4(J,I,K,L)=Y(4)
      GO TO 214
C   ---  PUT JKL IN INCREASING ORDER
```

```
      241 NN(1)=J
          NN(2)=K
          NN(3)=L
          IG=J
          DO 216 M=2,3
          IF(NN(M).GE.IG) GO TO 217
          KK=M-1
          DO 218 N=1,KK
          IF(NN(M).GE.NN(N)) GO TO 218
          ITX=NN(N)
          NN(N)=NN(M)
          NN(M)=ITX
      218 CONTINUE
      217 IG=NN(M)
      216  CONTINUE
          M1=NN(1)
          M2=NN(2)
          M3=NN(3)
          B4(I,J,K,L)=B4(I,M1,M2,M3)
          C3(J,I,K,L)=C3(M1,I,M2,M3)
          E4(J,K,L,I)=E4(M1,M2,M3,I)
          F4(J,I,K,L)=F4(M1,I,M2,M3)
      214 CONTINUE
          IR=0
      212 CONTINUE
      211 CONTINUE
      210 CONTINUE
C
C      *** CALCULATION OF THE FOLLOWING NON-SYMMETRIC COEFFICIENTS
C
C     **   R,D3,L3,K4,T4      : USING SUBROUTINE FCT8
C     **   A3,Y3,J4,M4,W4     : USING SUBROUTINE FCT9
C          (M4(I,J,K) HAS IK-SYMMETRY, BUT IT WAS LEFT HERE)
C
          DO 25 I=1,8
          AUX2=BETA(I)**2
          DO 26 J=I,8
          BJ2=BETA(J)**2
          BJ4=BETA(J)**4
          AUX1=AUX2*BJ2
          NCALL=9
          NI=5
          HH=0.01D0
          DO 666 IA=1,5
          Y(IA)=0.D0
      666 CONTINUE
          CALL DASCRU(0.D0,1.D0,HH,NI,FCT8,Y,IER9,AUX,I,J,K,L,NCALL,ERROR,
         1NERROR)
          DO 667 IA=1,5
          IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
      667 CONTINUE
          R(I,J)=Y(1)
          D3(I,J)=Y(2)
          XL3(I,J)=Y(3)
          XK4(I,J)=Y(4)
          T4(I,J)=Y(5)/BJ4-4.D0/AUX1
          IF(DABS(T4(I,J)).LE.1.D-4) T4(I,J)=0.D0
      251 DO 27 K=1,8
          NCALL=10
          NI=6
          HH=0.01D0
          DO 668 IA=1,6
          Y(IA)=0.D0
      668 CONTINUE
          CALL DASCRU(0.D0,1.D0,HH,NI,FCT9,Y,IER10,AUX,I,J,K,L,NCALL,ERROR,
         1NERROR)
          DO 669 IA=1,6
          IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
      669 CONTINUE
          A3(I,J,K)=Y(1)
          Y3(I,J,K)=Y(2)
          XJ4(I,J,K)=Y(3)/BJ4-2.D0*Y(4)/BJ2
          XM4(I,J,K)=Y(5)/BJ4
          W4(I,J,K)=Y(6)/BJ4
       27 CONTINUE
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```
   26   CONTINUE
   25   CONTINUE
C
C     ************************************
C     *                                  *
C     *  THE COEFFICIENTS P4,R4,V4       *
C     *                                  *
      DO 17 I=1,8
      DO 18 J=1,8
      DO 19 K=1,8
      P4(I,J,K)=-A3(K,J,I)
      DO 20 L=1,8
      R4(I,J,K,L)=-F3(K,L,I,J)
      V4(I,J,K,L)=S3(J,K,L,I)
   20 CONTINUE
   19 CONTINUE
   18 CONTINUE
   17 CONTINUE
C     *                                  *
C     ************************************
C
C     *** CALCULATION OF THE REMAINING COEFFICIENTS
C
C     **    DEL(I,J) AND
C     **    A,B,C,Q,S,H4,U4   : USING SUBROUTINE FCT10
C     **    I,J,O,M3,W3,O4    : USING SUBROUTINE FCT11
C
      DO 29 I=1,8
      NI=1
      IF(I.EQ.1.OR.I.EQ.3.OR.I.EQ.5.OR.I.EQ.7) NI=-1
      AUX1=ALPHA(I)/BETA(I)
      NCALL=11
      NI=7
      HH=0.01D0
      DO 670 IA=1,7
      Y(IA)=0.D0
  670 CONTINUE
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT10,Y,IER11,AUX,I,J,K,L,NCALL,ERROR,
     1NERROR)
      DO 671 IA=1,7
      IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
  671 CONTINUE
      A(I)=Y(1)
      B(I)=Y(2)
      C(I)=Y(3)
      Q(I)=Y(4)
      S(I)=Y(5)
      H4(I)=Y(6)
      U4(I)=Y(7)
      DO 30 J=1,8
      NJ=1
      IF(J.EQ.1.OR.J.EQ.3.OR.J.EQ.5.OR.J.EQ.7) NJ=-1
      NIJ=NI*NJ
      BJ2=BETA(J)**2
      DEL(I,J)=0.D0
      IF(I.EQ.J) DEL(I,J)=1.D0
      NCALL=12
      NI=6
      HH=0.01D0
      DO 672 IA=1,6
      Y(IA)=0.D0
  672 CONTINUE
      CALL DASCRU(0.D0,1.D0,HH,NI,FCT11,Y,IER12,AUX,I,J,K,L,NCALL,ERROR,
     1NERROR)
      DO 673 IA=1,6
      IF(DABS(Y(IA)).LE.1.D-4) Y(IA)=0.D0
  673 CONTINUE
      XI(I,J)=Y(1)
      XJ(I,J)=Y(2)
      O(I,J)=Y(3)
      XM3(I,J)=(Y(6)/BJ2-4*AUX1)/BJ2
      IF(DABS(XM3(I,J)).LE.1.D-4) XM3(I,J)=0.D0
      W3(I,J)=Y(4)
      O4(I,J)=Y(5)
   30 CONTINUE
```

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   29   CONTINUE
C
C***** CORRECTING XM4(I,J,K) AND W4(I,J,K) :    ******
C
      DO 31 I=1,8
      DO 32 J=1,8
      BJ2=BETA(J)**2
      DO 33 K=1,8
      XM4(I,J,K)=XM4(I,J,K)-2.D0*DEL(I,K)/BJ2
      W4(I,J,K)=W4(I,J,K)-2.D0*Q(I,K)/BJ2
      IF(DABS(XM4(I,J,K)).LE.1.D-4) XM4(I,J,K)=0.D0
      IF(DABS(W4(I,J,K)).LE.1.D-4) W4(I,J,K)=0.D0
   33 CONTINUE
   32 CONTINUE
   31 CONTINUE
C
C
C*********************************
C*                               *
C* GO TO 498 IF THE OUTPUT       *
C* IS NOT TO BE PUT ON TAPE      *
C*                               *
      GO TO 498
C*                               *
C*********************************
C
C   WRITTING OF THE OUTPUT ON TAPE
C
      DO 400 I=1,8
      WRITE(50) A(I),B(I),C(I),Q(I),S(I),H4(I),U4(I)
  400 CONTINUE
      DO 411 I=1,8
      DO 420 J=1,8
      WRITE(50) DEL(I,J),DELTA(I,J),D(I,J),E(I,J),XI(I,J),XJ(I,J)
      WRITE(50) XM(I,J),XN(I,J),O(I,J),P(I,J),R(I,J),D3(I,J)
      WRITE(50) G3(I,J),XJ3(I,J),XK3(I,J),XL3(I,J),XM3(I,J),W3(I,J)
      WRITE(50) XK4(I,J),XN4(I,J),O4(I,J),T4(I,J)
  420 CONTINUE
  411 CONTINUE
      DO 430 I=1,8
      DO 440 J=1,8
      DO 450 K=1,8
      WRITE(50) F(I,J,K),G(I,J,K),H(I,J,K),XK(I,J,K),A3(I,J,K)
     1,XN3(I,J,K)
      WRITE(50) O3(I,J,K),P3(I,J,K),Q3(I,J,K),T3(I,J,K),U3(I,J,K)
     1,V3(I,J,K)
      WRITE(50) X3(I,J,K),Y3(I,J,K),Z3(I,J,K),XJ4(I,J,K),XM4(I,J,K)
     1,P4(I,J,K)
      WRITE(50) S4(I,J,K),W4(I,J,K)
  450 CONTINUE
  440 CONTINUE
  430 CONTINUE
      DO 460 I=1,8
      DO 470 J=1,8
      DO 480 K=1,8
      DO 490 L=1,8
      WRITE(50) B3(I,J,K,L),C3(I,J,K,L),E3(I,J,K,L),F3(I,J,K,L)
     1,H3(I,J,K,L),XI3(I,J,K,L)
      WRITE(50) R3(I,J,K,L),S3(I,J,K,L),A4(I,J,K,L),B4(I,J,K,L)
     1,C4(I,J,K,L),D4(I,J,K,L)
      WRITE(50) E4(I,J,K,L),F4(I,J,K,L),G4(I,J,K,L),XI4(I,J,K,L)
     1,XL4(I,J,K,L),Q4(I,J,K,L)
      WRITE(50) R4(I,J,K,L),V4(I,J,K,L)
  490 CONTINUE
  480 CONTINUE
  470 CONTINUE
  460 CONTINUE
      WRITE(6,71)
C     ***************
C     ***************
      GO TO 499
C     ***************
C     ***************
C
C ***************************************************************************
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600.        C
601.        C   70  FORMAT(' IER1 TO IER20 : ',20(I2,2X))
602.        C       WRITE(6,70) IER1,IER2,IER3,IER4,IER5,IER6,IER7,IER8,IER9,IER10
603.        C      1,IER11,IER12,IER13,IER14,IER15,IER16,IER17,IER18,IER19,IER20
604.        C
605.        C ***************************************************************
606.        C
607.         498  WRITE(6,65)
608.              DO 40 I=5
609.              WRITE(6,66) A(I),B(I),C(I),Q(I),S(I),H4(I),U4(I)
610.          40  CONTINUE
611.              WRITE(6,69)
612.              DO 41 I=5
613.              WRITE(6,67) DEL(I,1),DEL(I,2),DEL(I,3),DEL(I,4),DEL(I,5)
614.          41  CONTINUE
615.              WRITE(6,68)
616.              WRITE(6,800)
617.          800 FORMAT(' DELTA')
618.              DO 42 I=5
619.              WRITE(6,67) DELTA(I,1),DELTA(I,2),DELTA(I,3),DELTA(I,4),DELTA(I,5)
620.          42  CONTINUE
621.              WRITE(6,68)
622.              WRITE(6,801)
623.          801 FORMAT(' D')
624.              DO 43 I=5
625.              WRITE(6,67) D(I,1),D(I,2),D(I,3),D(I,4),D(I,5)
626.          43  CONTINUE
627.              WRITE(6,68)
628.              WRITE(6,802)
629.          802 FORMAT(' E')
630.              DO 44 I=5
631.              WRITE(6,67) E(I,1),E(I,2),E(I,3),E(I,4),E(I,5)
632.          44  CONTINUE
633.              WRITE(6,68)
634.              WRITE(6,803)
635.          803 FORMAT(' I')
636.              DO 45 I=5
637.              WRITE(6,67) XI(I,1),XI(I,2),XI(I,3),XI(I,4),XI(I,5)
638.          45  CONTINUE
639.              WRITE(6,68)
640.              WRITE(6,804)
641.          804 FORMAT(' J')
642.              DO 46 I=5
643.              WRITE(6,67) XJ(I,1),XJ(I,2),XJ(I,3),XJ(I,4),XJ(I,5)
644.          46  CONTINUE
645.              WRITE(6,68)
646.              WRITE(6,805)
647.          805 FORMAT(' M')
648.              DO 47 I=5
649.              WRITE(6,67) XM(I,1),XM(I,2),XM(I,3),XM(I,4),XM(I,5)
650.          47  CONTINUE
651.              WRITE(6,68)
652.              WRITE(6,806)
653.          806 FORMAT(' N')
654.              DO 48 I=5
655.              WRITE(6,67) XN(I,1),XN(I,2),XN(I,3),XN(I,4),XN(I,5)
656.          48  CONTINUE
657.              WRITE(6,68)
658.              WRITE(6,807)
659.          807  FORMAT(' O')
660.              DO 49 I=5
661.              WRITE(6,67) O(I,1),O(I,2),O(I,3),O(I,4),O(I,5)
662.          49  CONTINUE
663.              WRITE(6,65)
664.              WRITE(6,808)
665.          808 FORMAT(' P')
666.              DO 50 I=5
667.              WRITE(6,67) P(I,1),P(I,2),P(I,3),P(I,4),P(I,5)
668.          50  CONTINUE
669.              WRITE(6,68)
670.              WRITE(6,809)
671.          809 FORMAT(' R')
672.              DO 51 I=5
673.              WRITE(6,67) R(I,1),R(I,2),R(I,3),R(I,4),R(I,5)
674.          51  CONTINUE
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      WRITE(6,68)
      WRITE(6,810)
  810 FORMAT(' D3')
      DO 52 I=5
      WRITE(6,67) D3(I,1),D3(I,2),D3(I,3),D3(I,4),D3(I,5)
   52 CONTINUE
      WRITE(6,68)
      WRITE(6,811)
  811 FORMAT(' G3')
      DO 53 I=5
      WRITE(6,67) G3(I,1),G3(I,2),G3(I,3),G3(I,4),G3(I,5)
   53 CONTINUE
      WRITE(6,68)
      WRITE(6,812)
  812 FORMAT(' J3')
      DO 54 I=5
      WRITE(6,67) XJ3(I,1),XJ3(I,2),XJ3(I,3),XJ3(I,4),XJ3(I,5)
   54 CONTINUE
      WRITE(6,68)
      WRITE(6,813)
  813 FORMAT(' K3')
      DO 55 I=5
      WRITE(6,67) XK3(I,1),XK3(I,2),XK3(I,3),XK3(I,4),XK3(I,5)
   55 CONTINUE
      WRITE(6,68)
      WRITE(6,814)
  814 FORMAT(' L3')
      DO 56 I=5
      WRITE(6,67) XL3(I,1),XL3(I,2),XL3(I,3),XL3(I,4),XL3(I,5)
   56 CONTINUE
      WRITE(6,68)
      WRITE(6,815)
  815 FORMAT(' M3')
      DO 57 I=5
      WRITE(6,67) XM3(I,1),XM3(I,2),XM3(I,3),XM3(I,4),XM3(I,5)
   57 CONTINUE
      WRITE(6,68)
      WRITE(6,816)
  816 FORMAT(' W3')
      DO 58 I=5
      WRITE(6,67) W3(I,1),W3(I,2),W3(I,3),W3(I,4),W3(I,5)
   58 CONTINUE
      WRITE(6,65)
      WRITE(6,817)
  817 FORMAT(' K4')
      DO 59 I=5
      WRITE(6,67) XK4(I,1),XK4(I,2),XK4(I,3),XK4(I,4),XK4(I,5)
   59 CONTINUE
      WRITE(6,68)
      WRITE(6,818)
  818 FORMAT(' N4')
      DO 60 I=5
      WRITE(6,67) XN4(I,1),XN4(I,2),XN4(I,3),XN4(I,4),XN4(I,5)
   60 CONTINUE
      WRITE(6,68)
      WRITE(6,819)
  819 FORMAT(' O4')
      DO 61 I=5
      WRITE(6,67) O4(I,1),O4(I,2),O4(I,3),O4(I,4),O4(I,5)
   61 CONTINUE
      WRITE(6,68)
        WRITE(6,820)
  820 FORMAT(' T4')
      DO 62 I=5
      WRITE(6,67) T4(I,1),T4(I,2),T4(I,3),T4(I,4),T4(I,5)
   62 CONTINUE
      WRITE(6,65)
      WRITE(6,821)
  821 FORMAT(' F')
      DO 501 I=5
      DO 502 J=1,5
      WRITE(6,67) F(I,J,1),F(I,J,2),F(I,J,3),F(I,J,4),F(I,J,5)
  502 CONTINUE
      WRITE(6,68)
  501 CONTINUE
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      WRITE(6,822)
  822 FORMAT(' G')
      DO 503 I=5
      DO 504 J=1,5
      WRITE(6,67) G(I,J,1),G(I,J,2),G(I,J,3),G(I,J,4),G(I,J,5)
  504 CONTINUE
      WRITE(6,68)
  503 CONTINUE
      WRITE(6,65)
      WRITE(6,823)
  823 FORMAT(' H')
      DO 505 I=5
      DO 506 J=1,5
      WRITE(6,67) H(I,J,1),H(I,J,2),H(I,J,3),H(I,J,4),H(I,J,5)
  506 CONTINUE
      WRITE(6,68)
  505 CONTINUE
      WRITE(6,824)
  824 FORMAT(' K')
      DO 507 I=5
      DO 508 J=1,5
      WRITE(6,67) XK(I,J,1),XK(I,J,2),XK(I,J,3),XK(I,J,4),XK(I,J,5)
  508 CONTINUE
      WRITE(6,68)
  507 CONTINUE
      WRITE(6,65)
      WRITE(6,825)
  825 FORMAT(' A3')
      DO 509 I=5
      DO 510 J=1,5
      WRITE(6,67) A3(I,J,1),A3(I,J,2),A3(I,J,3),A3(I,J,4),A3(I,J,5)
  510 CONTINUE
      WRITE(6,68)
  509 CONTINUE
      WRITE(6,826)
  826 FORMAT(' N3')
      DO 511 I=5
      DO 512 J=1,5
      WRITE(6,67) XN3(I,J,1),XN3(I,J,2),XN3(I,J,3),XN3(I,J,4),XN3(I,J,4)
  512  CONTINUE
      WRITE(6,68)
  511 CONTINUE
      WRITE(6,65)
      WRITE(6,827)
  827 FORMAT(' O3')
      DO 513 I=5
      DO 514 J=1,5
      WRITE(6,67) O3(I,J,1),O3(I,J,2),O3(I,J,3),O3(I,J,4),O3(I,J,5)
  514 CONTINUE
      WRITE(6,68)
  513 CONTINUE
      WRITE(6,828)
  828 FORMAT(' P3')
      DO 515 I=5
      DO 516 J=1,5
      WRITE(6,67) P3(I,J,1),P3(I,J,2),P3(I,J,3),P3(I,J,4),P3(I,J,5)
  516 CONTINUE
      WRITE(6,68)
  515 CONTINUE
      WRITE(6,65)
      WRITE(6,829)
  829 FORMAT(' Q3')
      DO 517 I=5
      DO 518 J=1,5
      WRITE(6,67) Q3(I,J,1),Q3(I,J,2),Q3(I,J,3),Q3(I,J,4),Q3(I,J,5)
  518 CONTINUE
      WRITE(6,68)
  517 CONTINUE
      WRITE(6,830)
  830 FORMAT(' T3')
      DO 519 I=5
      DO 520 J=1,5
      WRITE(6,67) T3(I,J,1),T3(I,J,2),T3(I,J,3),T3(I,J,4),T3(I,J,5)
  520 CONTINUE
      WRITE(6,68)
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      519 CONTINUE
          WRITE(6,65)
          WRITE(6,8310)
     8310 FORMAT(' U3')
          DO 521 I=5
          DO 522 J=1,5
          WRITE(6,67) U3(I,J,1),U3(I,J,2),U3(I,J,3),U3(I,J,4),U3(I,J,5)
      522 CONTINUE
          WRITE(6,68)
      521 CONTINUE
          WRITE(6,831)
      831 FORMAT(' V3')
          DO 523 I=5
          DO 524 J=1,5
          WRITE(6,67) V3(I,J,1),V3(I,J,2),V3(I,J,3),V3(I,J,4),V3(I,J,5)
      524 CONTINUE
          WRITE(6,68)
      523 CONTINUE
          WRITE(6,65)
          WRITE(6,832)
      832 FORMAT(' X3')
          DO 525 I=5
          DO 526 J=1,5
          WRITE(6,67) X3(I,J,1),X3(I,J,2),X3(I,J,3),X3(I,J,4),X3(I,J,5)
      526 CONTINUE
          WRITE(6,68)
      525 CONTINUE
          WRITE(6,833)
      833 FORMAT(' Y3')
          DO 527 I=5
          DO 528 J=1,5
          WRITE(6,67) Y3(I,J,1),Y3(I,J,2),Y3(I,J,3),Y3(I,J,4),Y3(I,J,5)
      528 CONTINUE
          WRITE(6,68)
      527 CONTINUE
          WRITE(6,65)
          WRITE(6,834)
      834 FORMAT(' Z3')
          DO 529 I=5
          DO 530 J=1,5
          WRITE(6,67) Z3(I,J,1),Z3(I,J,2),Z3(I,J,3),Z3(I,J,4),Z3(I,J,5)
      530 CONTINUE
          WRITE(6,68)
      529  CONTINUE
          WRITE(6,835)
      835 FORMAT(' J4')
          DO 531 I=5
          DO 532 J=1,5
          WRITE(6,67)XJ4(I,J,1),XJ4(I,J,2),XJ4(I,J,3),XJ4(I,J,4),XJ4(I,J,5)
      532 CONTINUE
          WRITE(6,68)
      531 CONTINUE
          WRITE(6,65)
          WRITE(6,836)
      836 FORMAT(' M4')
          DO 533 I=5
          DO 534 J=1,5
          WRITE(6,67) XM4(I,J,1),XM4(I,J,2),XM4(I,J,3),XM4(I,J,4),XM4(I,J,5)
      534 CONTINUE
          WRITE(6,68)
      533 CONTINUE
          WRITE(6,837)
      837 FORMAT(' P4')
          DO 535 I=5
          DO 536 J=1,5
          WRITE(6,67) P4(I,J,1),P4(I,J,2),P4(I,J,3),P4(I,J,4),P4(I,J,5)
      536 CONTINUE
          WRITE(6,68)
      535 CONTINUE
          WRITE(6,65)
          WRITE(6,838)
      838 FORMAT(' S4')
          DO 537 I=5
          DO 538 J=1,5
          WRITE(6,67) S4(I,J,1),S4(I,J,2),S4(I,J,3),S4(I,J,4),S4(I,J,5)
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      538 CONTINUE
          WRITE(6,68)
      537 CONTINUE
          WRITE(6,839)
      839 FORMAT(' W4')
          DO 539 I=5
          DO 540 J=1,5
          WRITE(6,67) W4(I,J,1),W4(I,J,2),W4(I,J,3),W4(I,J,4),W4(I,J,5)
      540 CONTINUE
          WRITE(6,68)
      539  CONTINUE
          WRITE(6,65)
          WRITE(6,840)
      840 FORMAT(' B3')
          DO 541  I=5
          DO 542 J=1,5
          DO 543 K=1,5
          WRITE(6,67) B3(I,J,K,1),B3(I,J,K,2),B3(I,J,K,3),B3(I,J,K,4)
     1,B3(I,J,K,5)
      543 CONTINUE
          WRITE(6,68)
      542 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      541 CONTINUE
          WRITE(6,65)
          WRITE(6,841)
      841 FORMAT(' C3')
          DO 544  I=5
          DO 545 J=1,5
          DO 546 K=1,5
          WRITE(6,67) C3(I,J,K,1),C3(I,J,K,2),C3(I,J,K,3),C3(I,J,K,4)
     1,C3(I,J,K,5)
      546 CONTINUE
          WRITE(6,68)
      545 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      544 CONTINUE
          WRITE(6,65)
          WRITE(6,842)
      842 FORMAT(' E3')
          DO 547 I=5
          DO 548 J=1,5
          DO 549 K=1,5
          WRITE(6,67) E3(I,J,K,1),E3(I,J,K,2),E3(I,J,K,3),E3(I,J,K,4)
     1,E3(I,J,K,5)
      549 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      548 CONTINUE
      547 CONTINUE
          WRITE(6,65)
          WRITE(6,843)
      843 FORMAT(' F3')
          DO 550 I=5
          DO 551 J=1,5
          DO 552 K=1,5
          WRITE(6,67) F3(I,J,K,1),F3(I,J,K,2),F3(I,J,K,3),F3(I,J,K,4)
     1,F3(I,J,K,5)
      552 CONTINUE
          WRITE(6,68)
      551 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      550 CONTINUE
          WRITE(6,65)
          WRITE(6,844)
      844 FORMAT(' H3')
          DO 553 I=5
          DO 554 J=1,5
          DO 555 K=1,5
          WRITE(6,67) H3(I,J,K,1),H3(I,J,K,2),H3(I,J,K,3),H3(I,J,K,4)
     1,H3(I,J,K,5)
      555 CONTINUE
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      WRITE(6,68)
  554 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  553 CONTINUE
      WRITE(6,65)
      WRITE(6,845)
  845 FORMAT(' I3')
      DO 556 I=5
      DO 557 J=1,5
      DO 558 K=1,5
      WRITE(6,67) XI3(I,J,K,1),XI3(I,J,K,2),XI3(I,J,K,3)
     1,XI3(I,J,K,4),XI3(I,J,K,5)
  558 CONTINUE
      WRITE(6,68)
  557 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  556 CONTINUE
      WRITE(6,65)
      WRITE(6,846)
  846 FORMAT(' R3')
      DO 559 I=5
      DO 560 J=1,5
      DO 561 K=1,5
      WRITE(6,67) R3(I,J,K,1),R3(I,J,K,2),R3(I,J,K,3),R3(I,J,K,4)
     1,R3(I,J,K,5)
  561 CONTINUE
      WRITE(6,68)
  560 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  559 CONTINUE
      WRITE(6,65)
      WRITE(6,847)
  847 FORMAT(' S3')
      DO 562 I=5
      DO 563 J=1,5
      DO 564 K=1,5
      WRITE(6,67) S3(I,J,K,1),S3(I,J,K,2),S3(I,J,K,3),S3(I,J,K,4)
     1,S3(I,J,K,5)
  564 CONTINUE
      WRITE(6,68)
  563 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  562 CONTINUE
      WRITE(6,65)
      WRITE(6,848)
  848 FORMAT(' A4')
      DO 565 I=5
      DO 566 J=1,5
      DO 567 K=1,5
      WRITE(6,67) A4(I,J,K,1),A4(I,J,K,2),A4(I,J,K,3),A4(I,J,K,4)
     1,A4(I,J,K,5)
  567 CONTINUE
      WRITE(6,68)
  566 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  565 CONTINUE
      WRITE(6,65)
      WRITE(6,849)
  849 FORMAT(' B4')
      DO 568 I=5
      DO 569 J=1,5
      DO 570 K=1,5
      WRITE(6,67) B4(I,J,K,1),B4(I,J,K,2),B4(I,J,K,3),B4(I,J,K,4)
     1,B4(I,J,K,5)
  570 CONTINUE
      WRITE(6,68)
  569 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  568 CONTINUE
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      WRITE(6,65)
      WRITE(6,850)
  850 FORMAT(' C4')
      DO 571 I=5
      DO 572 J=1,5
      DO 573 K=1,5
      WRITE(6,67) C4(I,J,K,1),C4(I,J,K,2),C4(I,J,K,3),C4(I,J,K,4)
     1,C4(I,J,K,5)
  573 CONTINUE
      WRITE(6,68)
  572 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  571 CONTINUE
      WRITE(6,65)
      WRITE(6,851)
  851 FORMAT(' D4')
      DO 574 I=5
      DO 575 J=1,5
      DO 576 K=1,5
      WRITE(6,67) D4(I,J,K,1),D4(I,J,K,2),D4(I,J,K,3),D4(I,J,K,4),
     1D4(I,J,K,5)
  576 CONTINUE
      WRITE(6,68)
  575 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  574 CONTINUE
      WRITE(6,65)
      WRITE(6,852)
  852 FORMAT(' E4')
      DO 577 I=5
      DO 578 J=1,5
      DO 579 K=1,5
      WRITE(6,67) E4(I,J,K,1),E4(I,J,K,2),E4(I,J,K,3),E4(I,J,K,4)
     1,E4(I,J,K,5)
  579 CONTINUE
      WRITE(6,68)
  578 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  577 CONTINUE
      WRITE(6,65)
      WRITE(6,853)
  853 FORMAT(' F4')
      DO 580 I=5
      DO 581 J=1,5
      DO 582 K=1,5
      WRITE(6,67) F4(I,J,K,1),F4(I,J,K,2),F4(I,J,K,3),F4(I,J,K,4)
     1,F4(I,J,K,5)
  582 CONTINUE
      WRITE(6,68)
  581 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  580 CONTINUE
      WRITE(6,65)
      WRITE(6,854)
  854 FORMAT(' G4')
      DO 583 I=5
      DO 584 J=1,5
      DO 585 K=1,5
      WRITE(6,67) G4(I,J,K,1),G4(I,J,K,2),G4(I,J,K,3),G4(I,J,K,4)
     1,G4(I,J,K,5)
  585 CONTINUE
      WRITE(6,68)
  584 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  583 CONTINUE
      WRITE(6,65)
      WRITE(6,855)
  855 FORMAT(' I4')
      DO 586 I=5
      DO 587 J=1,5
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      DO 588 K=1,5
      WRITE(6,67) XI4(I,J,K,1),XI4(I,J,K,2),XI4(I,J,K,3)
     1,XI4(I,J,K,4),XI4(I,J,K,5)
  588 CONTINUE
      WRITE(6,68)
  587 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  586 CONTINUE
      WRITE(6,65)
      WRITE(6,856)
  856 FORMAT(' L4')
      DO 589 I=5
      DO 590 J=1,5
      DO 591 K=1,5
      WRITE(6,67) XL4(I,J,K,1),XL4(I,J,K,2),XL4(I,J,K,3),XL4(I,J,K,4)
     1,XL4(I,J,K,5)
  591 CONTINUE
      WRITE(6,68)
  590 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  589 CONTINUE
      WRITE(6,65)
      WRITE(6,857)
  857 FORMAT(' Q4')
      DO 592 I=5
      DO 593 J=1,5
      DO 594 K=1,5
      WRITE(6,67) Q4(I,J,K,1),Q4(I,J,K,2),Q4(I,J,K,3),Q4(I,J,K,4)
     1,Q4(I,J,K,5)
  594 CONTINUE
      WRITE(6,68)
  593 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  592 CONTINUE
      WRITE(6,65)
      WRITE(6,858)
  858 FORMAT(' R4')
      DO 595 I=5
      DO 596 J=1,5
      DO 597 K=1,5
      WRITE(6,67) R4(I,J,K,1),R4(I,J,K,2),R4(I,J,K,3),R4(I,J,K,4)
     1,R4(I,J,K,5)
  597 CONTINUE
      WRITE(6,68)
  596 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  595 CONTINUE
      WRITE(6,65)
      WRITE(6,859)
  859 FORMAT(' V4')
      DO 598 I=5
      DO 599 J=1,5
      DO 600 K=1,5
      WRITE(6,67) V4(I,J,K,1),V4(I,J,K,2),V4(I,J,K,3),V4(I,J,K,4)
     1,V4(I,J,K,5)
  600 CONTINUE
      WRITE(6,68)
  599 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  598 CONTINUE
  499 STOP
      END
      FUNCTION FUNF(X,N)
      REAL*8 X,XX,ALPHA,BETA,FUNF,DCOSH,DCOS,DSINH,DSIN
      DIMENSION ALPHA(8),BETA(8)
      COMMON ALPHA,BETA
      XX=X*BETA(N)
      FUNF=DCOSH(XX)-DCOS(XX)-ALPHA(N)*(DSINH(XX)-DSIN(XX))
      RETURN
      END
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      FUNCTION FUNFP(X,N)
      REAL*8 FUNFP,X,XX,ALPHA,BETA,DCOSH,DCOS,DSINH,DSIN
      DIMENSION ALPHA(8),BETA(8)
      COMMON ALPHA,BETA
      XX=X*BETA(N)
      FUNFP=BETA(N)*(DSINH(XX)+DSIN(XX)-ALPHA(N)*(DCOSH(XX)-DCOS(XX)))
      RETURN
      END
      FUNCTION FUNFPP(X,N)
      REAL*8 FUNFPP,X,XX,ALPHA,BETA,DCOSH,DCOS,DSINH,DSIN
      DIMENSION ALPHA(8),BETA(8)
      COMMON ALPHA,BETA
      XX=X*BETA(N)
      FUNFPP=(BETA(N)**2)*(DCOSH(XX)+DCOS(XX)-ALPHA(N)*(DSINH(XX)
     1+DSIN(XX)))
      RETURN
      END
      FUNCTION FUNF3P(X,N)
      REAL*8 FUNF3P,X,XX,ALPHA,BETA,DCOSH,DCOS,DSINH,DSIN
      DIMENSION ALPHA(8),BETA(8)
      COMMON ALPHA,BETA
      XX=X*BETA(N)
      FUNF3P=(BETA(N)**3)*(DSINH(XX)-DSIN(XX)-ALPHA(N)*(DCOSH(XX)
     1+DCOS(XX)))
      RETURN
       END
      FUNCTION FUNG(X,N)
      REAL*8 FUNG,X,DSIN,XA
      XA=(2*N-1)*X*1.570796327D0
      FUNG=DSIN(XA)*1.414213562D0
      RETURN
      END
      FUNCTION FUNGP(X,N)
      REAL*8 FUNGP,X,A,DCOS,XA
      A=(2*N-1)*1.570796327D0
      FUNGP=A*DCOS(A*X)*1.414213562D0
      RETURN
      END
      FUNCTION FUNGPP(X,N)
      REAL*8 FUNGPP,X,XA,FUNG
      XA=((2*N-1)*1.570796327D0)**2
      FUNGPP=-XA*FUNG(X,N)
      RETURN
      END
      SUBROUTINE FI3(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,FUNFP
      DIMENSION Y(2),DY(2)
      DY(1)=(X**2-1)*FUNFP(X,I)*FUNFP(X,J)*FUNFP(X,K)*FUNFP(X,L)
      RETURN
      END
      SUBROUTINE FCT1(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,XX,XX1,XX2,XX3,FUNF,FUNFP,FUNFPP,FUNF3P,FUNG,FUNGP
      DIMENSION Y(10),DY(10)
      DY(1)=X*FUNG(X,I)*FUNG(X,J)
      XX=X**2
      XX1=X*FUNF(X,I)*FUNF(X,J)
      XX2=FUNFP(X,I)*FUNFP(X,J)
      XX3=FUNGP(X,I)*FUNGP(X,J)
      DY(2)=(1-XX)*XX3/2
      DY(4)=XX1
      DY(5)=-XX2
      DY(6)=FUNFPP(X,I)*FUNFPP(X,J)
      DY(7)=(1-XX)*XX2
      DY(3)=-(1-XX)*DY(7)
      DY(8)=-XX3
      DY(9)=(XX-5)*DY(7)
      DY(7)=DY(7)/2
      DY(10)=(1-XX/3)*XX1
      RETURN
      END
      SUBROUTINE FCT2(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,XX1,XX3,XX4,XX5,FUNF,FUNFP,FUNFPP,FUNF3P,FUNG,FUNGP
      DIMENSION Y(10),DY(10)
      XX1=FUNFP(X,I)*FUNFP(X,J)
      XX3=FUNF(X,I)*FUNF(X,J)
```

```
      XX4=FUNG(X,K)
      XX5=FUNFP(X,K)
      DY(1)=X*X*XX5*Y(2)
      DY(2)=XX1
      DY(3)=-XX1*FUNF3P(X,K)
      DY(5)=XX3*XX4
      DY(4)=X*DY(5)
      DY(6)=X*XX5*Y(2)
      DY(9)=XX3*XX5
      DY(7)=X*DY(9)
      DY(8)=XX3*FUNF(X,K)
      DY(10)=XX4*FUNFPP(X,I)*FUNFPP(X,J)
      RETURN
      END
      SUBROUTINE FCT3(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,XX1,XX2,XX3,FUNF,FUNFP,FUNFPP,FUNF3P,FUNG,FUNGP
      DIMENSION Y(5),DY(5)
      XX1=FUNFP(X,I)*FUNFP(X,J)
      XX2=FUNFP(X,K)
      XX3=FUNG(X,L)
      DY(1)=X*X*XX2*XX3*Y(2)
      DY(2)=XX1
      DY(3)=X*XX2*FUNF(X,L)*Y(2)
      DY(4)=-XX1*(XX2*FUNF3P(X,L)+FUNFPP(X,K)*FUNFPP(X,L))
      DY(5)=X*FUNF(X,I)*FUNF(X,J)*XX2*XX3
      RETURN
      END
      SUBROUTINE FCT4(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,XX1,XX2,FUNF,FUNFP,FUNFPP,FUNF3P,FUNG,FUNGP
      DIMENSION Y(6),DY(6)
      XX1=X*FUNF(X,I)
      XX2=FUNFP(X,J)*FUNFP(X,K)
      DY(3)=XX1*XX2
      DY(1)=X*DY(3)
      DY(4)=XX1*FUNG(X,J)*FUNG(X,K)
      DY(2)=X*DY(4)
      DY(5)=XX1*Y(6)
      DY(6)=XX2
      RETURN
      END
      SUBROUTINE FCT5(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,FUNF,FUNFP,FUNG
      DIMENSION Y(3),DY(3)
      DY(2)=FUNFP(X,J)*FUNFP(X,K)
      DY(3)=X*FUNF(X,I)*FUNG(X,L)
      DY(1)=Y(2)*DY(3)
      DY(3)=X*DY(3)*DY(2)
      RETURN
      END
      SUBROUTINE FCT6(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,FUNF,FUNFP,FUNFPP,FUNF3P,FUNG,FUNGP
     1,XX,XX1,XX2,XX3,XX4,XX5,XX6
      DIMENSION Y(9),DY(9)
      XX=FUNG(X,K)*FUNG(X,L)
      XX1=FUNFP(X,I)
      XX2=FUNFP(X,J)
      XX3=FUNFPP(X,I)
      XX4=FUNFPP(X,J)
      XX5=FUNFP(X,K)
      XX6=FUNFP(X,L)
      DY(1)=FUNF(X,I)*FUNF(X,J)
      DY(2)=XX3*XX4
      DY(6)=XX5*XX6
      DY(9)=XX1*XX2
      DY(3)=DY(2)*DY(6)
      DY(2)=DY(2)*XX
      DY(8)=Y(9)*Y(6)
      DY(5)=DY(1)*Y(6)
      DY(4)=X*DY(1)
      DY(1)=DY(4)*XX
      DY(4)=DY(4)*DY(6)
      DY(7)=(XX2*XX3+XX1*XX4)*(XX6*FUNFPP(X,K)+XX5*FUNFPP(X,L))
      RETURN
      END
      SUBROUTINE FCT7(Y,X,N,DY,I,J,K,L)
```

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      REAL*8 X,Y,DY,XX,FUNF,FUNG,FUNFP,FUNF3P
      DIMENSION Y(4),DY(4)
      XX=FUNF(X,J)
      DY(1)=X*X*FUNF(X,I)*FUNG(X,J)*FUNG(X,K)*FUNG(X,L)
      DY(2)=-FUNFP(X,J)*FUNF3P(X,I)*FUNFP(X,K)*FUNFP(X,L)/2
      DY(3)=FUNF(X,K)*FUNF(X,L)
      DY(4)=XX*FUNFP(X,I)*DY(3)
      DY(3)=XX*DY(3)*FUNG(X,I)
      RETURN
      END
      SUBROUTINE FCT8(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,XX,XX1,XX2,XX3,XX4,FUNG,FUNF,FUNFP,FUNFPP,FUNF3P
      DIMENSION Y(5),DY(5)
      XX=X**2
      XX1=FUNFP(X,J)
      XX2=FUNFP(X,I)
      XX3=FUNF(X,I)
      XX4=FUNFPP(X,J)
      DY(1)=X*XX1*FUNG(X,I)
      DY(2)=3*XX2*((1-XX)*FUNF3P(X,J)-2*X*XX4)/2-XX1*XX2
      DY(3)=FUNG(X,J)
      DY(4)=XX*(1-XX/3)*XX3*DY(3)
      DY(3)=-XX2*DY(3)
      DY(5)=X*XX3*XX4
      RETURN
      END
      SUBROUTINE FCT9(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,FUNF,FUNFP,FUNFPP,FUNG,FUNGP
      DIMENSION Y(6),DY(6)
      DY(6)=FUNF(X,I)
      DY(4)=X*DY(6)*FUNG(X,K)
      DY(2)=DY(4)*FUNFP(X,J)
      DY(1)=FUNFP(X,K)
      DY(3)=FUNFPP(X,J)
      DY(6)=DY(6)*DY(3)
      DY(5)=DY(6)*FUNF(X,K)
      DY(6)=X*DY(6)*DY(1)
      DY(3)=DY(3)*DY(4)
      DY(1)=DY(1)*FUNFPP(X,I)*FUNGP(X,J)
      RETURN
      END
      SUBROUTINE FCT10(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,XX,XX1,XX2,FUNF,FUNFP,FUNG
      DIMENSION Y(7),DY(7)
      XX=X**2
      XX1=FUNF(X,I)
      XX2=FUNG(X,I)
      DY(1)=XX1
      DY(2)=X*XX1
      DY(3)=XX*XX1
      DY(4)=XX2
      DY(5)=X*XX2
      DY(6)=X*(3-XX)*XX1/3
      DY(7)=(X**5-5*X**3+4)*FUNFP(X,I)/15
      RETURN
      END
      SUBROUTINE FCT11(Y,X,N,DY,I,J,K,L)
      REAL*8 X,Y,DY,XX1,XX2,XX3,XX4,FUNF,FUNFP,FUNFPP,FUNG
      DIMENSION Y(6),DY(6)
      XX1=FUNF(X,I)
      XX2=XX1*FUNG(X,J)
      XX3=XX1*FUNFP(X,J)
      XX4=FUNF(X,J)
      DY(1)=X*XX2
      DY(2)=X*DY(1)
      DY(3)=X*XX3
      DY(4)=XX3
      DY(5)=XX2
      DY(6)=XX1*FUNFPP(X,J)
      RETURN
      END
      SUBROUTINE DASCRU(A,B,H,N,F,XO,IER,WK,K,L,M,NN,NCALL,EO,NERROR)
C
      DIMENSION          WK(1),XO(1)
      INTEGER            SW
```

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```
      LOGICAL                BE,BH,BR,BX
C
C*************************************************************
C***                                                        *
C***   E5 SHOULD BE SET TO .5 TIMES THE DESIRED RELATIVE    *
C***   PRECISION OF THE SOLUTION                            *
C***                                                        *
C*************************************************************
      REAL*8 DSIGN,DABS
      DOUBLE PRECISION   A,B,H,X0,WK,HMIN,X,XS,Q,H3,R,E,E0,ZERO,
     *                   P5,0P5,THREE,FOUR,HS
      DATA               ZERO,P5,0P5,THREE,FOUR/0.D0,.5D0,1.5D0,
     *                   3.D0,4.D0/
      IER = 0
      IF(A.EQ.B) GO TO 100
      IB1=N+N
      IB2=IB1+N
      HMIN=DABS(H)/NERROR
      BH=.TRUE.
      BR=.TRUE.
      BX=.TRUE.
C                                        CHECK FOR THE PROPER SIGN OF H
      H=DSIGN(DABS(H),B-A)
      X=A
    5 XS=X
      DO 10  J=1,N
         IJK0=N+J
         WK(IJK0)=X0(J)
   10 CONTINUE
   15 HS=H
      Q=X+H-B
      BE=.TRUE.
      IF(.NOT.((H.GT.ZERO.AND.Q.GE.ZERO).OR.(H.LT.ZERO.AND.Q.LE.ZERO)))
     1    GO TO 20
      H=B-X
      BR=.FALSE.
   20 H3=H/THREE
C                                        CALCULATE SOLN. AT X+H.
      DO 90  SW=1,5
         CALL F(X0,X,N,WK,K,L,M,NN)
         DO 70  I=1,N
            Q=H3*WK(I)
            IJK0=N+I
            IJK1=IB1+I
            IJK2=IB2+I
            GO TO (25,30,35,40,45),SW
   25       R=0.
            WK(IJK1)=Q
            GO TO 50
   30       R=P5*(Q+WK(IJK1))
            GO TO 50
   35       R=THREE*Q
            WK(IJK2)=R
            R=.375D0*(R+WK(IJK1))
            GO TO 50
   40       R=WK(IJK1)+FOUR*Q
            WK(IJK1)=R
            R=0P5*(R-WK(IJK2))
            GO TO 50
   45       R=P5*(Q+WK(IJK1))
            Q=DABS(R+R - 0P5*(Q+WK(IJK2)))
   50       X0(I)=WK(IJK0)+R
            IF(SW.NE.5) GO TO 70
C                                        AUTOMATIC STEP CHANGE
            E=DABS(X0(I))
            R=E5
            IF(E.GE.1.D-7) R=E*E5
C                                        TEST ADJUSTMENT OF THE STEP
            IF(Q.LT.R .OR.(.NOT. BX)) GO TO 65
            BR=.TRUE.
            BH=.FALSE.
            H=P5*H
            IF(DABS(H).GE.HMIN) GO TO 55
C                                        THE STEP IS HALVED RESTORE X AND X0,
C                                        AND GO BACK FOR REPEATED INTEGRATION
```

```
C                                                  WITH THIS NEW STEP
            H=DSIGN(1.D0,H)*HMIN
            BX=.FALSE.
   55       DO 60  J=1,N
               IJK0=N+J
               X0(J)=WK(IJK0)
   60       CONTINUE
            X=XS
            GO TO 15
   65       IF(Q.GE.0.03125D0*R) BE=.FALSE.
   70    CONTINUE
         GO TO (75,90,80,85,90),SW
   75    X=X+H3
         GO TO 90
   80    X=X+P5*H3
         GO TO 90
   85    X=X+P5*H
   90 CONTINUE
C                                                  TEST A POSSIBLE DOUBLING OF THE STEP
      IF(.NOT.(BE.AND.BH.AND.BR)) GO TO 95
      H=H+H
      BX=.TRUE.
   95 BH=.TRUE.
      IF(BR) GO TO 5
      H=HS
      IF(BX .OR. BE) GO TO 9005
      IER = 33
      GO TO 9000
  100 DO 105 I=1,N
         X0(I)=ZERO
  105 CONTINUE
      GO TO 9005
 9000 CONTINUE
      CALL UERTST(IER,6HDASCRU,NCALL,K,L,M,NN)
 9005 RETURN
      END
      SUBROUTINE UERTST(IER,NAME,NCALL,K,L,M,NN)
C
      DIMENSION          ITYP(5,4),IBIT(4)
      INTEGER*2          NAME(3)
      INTEGER            WARN,WARF,TERM,PRINTR
      EQUIVALENCE        (IBIT(1),WARN),(IBIT(2),WARF),(IBIT(3),TERM)
      DATA   ITYP /'WARN','ING ','    ','    ',
     *             'WARN','ING(','WITH',' FIX',')   ',
     *             'TERM','INAL','    ','    ',
     *             'NON-','DEFI','NED ','    ',/,
     *       IBIT  / 32,64,128,0/
      DATA   PRINTR / 6/
      IER2=IER
      IF (IER2 .GE. WARN).GO TO 5
C                                                  NON-DEFINED
      IER1=4
      GO TO 20
    5 IF (IER2 .LT. TERM) GO TO 10
C                                                  TERMINAL
      IER1=3
      GO TO 20
   10 IF (IER2 .LT. WARF) GO TO 15
C                                                  WARNING(WITH FIX)
      IER1=2
      GO TO 20
C                                                  WARNING
   15 IER1=1
C                                                  EXTRACT 'N'
   20 IER2=IER2-IBIT(IER1)
C                                                  PRINT ERROR MESSAGE
      WRITE (PRINTR,25) (ITYP(I,IER1),I=1,3),NAME,IER2,IER
     1,NCALL,K,L,M,NN
   25 FORMAT(' *** I N S L(UERTST) *** ',5A4,4X,3A2,4X,I2,
     *       (IER = ',I3,')',4X,'NCALL= ',I2,'  (  ',4I2,'  )')
      RETURN
      END
```

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C     ******************************************************
C     *                                                    *
C     *                 #COEFFPOL                          *
C     *                                                    *
C     ******************************************************
C     CALCULATION OF THE GALERKIN COEFFICIENTS FOR THE FLAP-LAG-TORSIONAL
C     MOTION OF A ROTOR BLADE IN HOVER USING SHIFTED,AND NORMALIZED,
C     LEGENDRE POLYNOMIALS (COMPLETE SET).
C     FOR ACCURACY, ALL OPERATIONS WITH POLYNOMIALS, INCLUDING
C     INTEGRATION, ARE DONE ALGEBRAICALLY USING THE SSP SUBROUTINES
C     PMPY,PDER,PINT AND PADDM.
C     (PDER HAD TO BE SLIGHTLY MODIFIED FOR IT TO BE ABLE TO GIVE
C      THE DERIVATIVE OF A CONSTANT : THE NULL POLYNOMIAL WITH 1 TERM )
C     ******************************************************
C
C     THIS IS THE LATEST VERSION OF THE CALCULATION OF THE GALERKIN
C     COEFFICIENTS; PREVIOUS VERSIONS, WHICH PROVED TO BE UNSATISFACTORY,
C     INCLUDED USING DQATR, AND THEN DASCRU, FOR DOING ALL THE
C     INTEGRATIONS.
C
C     ************************************************************
      IMPLICIT REAL*8(A-H,O-Z)
      REAL XA
      COMMON PI
      DIMENSION NN(4)
      DIMENSION DELTA(8,8),A(8),B(8),C(8),D(8,8),E(8,8),F(8,8,8),
     1G(8,8,8),H(8,8,8),XI(8,8),XJ(8,8),XK(8,8,8),XM(8,8),XN(8,8),O(8,8)
     2,P(8,8),Q(8),R(8,8),S(8),A3(8,8,8),B3(8,8,8,8),C3(8,8,8,8),
     3D3(8,8),E3(8,8,8,8),F3(8,8,8,8),G3(8,8),H3(8,8,8,8),XI3(8,8,8,8)
     4,XJ3(8,8),XK3(8,8),XL3(8,8),XM3(8,8),XN3(8,8,8),O3(8,8,8),
     5P3(8,8,8),Q3(8,8,8),R3(8,8,8,8),S3(8,8,8,8),T3(8,8,8),DEL(8,8)
      DIMENSION U3(8,8,8),V3(8,8,8),W3(8,8),X3(8,8,8),Y3(8,8,8),Z3(8,8,8
     1),A4(8,8,8,8),B4(8,8,8,8),C4(8,8,8,8),D4(8,8,8,8),E4(8,8,8,8),
     2F4(8,8,8,8),G4(8,8,8,8),H4(8),XI4(8,8,8,8),XJ4(8,8,8),XK4(8,8),
     3XL4(8,8,8,8),XM4(8,8,8),XN4(8,8),O4(8,8),P4(8,8,8),Q4(8,8,8,8),
     4R4(8,8,8,8),S4(8,8,8),T4(8,8),U4(8),V4(8,8,8,8),W4(8,8,8)
C  66  FORMAT(' ',6(D14.7,2X))
C  67  FORMAT(' ',2(D14.7,2X))
C  68  FORMAT(' ',//)
C  69  FORMAT(' ',3(D14.7,2X))
C  70  FORMAT(' IER1 TO IER20 ',20(I2,2X))
   71  FORMAT(' ALL THE GALERKIN-LEGENDRE HOVER COEFFICIENTS WERE PUT ON
     1TAPE NUMBER T07316 (A PRIVATE TAPE) -- (I,J,K,L) UP TO (8,8,8,8)')
      PI=3141592653589793D-15
      DO 2 J=1,8
      R(J,1)=0.D0
      T4(1,J)=0.D0
      D3(1,J)=0.D0
      D3(J,1)=0.D0
      G3(1,J)=0.D0
      G3(J,1)=0.D0
      XJ3(1,J)=0.D0
      XJ3(J,1)=0.D0
      XK4(1,J)=0.D0
      XN4(1,J)=0.D0
      T4(1,J)=0.D0
      DO 3 K=1,8
      XK(J,1,K)=0.D0
      XK(J,2,K)=0.D0
      XK(J,K,1)=0.D0
      A3(1,J,K)=0.D0
      A3(J,K,1)=0.D0
      O3(1,J,K)=0.D0
      O3(J,1,K)=0.D0
      O3(J,K,1)=0.D0
      Q3(1,J,K)=0.D0
      Q3(J,1,K)=0.D0
      Q3(J,K,1)=0.D0
      U3(1,J,K)=0.D0
      XJ4(1,J,K)=0.D0
      XM4(1,J,K)=0.D0
      P4(1,J,K)=0.D0
      P4(J,K,1)=0.D0
      P4(J,K,2)=0.D0
      W4(1,J,K)=0.D0
      W4(J,K,1)=0.D0
      DO 4 L=1,8
      B3(1,J,K,L)=0.D0
      B3(J,K,L,1)=0.D0
      B3(J,K,L,2)=0.D0
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      C3(J,1,K,L)=0.D0
      C3(J,J,K,L)=0.D0
      C3(J,K,1,L)=0.D0
      C3(J,K,L,1)=0.D0
      E3(1,J,K,L)=0.D0
      E3(J,1,K,L)=0.D0
      E3(J,K,1,L)=0.D0
      E3(J,K,L,1)=0.D0
      F3(J,K,1,L)=0.D0
      F3(J,K,L,1)=0.D0
      F3(J,1,K,L)=0.D0
      F3(J,2,K,L)=0.D0
      F3(1,J,K,L)=0.D0
      H3(1,J,K,L)=0.D0
      H3(J,1,K,L)=0.D0
      H3(J,K,1,L)=0.D0
      H3(J,K,L,1)=0.D0
      XI3(1,J,K,L)=0.D0
      XI3(J,1,K,L)=0.D0
      XI3(J,K,1,L)=0.D0
      XI3(J,K,L,1)=0.D0
      R3(1,J,K,L)=0.D0
      R3(J,1,K,L)=0.D0
      R3(J,K,1,L)=0.D0
      S3(1,J,K,L)=0.D0
      S3(J,1,K,L)=0.D0
      S3(J,K,1,L)=0.D0
      A4(1,J,K,L)=0.D0
      A4(J,K,1,L)=0.D0
      B4(1,J,K,L)=0.D0
      C4(1,J,K,L)=0.D0
      C4(J,1,K,L)=0.D0
      C4(J,K,1,L)=0.D0
      D4(1,J,K,L)=0.D0
      E4(1,J,K,L)=0.D0
      F4(1,J,K,L)=0.D0
      F4(J,1,K,L)=0.D0
      G4(1,J,K,L)=0.D0
      G4(J,K,1,L)=0.D0
      G4(J,K,L,1)=0.D0
      XI4(1,J,K,L)=0.D0
      XI4(J,1,K,L)=0.D0
      XI4(J,K,1,L)=0.D0
      XL4(1,J,K,L)=0.D0
      XL4(J,K,1,L)=0.D0
      XL4(J,K,L,1)=0.D0
      Q4(1,J,K,L)=0.D0
      Q4(J,1,K,L)=0.D0
      Q4(J,K,1,L)=0.D0
      Q4(J,K,L,1)=0.D0
      Q4(J,K,L,2)=0.D0
      R4(1,J,K,L)=0.D0
      R4(J,1,K,L)=0.D0
      R4(J,K,1,L)=0.D0
      R4(J,K,2,L)=0.D0
      R4(J,K,L,1)=0.D0
      R4(J,K,L,2)=0.D0
      V4(1,J,K,L)=0.D0
      V4(J,1,K,L)=0.D0
      V4(J,K,1,L)=0.D0
      V4(J,K,L,1)=0.D0
    4 CONTINUE
    3 CONTINUE
    2 CONTINUE
C   *** CALCULATION OF THE IJKL-SYMMETRIC I3 COEFFICIENTS
      IR1=0
      IR2=0
      DO 110 I=2,8
      DO 111 J=2,8
      IF(J.GE.I) GO TO 112
      IR1=1
  112 DO 113 K=2,8
      IF(K.GE.J) GO TO 114
      IR2=1
  114 DO 115 L=2,8
      IF(L.LT.K) GO TO 141
      IF(IR1.EQ.0.AND.IR2.EQ.0) GO TO 119
      GO TO 141
  119 CALL FI3(XI3(I,J,K,L),I,J,K,L)
      GO TO 115
C ---- PUT IJKL IN INCREASING ORDER
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      141 NN(1)=I
          NN(2)=J
          NN(3)=K
          NN(4)=L
          IG=I
          DO 130 M=2,4
          IF(NN(M).GE.IG) GO TO 131
          KK=M-1
          DO 132 N=1,KK
          IF(NN(M).GE.NN(N)) GO TO 132
          ITX=NN(N)
          NN(N)=NN(M)
          NN(M)=ITX
      132 CONTINUE
      131 IG=NN(M)
      130 CONTINUE
          M1=NN(1)
          M2=NN(2)
          M3=NN(3)
          M4=NN(4)
          XI3(I,J,K,L)=XI3(M1,M2,M3,M4)
      115 CONTINUE
          IR2=0
      113 CONTINUE
      111 IR1=0
      110 CONTINUE
C     ***** CALCULATION OF THE --(I,J,K,L) COEFFICIENTS WITH IJ-SYMMETRY,
C     **   OF THE M AND N COEFFICIENTS,
C     *** AND ALSO OF THE G3,J3,Q3,AND Q4 COEFFICIENTS BY DIRECT INTEGRATION
          DO 5 I=1,8
          DO 6 J=I,8
          CALL FM(XM(I,J),I,J,K,L)
          CALL FN(XN(I,J),I,J,K,L)
          IF(I.EQ.1) GO TO 666
          CALL FG3(G3(I,J),I,J,K,L)
          CALL FJ3(XJ3(I,J),I,J,K,L)
          DO 7 K=2,8
          CALL FQ3(Q3(I,J,K),I,J,K,L)
          DO 8 L=1,8
          CALL FR3(R3(I,J,K,L),I,J,K,L)
          CALL FS3(S3(I,J,K,L),I,J,K,L)
          R3(J,I,K,L)=R3(I,J,K,L)
          S3(J,I,K,L)=S3(I,J,K,L)
          IF(L.LE.2) GO TO 8
          CALL FQ4(Q4(I,J,K,L),I,J,K,L)
          Q4(J,I,K,L)=Q4(I,J,K,L)
        8 CONTINUE
          Q3(J,I,K)=Q3(I,J,K)
        7 CONTINUE
          XJ3(J,I)=XJ3(I,J)
          G3(J,I)=G3(I,J)
      666 XM(J,I)=XM(I,J)
          XN(J,I)=XN(I,J)
        6 CONTINUE
        5 CONTINUE
C     *** CALCULATION OF THE --(I,J,K,L) COEFFICIENTS WITH JK-SYMMETRY,
C     **   AND ALSO OF THE O3 AND U3 COEFFICIENTS BY DIRECT INTEGRATION **
          DO 9 I=2,8
          DO 10 J=1,8
          DO 11 K=J,8
          IF(J.NE.1) CALL FO3(O3(I,J,K),I,J,K,L)
          CALL U3D4(U3(I,J,K),I,J,K,L,1,0)
          DO 12 L=1,8
          CALL ACEI4(E4(I,J,K,L),I,J,K,L,0,0,1,0)
          IF(L.GT.2) CALL FB3(B3(I,J,K,L),I,J,K,L)
          IF(J.EQ.1) GO TO 1203
     1201 CALL ACEI4(XI4(I,J,K,L),I,J,K,L,0,0,0,1)
          CALL ACEI4(C4(I,J,K,L),I,J,K,L,0,1,0,0)
          IF(L.NE.1) CALL FV4(V4(I,J,K,L),I,J,K,L)
     1203 B3(I,K,J,L)=B3(I,J,K,L)
          C4(I,K,J,L)=C4(I,J,K,L)
          E4(I,K,J,L)=E4(I,J,K,L)
          XI4(I,K,J,L)=XI4(I,J,K,L)
          V4(I,K,J,L)=V4(I,J,K,L)
       12 CONTINUE
          O3(I,K,J)=O3(I,J,K)
          U3(I,K,J)=U3(I,J,K)
       11 CONTINUE
       10 CONTINUE
        9 CONTINUE
C     **** CALCULATION OF THE --(I,J,K,L) COEFFICIENTS WITH KL-SYMMETRY,
C     ** AND ALSO OF THE C3 AND F3 COEFFICIENTS BY DIRECT INTEGRATION  **
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      DO 13 I=2,8
      DO 14 J=1,8
      DO 15 K=1,8
      DO 16 L=K,8
      CALL U3D4(D4(I,J,K,L),I,J,K,L,0,1)
      IF(J.NE.1) CALL FF4(F4(I,J,K,L),I,J,K,L)
      IF(K.EQ.1) GO TO 1601
      CALL FG4(G4(I,J,K,L),I,J,K,L)
      CALL FL4(XL4(I,J,K,L),I,J,K,L)
      IF(J.LT.2) GO TO 1601
      CALL FF3(F3(I,J,K,L),I,J,K,L)
      IF(J.NE.3) CALL FC3(C3(I,J,K,L),I,J,K,L)
 1601 F4(I,J,L,K)=F4(I,J,K,L)
      G4(I,J,L,K)=G4(I,J,K,L)
      XL4(I,J,L,K)=XL4(I,J,K,L)
      D4(I,J,L,K)=D4(I,J,K,L)
      F3(I,J,L,K)=F3(I,J,K,L)
      C3(I,J,L,K)=C3(I,J,K,L)
   16 CONTINUE
   15 CONTINUE
   14 CONTINUE
   13 CONTINUE
C    ***    CALCULATION OF THE JKL-SYMMETRIC B4 COEFFICIENT,
C     **   AND ALSO OF THE D3,K4,N4,T4,A3,J4,M4,W4 COEFFICIENTS
C     **   BY DIRECT INTEGRATION"  **
      IR=0
      DO 210 I=2,8
      DO 211 J=1,8
      CALL J4K4(XK4(I,J),I,J,K,L,0,1)
      CALL FN4(XN4(I,J),I,J,K,L)
      CALL FT4(T4(I,J),I,J,K,L)
      IF(J.NE.1) CALL FD3(D3(I,J),I,J,K,L)
      DO 212 K=1,8
      CALL J4K4(XJ4(I,J,K),I,J,K,L,1,0)
      CALL FM4(XM4(I,J,K),I,J,K,L)
      IF(K.EQ.1) GO TO 2111
      CALL A3P4(A3(I,J,K),I,J,K,L,1,0)
      CALL FW4(W4(I,J,K),I,J,K,L)
 2111 IF(K.GE.J) GO TO 213
      IR=1
  213 DO 214 L=1,8
      IF(L.LT.K) GO TO 241
      IF(IR.EQ.0) GO TO 215
      GO TO 241
  215 CALL FB4(B4(I,J,K,L),I,J,K,L)
      GO TO 214
C     ---   PUT JKL IN INCREASING ORDER
  241 NN(1)=J
      NN(2)=K
      NN(3)=L
      IG=J
      DO 216 M=2,3
      IF(NN(M).GE.IG) GO TO 217
      KK=M-1
      DO 218 N=1,KK
      IF(NN(M).GE.NN(N)) GO TO 218
      ITX=NN(N)
      NN(N)=NN(M)
      NN(M)=ITX
  218 CONTINUE
  217 IG=NN(M)
  216  CONTINUE
      M1=NN(1)
      M2=NN(2)
      M3=NN(3)
      B4(I,J,K,L)=B4(I,M1,M2,M3)
  214 CONTINUE
      IR=0
  212 CONTINUE
  211 CONTINUE
  210 CONTINUE
C    ** CALCULATION OF THE (IJ,KL)-SYMMETRIC H3 AND R4 COEFFICIENTS,
C       ***** AND ALSO OF E3 BY DIRECT INTEGRATION  ******
      DO 20 I=2,8
      DO 21 J=I,8
      DO 22 K=2,8
      DO 23 L=K,8
      CALL FE3(E3(I,J,K,L),I,J,K,L)
      IF(K.EQ.2) GO TO 231
      CALL FR4(R4(I,J,K,L),I,J,K,L)
  231 CALL FH3(H3(I,J,K,L),I,J,K,L)
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      H3(I,J,L,K)=H3(I,J,K,L)
      H3(J,I,K,L)=H3(I,J,K,L)
      H3(J,I,L,K)=H3(I,J,K,L)
      R4(I,J,L,K)=R4(I,J,K,L)
      R4(J,I,K,L)=R4(I,J,K,L)
      R4(J,I,L,K)=R4(I,J,K,L)
      E3(I,J,L,K)=E3(I,J,K,L)
      E3(J,I,K,L)=E3(I,J,K,L)
      E3(J,I,L,K)=E3(I,J,K,L)
      GO TO 23
   23 CONTINUE
   22 CONTINUE
   21 CONTINUE
   20 CONTINUE
C  *** CALCULATION OF THE A4 AND P4 COEFFICIENTS
      DO 25 I=2,8
      DO 26 J=1,8
      DO 27 K=2,8
      IF(K.GE.3) CALL A3P4(P4(I,J,K),I,J,K,L,0,1)
      DO 28 L=1,8
      CALL ACEI4(A4(I,J,K,L),I,J,K,L,1,0,0,0)
   28 CONTINUE
   27 CONTINUE
   26 CONTINUE
   25 CONTINUE
C  *** CALCULATION OF THE REMAINING COEFFICIENTS
C  **  THE MAIN GENERATORS ARE F4,G4,V4,XI3,A4,C4,I4,E4,L4,S3,D4,Q4,R4
C       *** (P4 IS ALSO A GENERATOR, BUT WAS NOT USED AS SUCH) ***
      ROOT3=2*DSQRT(3.D0)
      ROOT5=DSQRT(5.D0)
      ROOT7=DSQRT(7.D0)
      XXL3=-ROOT3*PI**2
      DO 29 I=1,8
      A(I)=F4(I,2,1,1)/ROOT3
      B(I)=G4(I,1,2,2)/12
      C(I)=V4(I,2,2,2)/(12*ROOT3)
      DO 30 J=1,8
      IF(J.NE.1) CALL FR(R(I,J),I,J,K,L)
      DEL(I,J)=0.D0
      IF(J.EQ.I) DEL(I,J)=1.D0
      DELTA(I,J)=Q4(I,2,2,J)/12
      P(I,J)=-DEL(I,J)*((PI*(I-0.5D0))**2)
      D(I,J)=-XI3(I,J,2,2)/24
      E(I,J)=G4(I,J,2,2)/12
      XI(I,J)=A4(I,1,2,J)/ROOT3
      XJ(I,J)=C4(I,2,2,J)/12
      O(I,J)=G4(I,1,J,2)/ROOT3
      XL3(I,J)=A3(I,J,2)/(XXL3*(J-0.5D0)**2)
      XK3(I,J)=R4(I,J,3,3)/720.D0
      D3(I,J)=D3(I,J)+XK3(I,J)
      IF(DABS(D3(I,J)).LT.1.D-7) D3(I,J)=0.D0
      W3(I,J)=F4(I,J,1,1)
      O4(I,J)=E4(I,1,1,J)
      DO 31 K=1,8
      IF(K.NE.1.AND.J.GT.2) CALL FK(XK(I,J,K),I,J,K,L)
      F(I,J,K)=XL4(K,1,I,J)
      G(I,J,K)=A4(I,J,2,K)/ROOT3
      H(I,J,K)=E4(I,J,1,K)
      XN3(I,J,K)=G4(I,1,J,K)
      P3(I,J,K)=S3(I,J,K,1)
      T3(I,J,K)=G4(I,J,K,2)/ROOT3
      V3(I,J,K)=F4(I,2,J,K)/ROOT3
      X3(I,J,K)=D4(I,1,J,K)
      Y3(I,J,K)=A4(I,1,J,K)
      Z3(I,J,K)=F4(I,K,J,1)
      S4(I,J,K)=V4(I,J,K,2)/ROOT3
   31 CONTINUE
      XM3(I,J)=XM4(I,J,1)
   30 CONTINUE
      H4(I)=XN4(I,1)
      CALL FU4(U4(I),I,J,K,L)
   29 CONTINUE
      SA=DSQRT(2.D0)/PI**2
      DO 36 I=1,8
      Q(I)=-XL3(2,I)/ROOT3
      SSA=I-0.5D0
      S(I)=SA*DSIN(SSA*PI)/SSA**2
   36 CONTINUE
      DO 400 I=1,8
      WRITE(50) A(I),B(I),C(I),Q(I),S(I),H4(I),U4(I)
  400 CONTINUE
      DO 411 I=1,8
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409.              DO 420 J=1,8
410.              WRITE(50) DEL(I,J),DELTA(I,J),D(I,J),E(I,J),XI(I,J),XJ(I,J)
411.              WRITE(50) XM(I,J),XN(I,J),O(I,J),P(I,J),R(I,J),D3(I,J)
412.              WRITE(50) G3(I,J),XJ3(I,J),XK3(I,J),XL3(I,J),XM3(I,J),W3(I,J)
413.              WRITE(50) XK4(I,J),XN4(I,J),O4(I,J),T4(I,J)
414.        420   CONTINUE
415.        411   CONTINUE
416.              DO 430 I=1,8
417.              DO 440 J=1,8
418.              DO 450 K=1,8
419.              WRITE(50) F(I,J,K),G(I,J,K),H(I,J,K),XK(I,J,K),A3(I,J,K)
420.             1,XN3(I,J,K)
421.              WRITE(50) O3(I,J,K),P3(I,J,K),Q3(I,J,K),T3(I,J,K),U3(I,J,K)
422.             1,V3(I,J,K)
423.              WRITE(50) X3(I,J,K),Y3(I,J,K),Z3(I,J,K),XJ4(I,J,K),XM4(I,J,K)
424.             1,P4(I,J,K)
425.              WRITE(50) S4(I,J,K),W4(I,J,K)
426.        450   CONTINUE
427.        440   CONTINUE
428.        430   CONTINUE
429.              DO 460 I=1,8
430.              DO 470 J=1,8
431.              DO 480 K=1,8
432.              DO 490 L=1,8
433.              WRITE(50) B3(I,J,K,L),C3(I,J,K,L),E3(I,J,K,L),F3(I,J,K,L)
434.             1,H3(I,J,K,L),XI3(I,J,K,L)
435.              WRITE(50) R3(I,J,K,L),S3(I,J,K,L),A4(I,J,K,L),B4(I,J,K,L)
436.             1,C4(I,J,K,L),D4(I,J,K,L)
437.              WRITE(50) E4(I,J,K,L),F4(I,J,K,L),G4(I,J,K,L),XI4(I,J,K,L)
438.             1,XL4(I,J,K,L),Q4(I,J,K,L)
439.              WRITE(50) R4(I,J,K,L),V4(I,J,K,L)
440.        490   CONTINUE
441.        480   CONTINUE
442.        470   CONTINUE
443.        460   CONTINUE
444.              WRITE(6,71)
445.     C        ***************
446.     C        ***************
447.              GO TO 499
448.     C        ***************
449.     C        ***************
450.         65   FORMAT('1')
451.         66   FORMAT(' ',7(D14.7,2X))
452.         67   FORMAT(' ',5(D14.7,2X))
453.         68   FORMAT(' ')
454.         69   FORMAT(' ',/)
455.              WRITE(6,65)
456.              DO 40 I=1,5
457.              WRITE(6,66) A(I),B(I),C(I),Q(I),S(I),H4(I),U4(I)
458.          40  CONTINUE
459.              WRITE(6,69)
460.              DO 41 I=1,5
461.              WRITE(6,67) DEL(I,1),DEL(I,2),DEL(I,3),DEL(I,4),DEL(I,5)
462.         41   CONTINUE
463.              WRITE(6,68)
464.              WRITE(6,800)
465.         800  FORMAT(' DELTA')
466.              DO 42 I=1,5
467.              WRITE(6,67) DELTA(I,1),DELTA(I,2),DELTA(I,3),DELTA(I,4),DELTA(I,5)
468.         42   CONTINUE
469.              WRITE(6,68)
470.              WRITE(6,801)
471.         801  FORMAT(' D')
472.              DO 43 I=1,5
473.              WRITE(6,67) D(I,1),D(I,2),D(I,3),D(I,4),D(I,5)
474.         43   CONTINUE
475.              WRITE(6,68)
476.              WRITE(6,802)
477.         802  FORMAT(' E')
478.              DO 44 I=1,5
479.              WRITE(6,67) E(I,1),E(I,2),E(I,3),E(I,4),E(I,5)
480.         44   CONTINUE
481.              WRITE(6,68)
482.              WRITE(6,803)
483.         803  FORMAT(' I')
484.              DO 45 I=1,5
485.              WRITE(6,67) XI(I,1),XI(I,2),XI(I,3),XI(I,4),XI(I,5)
486.         45   CONTINUE
487.              WRITE(6,68)
488.              WRITE(6,804)
489.         804  FORMAT(' J')
490.              DO 46 I=1,5
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      WRITE(6,67) XJ(I,1),XJ(I,2),XJ(I,3),XJ(I,4),XJ(I,5)
   46 CONTINUE
      WRITE(6,68)
      WRITE(6,805)
  805 FORMAT(' M')
      DO 47 I=1,5
      WRITE(6,67) XM(I,1),XM(I,2),XM(I,3),XM(I,4),XM(I,5)
   47 CONTINUE
      WRITE(6;68)
      WRITE(6,806)
  806 FORMAT(' N')
      DO 48 I=1,5
      WRITE(6,67) XN(I,1),XN(I,2),XN(I,3),XN(I,4),XN(I,5)
   48 CONTINUE
      WRITE(6,68)
      WRITE(6,807)
  807  FORMAT(' O')
      DO 49 I=1,5
      WRITE(6,67) O(I,1),O(I,2),O(I,3),O(I,4),O(I,5)
   49 CONTINUE
      WRITE(6,65)
      WRITE(6,808)
  808 FORMAT(' P')
      DO 50 I=1,5
      WRITE(6,67) P(I,1),P(I,2),P(I,3),P(I,4),P(I,5)
   50 CONTINUE
      WRITE(6,68)
      WRITE(6,809)
  809 FORMAT(' R')
      DO 51 I=1,5
      WRITE(6,67) R(I,1),R(I,2),R(I,3),R(I,4),R(I,5)
   51 CONTINUE
      WRITE(6,68)
      WRITE(6,810)
  810 FORMAT(' D3')
      DO 52 I=1,5
      WRITE(6,67) D3(I,1),D3(I,2),D3(I,3),D3(I,4),D3(I,5)
   52 CONTINUE
      WRITE(6,68)
      WRITE(6,811)
  811 FORMAT(' G3')
      DO 53 I=1,5
      WRITE(6,67) G3(I,1),G3(I,2),G3(I,3),G3(I,4),G3(I,5)
   53 CONTINUE
      WRITE(6,68)
      WRITE(6,812)
  812 FORMAT(' J3')
      DO 54 I=1,5
      WRITE(6,67) XJ3(I,1),XJ3(I,2),XJ3(I,3),XJ3(I,4),XJ3(I,5)
   54 CONTINUE
      WRITE(6,68)
      WRITE(6,813)
  813 FORMAT(' K3')
      DO 55 I=1,5
      WRITE(6,67) XK3(I,1),XK3(I,2),XK3(I,3),XK3(I,4),XK3(I,5)
   55 CONTINUE
      WRITE(6,68)
      WRITE(6,814)
  814 FORMAT(' L3')
      DO 56 I=1,5
      WRITE(6,67) XL3(I,1),XL3(I,2),XL3(I,3),XL3(I,4),XL3(I,5)
   56 CONTINUE
      WRITE(6,68)
      WRITE(6,815)
  815 FORMAT(' M3')
      DO 57 I=1,5
      WRITE(6,67) XM3(I,1),XM3(I,2),XM3(I,3),XM3(I,4),XM3(I,5)
   57 CONTINUE
      WRITE(6,68)
      WRITE(6,816)
  816 FORMAT(' W3')
      DO 58 I=1,5
      WRITE(6,67) W3(I,1),W3(I,2),W3(I,3),W3(I,4),W3(I,5)
   58 CONTINUE
      WRITE(6,65)
      WRITE(6,817)
  817 FORMAT(' K4')
      DO 59 I=1,5
      WRITE(6,67) XK4(I,1),XK4(I,2),XK4(I,3),XK4(I,4),XK4(I,5)
   59 CONTINUE
      WRITE(6,68)
      WRITE(6,818)
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      818 FORMAT(' N4')
          DO 60 I=1,5
          WRITE(6,67) XN4(I,1),XN4(I,2),XN4(I,3),XN4(I,4),XN4(I,5)
       60 CONTINUE
          WRITE(6,68)
          WRITE(6,819)
      819 FORMAT(' O4')
          DO 61 I=1,5
          WRITE(6,67) O4(I,1),O4(I,2),O4(I,3),O4(I,4),O4(I,5)
       61 CONTINUE
          WRITE(6,68)
            WRITE(6,820)
      820 FORMAT(' T4')
          DO 62 I=1,5
          WRITE(6,67) T4(I,1),T4(I,2),T4(I,3),T4(I,4),T4(I,5)
       62 CONTINUE
          WRITE(6,65)
          WRITE(6,821)
      821 FORMAT(' F')
          DO 501 I=1,5
          DO 502 J=1,5
          WRITE(6,67) F(I,J,1),F(I,J,2),F(I,J,3),F(I,J,4),F(I,J,5)
      502 CONTINUE
          WRITE(6,68)
      501 CONTINUE
          WRITE(6,822)
      822 FORMAT(' G')
          DO 503 I=1,5
          DO 504 J=1,5
          WRITE(6,67) G(I,J,1),G(I,J,2),G(I,J,3),G(I,J,4),G(I,J,5)
      504 CONTINUE
          WRITE(6,68)
      503 CONTINUE
          WRITE(6,65)
          WRITE(6,823)
      823 FORMAT(' H')
          DO 505 I=1,5
          DO 506 J=1,5
          WRITE(6,67) H(I,J,1),H(I,J,2),H(I,J,3),H(I,J,4),H(I,J,5)
      506 CONTINUE
          WRITE(6,68)
      505 CONTINUE
          WRITE(6,824)
      824 FORMAT(' K')
          DO 507 I=1,5
          DO 508 J=1,5
          WRITE(6,67) XK(I,J,1),XK(I,J,2),XK(I,J,3),XK(I,J,4),XK(I,J,5)
      508 CONTINUE
          WRITE(6,68)
      507 CONTINUE
          WRITE(6,65)
          WRITE(6,825)
      825 FORMAT(' A3')
          DO 509 I=1,5
          DO 510 J=1,5
          WRITE(6,67) A3(I,J,1),A3(I,J,2),A3(I,J,3),A3(I,J,4),A3(I,J,5)
      510 CONTINUE
          WRITE(6,68)
      509 CONTINUE
          WRITE(6,826)
      826 FORMAT(' N3')
          DO 511 I=1,5
          DO 512 J=1,5
          WRITE(6,67) XN3(I,J,1),XN3(I,J,2),XN3(I,J,3),XN3(I,J,4),XN3(I,J,4)
      512  CONTINUE
          WRITE(6,68)
      511 CONTINUE
          WRITE(6,65)
          WRITE(6,827)
      827 FORMAT(' O3')
          DO 513 I=1,5
          DO 514 J=1,5
          WRITE(6,67) O3(I,J,1),O3(I,J,2),O3(I,J,3),O3(I,J,4),O3(I,J,5)
      514 CONTINUE
          WRITE(6,68)
      513 CONTINUE
          WRITE(6,828)
      828 FORMAT(' P3')
          DO 515 I=1,5
          DO 516 J=1,5
          WRITE(6,67) P3(I,J,1),P3(I,J,2),P3(I,J,3),P3(I,J,4),P3(I,J,5)
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```
      516 CONTINUE
          WRITE(6,68)
      515 CONTINUE
          WRITE(6,65)
          WRITE(6,829)
      829 FORMAT(' Q3')
          DO 517 I=1,5
          DO 518 J=1,5
          WRITE(6,67) Q3(I,J,1),Q3(I,J,2),Q3(I,J,3),Q3(I,J,4),Q3(I,J,5)
      518 CONTINUE
          WRITE(6,68)
      517 CONTINUE
          WRITE(6,830)
      830 FORMAT(' T3')
          DO 519 I=1,5
          DO 520 J=1,5
          WRITE(6,67) T3(I,J,1),T3(I,J,2),T3(I,J,3),T3(I,J,4),T3(I,J,5)
      520 CONTINUE
          WRITE(6,68)
      519 CONTINUE
          WRITE(6,65)
          WRITE(6,8310)
     8310 FORMAT(' U3')
          DO 521 I=1,5
          DO 522 J=1,5
          WRITE(6,67) U3(I,J,1),U3(I,J,2),U3(I,J,3),U3(I,J,4),U3(I,J,5)
      522 CONTINUE
          WRITE(6,68)
      521 CONTINUE
          WRITE(6,831)
      831 FORMAT(' V3')
          DO 523 I=1,5
          DO 524 J=1,5
          WRITE(6,67) V3(I,J,1),V3(I,J,2),V3(I,J,3),V3(I,J,4),V3(I,J,5)
      524 CONTINUE
          WRITE(6,68)
      523 CONTINUE
          WRITE(6,65)
          WRITE(6,832)
      832 FORMAT(' X3')
          DO 525 I=1,5
          DO 526 J=1,5
          WRITE(6,67) X3(I,J,1),X3(I,J,2),X3(I,J,3),X3(I,J,4),X3(I,J,5)
      526 CONTINUE
          WRITE(6,68)
      525 CONTINUE
          WRITE(6,833)
      833 FORMAT(' Y3')
          DO 527 I=1,5
          DO 528 J=1,5
          WRITE(6,67) Y3(I,J,1),Y3(I,J,2),Y3(I,J,3),Y3(I,J,4),Y3(I,J,5)
      528 CONTINUE
          WRITE(6,68)
      527 CONTINUE
          WRITE(6,65)
          WRITE(6,834)
      834 FORMAT(' Z3')
          DO 529 I=1,5
          DO 530 J=1,5
          WRITE(6,67) Z3(I,J,1),Z3(I,J,2),Z3(I,J,3),Z3(I,J,4),Z3(I,J,5)
      530 CONTINUE
          WRITE(6,68)
      529  CONTINUE
          WRITE(6,835)
      835 FORMAT(' J4')
          DO 531 I=1,5
          DO 532 J=1,5
          WRITE(6,67)XJ4(I,J,1),XJ4(I,J,2),XJ4(I,J,3),XJ4(I,J,4),XJ4(I,J,5)
      532 CONTINUE
          WRITE(6,68)
      531 CONTINUE
          WRITE(6,65)
          WRITE(6,836)
      836 FORMAT(' M4')
          DO 533 I=1,5
          DO 534 J=1,5
          WRITE(6,67) XM4(I,J,1),XM4(I,J,2),XM4(I,J,3),XM4(I,J,4),XM4(I,J,5)
      534 CONTINUE
          WRITE(6,68)
      533 CONTINUE
          WRITE(6,837)
      837 FORMAT(' P4')
```

```
      DO 535 I=1,5
      DO 536 J=1,5
      WRITE(6,67) P4(I,J,1),P4(I,J,2),P4(I,J,3),P4(I,J,4),P4(I,J,5)
  536 CONTINUE
      WRITE(6,68)
  535 CONTINUE
      WRITE(6,65)
      WRITE(6,838)
  838 FORMAT(' S4')
      DO 537 I=1,5
      DO 538 J=1,5
      WRITE(6,67) S4(I,J,1),S4(I,J,2),S4(I,J,3),S4(I,J,4),S4(I,J,5)
  538 CONTINUE
      WRITE(6,68)
  537 CONTINUE
      WRITE(6,839)
  839 FORMAT(' W4')
      DO 539 I=1,5
      DO 540 J=1,5
      WRITE(6,67) W4(I,J,1),W4(I,J,2),W4(I,J,3),W4(I,J,4),W4(I,J,5)
  540 CONTINUE
      WRITE(6,68)
  539  CONTINUE
      WRITE(6,65)
      WRITE(6,840)
  840 FORMAT(' B3')
      DO 541 I=1,5
      DO 542 J=1,5
      DO 543 K=1,5
      WRITE(6,67) B3(I,J,K,1),B3(I,J,K,2),B3(I,J,K,3),B3(I,J,K,4)
     1,B3(I,J,K,5)
  543 CONTINUE
      WRITE(6,68)
  542 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  541 CONTINUE
      WRITE(6,65)
      WRITE(6,841)
  841 FORMAT(' C3')
      DO 544 I=1,5
      DO 545 J=1,5
      DO 546 K=1,5
      WRITE(6,67) C3(I,J,K,1),C3(I,J,K,2),C3(I,J,K,3),C3(I,J,K,4)
     1,C3(I,J,K,5)
  546 CONTINUE
      WRITE(6,68)
  545 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  544 CONTINUE
      WRITE(6,65)
      WRITE(6,842)
  842 FORMAT(' E3')
      DO 547 I=1,5
      DO 548 J=1,5
      DO 549 K=1,5
      WRITE(6,67) E3(I,J,K,1),E3(I,J,K,2),E3(I,J,K,3),E3(I,J,K,4)
     1,E3(I,J,K,5)
  549 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  548 CONTINUE
  547 CONTINUE
      WRITE(6,65)
      WRITE(6,843)
  843 FORMAT(' F3')
      DO 550 I=1,5
      DO 551 J=1,5
      DO 552 K=1,5
      WRITE(6,67) F3(I,J,K,1),F3(I,J,K,2),F3(I,J,K,3),F3(I,J,K,4)
     1,F3(I,J,K,5)
  552 CONTINUE
      WRITE(6,68)
  551 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  550 CONTINUE
      WRITE(6,65)
      WRITE(6,844)
  844 FORMAT(' H3')
      DO 553 I=1,5
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```
      DO 554 J=1,5
      DO 555 K=1,5
      WRITE(6,67) H3(I,J,  ),H3(I,J,K,2),H3(I,J,K,3),H3(I,J,K,4)
     1,H3(I,J,K,5)
  555 CONTINUE
      WRITE(6,68)
  554 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  553 CONTINUE
      WRITE(6,65)
      WRITE(6,845)
  845 FORMAT(' I3')
      DO 556 I=1,5
      DO 557 J=1,5
      DO 558 K=1,5
      WRITE(6,67) XI3(I,J,K,1),XI3(I,J,K,2),XI3(I,J,K,3)
     1,XI3(I,J,K,4),XI3(I,J,K,5)
  558  CONTINUE
      WRITE(6,68)
  557 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  556 CONTINUE
      WRITE(6,65)
      WRITE(6,846)
  846 FORMAT(' R3')
      DO 559 I=1,5
      DO 560 J=1,5
      DO 561 K=1,5
      WRITE(6,67) R3(I,J,K,1),R3(I,J,K,2),R3(I,J,K,3),R3(I,J,K,4)
     1,R3(I,J,K,5)
  561 CONTINUE
      WRITE(6,68)
  560 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  559 CONTINUE
      WRITE(6,65)
      WRITE(6,847)
  847 FORMAT(' S3')
      DO 562 I=1,5
      DO 563 J=1,5
      DO 564 K=1,5
      WRITE(6,67) S3(I,J,K,1),S3(I,J,K,2),S3(I,J,K,3),S3(I,J,K,4)
     1,S3(I,J,K,5)
  564 CONTINUE
      WRITE(6,68)
  563 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  562 CONTINUE
      WRITE(6,65)
      WRITE(6,848)
  848 FORMAT(' A4')
      DO 565 I=1,5
      DO 566 J=1,5
      DO 567 K=1,5
      WRITE(6,67) A4(I,J,K,1),A4(I,J,K,2),A4(I,J,K,3),A4(I,J,K,4)
     1,A4(I,J,K,5)
  567 CONTINUE
      WRITE(6,68)
  566 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  565 CONTINUE
      WRITE(6,65)
      WRITE(6,849)
  849 FORMAT(' B4')
      DO 568 I=1,5
      DO 569 J=1,5
      DO 570 K=1,5
      WRITE(6,67) B4(I,J,K,1),B4(I,J,K,2),B4(I,J,K,3),B4(I,J,K,4)
     1,B4(I,J,K,5)
  570 CONTINUE
      WRITE(6,68)
  569 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  568 CONTINUE
      WRITE(6,65)
      WRITE(6,850)
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      850 FORMAT(' C4')
          DO 571 I=1,5
          DO 572 J=1,5
          DO 573 K=1,5
          WRITE(6,67) C4(I,J,K,1),C4(I,J,K,2),C4(I,J,K,3),C4(I,J,K,4)
     1,C4(I,J,K,5)
      573 CONTINUE
          WRITE(6,68)
      572 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      571 CONTINUE
          WRITE(6,65)
          WRITE(6,851)
      851 FORMAT(' D4')
          DO 574 I=1,5
          DO 575 J=1,5
          DO 576 K=1,5
          WRITE(6,67) D4(I,J,K,1),D4(I,J,K,2),D4(I,J,K,3),D4(I,J,K,4),
     1D4(I,J,K,5)
      576 CONTINUE
          WRITE(6,68)
      575 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      574 CONTINUE
          WRITE(6,65)
          WRITE(6,852)
      852 FORMAT(' E4')
          DO 577 I=1,5
          DO 578 J=1,5
          DO 579 K=1,5
          WRITE(6,67) E4(I,J,K,1),E4(I,J,K,2),E4(I,J,K,3),E4(I,J,K,4)
     1,E4(I,J,K,5)
      579 CONTINUE
          WRITE(6,68)
      578 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      577 CONTINUE
          WRITE(6,65)
          WRITE(6,853)
      853 FORMAT(' F4')
          DO 580 I=1,5
          DO 581 J=1,5
          DO 582 K=1,5
          WRITE(6,67) F4(I,J,K,1),F4(I,J,K,2),F4(I,J,K,3),F4(I,J,K,4)
     1,F4(I,J,K,5)
      582 CONTINUE
          WRITE(6,68)
      581 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      580 CONTINUE
          WRITE(6,65)
          WRITE(6,854)
      854 FORMAT(' G4')
          DO 583 I=1,5
          DO 584 J=1,5
          DO 585 K=1,5
          WRITE(6,67) G4(I,J,K,1),G4(I,J,K,2),G4(I,J,K,3),G4(I,J,K,4)
     1,G4(I,J,K,5)
      585 CONTINUE
          WRITE(6,68)
      584 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      583 CONTINUE
          WRITE(6,65)
          WRITE(6,855)
      855 FORMAT(' I4')
          DO 586 I=1,5
          DO 587 J=1,5
          DO 588 K=1,5
          WRITE(6,67) XI4(I,J,K,1),XI4(I,J,K,2),XI4(I,J,K,3)
     1,XI4(I,J,K,4),XI4(I,J,K,5)
      588 CONTINUE
          WRITE(6,68)
      587 CONTINUE
          IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
          IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
      586 CONTINUE
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      WRITE(6,65)
      WRITE(6,856)
  856 FORMAT(' L4')
      DO 589 I=1,5
      DO 590 J=1,5
      DO 591 K=1,5
      WRITE(6,67) XL4(I,J,K,1),XL4(I,J,K,2),XL4(I,J,K,3),XL4(I,J,K,4)
     1,XL4(I,J,K,5)
  591 CONTINUE
      WRITE(6,68)
  590 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  589 CONTINUE
      WRITE(6,65)
      WRITE(6,857)
  857 FORMAT(' Q4')
      DO 592 I=1,5
      DO 593 J=1,5
      DO 594 K=1,5
      WRITE(6,67) Q4(I,J,K,1),Q4(I,J,K,2),Q4(I,J,K,3),Q4(I,J,K,4)
     1,Q4(I,J,K,5)
  594 CONTINUE
      WRITE(6,68)
  593 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  592 CONTINUE
      WRITE(6,65)
      WRITE(6,858)
  858 FORMAT(' R4')
      DO 595 I=1,5
      DO 596 J=1,5
      DO 597 K=1,5
      WRITE(6,67) R4(I,J,K,1),R4(I,J,K,2),R4(I,J,K,3),R4(I,J,K,4)
     1,R4(I,J,K,5)
  597 CONTINUE
      WRITE(6,68)
  596 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  595 CONTINUE
      WRITE(6,65)
      WRITE(6,859)
  859 FORMAT(' V4')
      DO 598 I=1,5
      DO 599 J=1,5
      DO 600 K=1,5
      WRITE(6,67) V4(I,J,K,1),V4(I,J,K,2),V4(I,J,K,3),V4(I,J,K,4)
     1,V4(I,J,K,5)
  600 CONTINUE
      WRITE(6,68)
  599 CONTINUE
      IF(I.EQ.2.OR.I.EQ.4) WRITE(6,65)
      IF(I.EQ.1.OR.I.EQ.3) WRITE(6,69)
  598 CONTINUE
  499 STOP
      END
      SUBROUTINE FC3(C3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C4(100)
      CALL FI3P(C1,I1,J)
      CALL FIP(C2,I2,K)
      CALL PMPY(C4,I3,C1,I1,C2,I2)
      CALL FIP(C2,I2,L)
      CALL PMPY(C1,I1,C2,I2,C4,I3)
      CALL FIP(C2,I2,I)
      CALL PMPY(C4,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C4,I3)
      X=0.D0
      DO 1 N=1,I1
      X=X-C1(N)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      C3=X*DSQRT(XX)/2.D0
      RETURN
      END
      SUBROUTINE FD3(D3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIPP(C1,I1,J)
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      CALL PA(C2,I2,1)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PDER(C1,I1,C3,I3)
      CALL FIP(C2,I2,I)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 1 N=1,I1
      X=X+C1(N)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      D3=3.D0*X*DSQRT(XX)/2.D0
      RETURN
      END
      SUBROUTINE FE3(E3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      CALL FIP(C1,I1,K)
      CALL FIP(C2,I2,L)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PDER(C2,I2,C3,I3)
      CALL PDER(C1,I1,C2,I2)
      CALL FIP(C2,I2,I)
      CALL FIP(C3,I3,J)
      CALL PMPY(C4,I4,C2,I2,C3,I3)
      CALL PMPY(C2,I2,C1,I1,C4,I4)
      CALL PINT(C1,I1,C2,I2)
      X=0.D0
      DO 1 N=1,I1
      X=X-C1(N)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      E3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FF3(F3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,K)
      CALL FIP(C2,I2,L)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL FIPP(C2,I2,J)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PDER(C2,I2,C1,I1)
      CALL FIP(C3,I3,I)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,IINT,C1,I1)
      X=0.D0
      DO 1 N=1,IINT
      X=X-C2(N)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      F3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FG3(G3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,I)
      CALL FIP(C2,I2,J)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PA(C2,I2,2)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
      DO 1 N=1,I2
      X=X-C2(N)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      G3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FH3(H3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      CALL FIP(C1,I1,I)
      CALL FIP(C2,I2,J)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
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      CALL PINT(C1,I1,C3,IJ)
      CALL FIP(C2,I2,K)
      CALL FIP(C4,I4,L)
      CALL PMPY(C3,I3,C4,I4,C2,I2)
      CALL PINT(C2,I2,C3,I3)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 1 N=1,I1
      X=X+C1(N)
1     CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      H3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FI3(XI3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,I)
      CALL FIP(C3,I3,J)
      CALL PMPY(C2,IJ,C1,I1,C3,I3)
      CALL FIP(C3,I3,K)
      CALL PMPY(C1,IJK,C3,I3,C2,IJ)
      CALL FIP(C3,I3,L)
      CALL PMPY(C2,IJKL,C1,IJK,C3,I3)
      CALL PA(C3,IPA,1)
      CALL PMPY(C1,I1,C3,IPA,C2,IJKL)
      CALL PINT(C2,IINT,C1,I1)
      X=0.D0
      DO 1 N=1,IINT
      X=X-C2(N)
1     CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      XI3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FJ3(XJ3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,I)
      CALL FIP(C2,I2,J)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PA(C2,I2,3)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
      DO 1 N=1,I2
      X=X-C2(N)
1     CONTINUE
      XX=(2*I-1)*(2*J-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      XJ3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FD3(D3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,J)
      CALL FIP(C2,I2,K)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PA(C2,I2,5)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
      DO 1 N=1,I2
      X=X+C2(N)
1     CONTINUE
      C2(1)=C2(1)-X
      CALL FIP(C3,I3,I)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
      DO 2 N=1,I2
      X=X-C2(N)
2     CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      D3=X*DSQRT(XX)
      RETURN
      END
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```
      SUBROUTINE FQ3(Q3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,K)
      CALL PA(C2,I2,5)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      X=0.DO
      DO 1 N=1,I1
      X=X+C1(N)
    1 CONTINUE
      C1(1)=C1(1)-X
      CALL FIP(C2,I2,J)
      CALL PMPY(C3,I3,C2,I2,C1,I1)
      CALL FIP(C2,I2,I)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      X=0.DO
      DO 3 N=1,I2
      X=X-C2(N)
    3 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)
      IF(DABS(X).LT.1.D-7) X=0.DO
      Q3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FS3(S3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,I)
      CALL FIP(C2,IJ,J)
      CALL PMPY(C3,IJ,C1,I1,C2,J1)
      CALL PINT(C2,I1,C3,IJ)
      CALL FI(C3,L)
      CALL PMPY(C1,IJL,C2,I1,C3,L)
      CALL FIP(C3,I1,K)
      CALL PMPY(C2,IJKL,C1,IJL,C3,I1)
      CALL PA(C3,IPA,4)
      CALL PMPY(C1,I1,C2,IJKL,C3,IPA)
      CALL PINT(C2,IINT,C1,I1)
      X=0.DO
      DO 1 N=1,IINT
      X=X+C2(N)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.DO
      S3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FF4(F4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      CALL FIP(C1,I1,J)
      CALL FI(C2,K)
      CALL PMPY(C3,JK,C1,I1,C2,K)
      CALL FI(C1,L)
      CALL PMPY(C2,JKL,C3,JK,C1,L)
      CALL PINT(C1,I1,C2,JKL)
      X=0.DO
      DO 1 N=1,I1
      X=X+C1(N)
    1 CONTINUE
      C1(1)=C1(1)-X
      CALL FIP(C3,I3,I)
      CALL PMPY(C2,I2,C3,I3,C1,I1)
      CALL PINT(C3,I3,C2,I2)
      X=0.DO
      DO 2 N=1,I3
      X=X-C3(N)
    2 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.DO
      F4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FG4(G4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C2,I2,K)
      CALL FIP(C1,I1,L)
      CALL PMPY(C3,KL,C1,I1,C2,I2)
      CALL FI(C1,J)
```

```
      CALL PMPY(C2,JKL,C1,J,C3,KL)
      CALL PA(C1,IPA,4)
      CALL PMPY(C3,I3,C2,JKL,C1,IPA)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 1 N=1,I1
      X=X+C1(N)
    1 CONTINUE
      C1(1)=C1(1)-X
      CALL FIP(C3,I3,I)
      CALL PMPY(C2,I2,C3,I3,C1,I1)
      CALL PINT(C3,I3,C2,I2)
      X=0.D0
      DO 2 N=1,I3
      X=X-C3(N)
    2 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      G4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FL4(XL4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,IK,K)
      CALL FIP(C2,IL,L)
      CALL PMPY(C3,I1,C1,IK,C2,IL)
      CALL PINT(C1,IINT,C3,I1)
      CALL FI(C2,J)
      CALL PMPY(C3,I3,C2,J,C1,IINT)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 1 N=1,I1
      X=X+C1(N)
    1 CONTINUE
      C1(1)=C1(1)-X
      CALL FIP(C2,I2,I)
      CALL PMPY(C3,I3,C2,I2,C1,I1)
      CALL PINT(C2,IINT,C3,I3)
      X=0.D0
      DO 2 N=1,IINT
      X=X-C2(N)
    2 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      XL4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FM4(XM4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FI(C2,J)
      CALL PINT(C1,I1,C2,J)
      X=0.D0
      DO 1 N=1,I1
      X=X+C1(N)
    1 CONTINUE
      C1(1)=C1(1)-X
      CALL PINT(C2,I2,C1,I1)
      CALL FI(C3,K)
      CALL PMPY(C1,I1,C2,I2,C3,K)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
      DO 2 N=1,I2
      X=X+C2(N)
    2 CONTINUE
      C2(1)=C2(1)-X
      CALL FIP(C3,I3,I)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
      DO 3 N=1,I2
      X=X-C2(N)
    3 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      XM4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FN4(XN4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
```

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```
      CALL PA(C2,I2,1)
      CALL PINT(C1,I1,C2,I2)
      CALL FI(C2,J)
      CALL PMPY(C3,I3,C1,I1,C2,J)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 1 N=1,I1
      X=X+C1(N)
    1 CONTINUE
      C1(1)=C1(1)-X
      CALL FIP(C2,I2,I)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 3 N=1,I1
      X=X-C1(N)
    3 CONTINUE
      XX=(2*I-1)*(2*J-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      XN4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FQ4(Q4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      CALL FIP(C2,ID1,I)
      CALL FIP(C3,ID2,J)
      CALL PMPY(C1,IP1,C2,ID1,C3,ID2)
      CALL FIP(C3,ID1,K)
      CALL FIPP(C2,ID3,L)
      CALL PMPY(C4,ID4,C3,ID1,C2,ID3)
      CALL PDER(C2,ID2,C4,ID4)
      CALL PMPY(C3,IP2,C2,ID2,C1,IP1)
      CALL PINT(C1,IINT,C3,IP2)
      X=0.D0
      DO 1 N=1,IINT
      X=X-C1(N)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      Q4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FR4(R4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      CALL FIP(C2,ID1,I)
      CALL FIP(C3,ID2,J)
      CALL PMPY(C1,IP1,C2,ID1,C3,ID2)
      CALL FIPP(C2,K2,K)
      CALL FIPP(C3,L2,L)
      CALL PMPY(C4,IP2,C2,K2,C3,L2)
      CALL PMPY(C2,IP,C1,IP1,C4,IP2)
      CALL PINT(C1,IINT,C2,IP)
      X=0.D0
      DO 1 N=1,IINT
      X=X-C1(N)
    1 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      R4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FT4(T4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FI(C1,J)
      CALL PINT(C2,I2,C1,J)
      X=0.D0
      DO 1 N=1,I2
      X=X+C2(N)
    1 CONTINUE
      C2(1)=C2(1)-X
      CALL PINT(C1,I1,C2,I2)
      CALL PA(C2,I2,4)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 2 N=1,I1
      X=X+C1(N)
    2 CONTINUE
      C1(1)=C1(1)-X
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```
      CALL FIP(C2,I2,I)
      CALL PMPY(C3,I3,C2,I2,C1,I1)
      CALL PINT(C2,I2,C3,I3)
      X=0.D0
      DO 3 N=1,I2
      X=X-C2(N)
    3 CONTINUE
      XX=(2*I-1)*(2*J-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      T4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FU4(U4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,I)
      CALL PA(C2,I2,6)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 1 N=1,I1
      X=X+C1(N)
    1 CONTINUE
      XX=2*I-1
      IF(DABS(X).LT.1.D-7) X=0.D0
      U4=X*DSQRT(XX)/15.D0
      RETURN
      END
      SUBROUTINE FV4(V4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FIP(C1,I1,J)
      CALL FIP(C2,I2,K)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      CALL FIP(C2,I2,L)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PA(C2,I2,4)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
      DO 1 N=1,I2
      X=X+C2(N)
    1 CONTINUE
      C2(1)=C2(1)-X
      CALL FIP(C1,I1,I)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PINT(C1,I1,C3,I3)
      X=0.D0
      DO 2 N=1,I1
      X=X-C1(N)
    2 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)*(2*L-1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      V4=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FW4(W4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100)
      CALL FI(C1,J)
      CALL PINT(C2,I2,C1,J)
      X=0.D0
      DO 1 N=1,I2
      X=X+C2(N)
    1 CONTINUE
      C2(1)=C2(1)-X
      CALL PINT(C1,I1,C2,I2)
      CALL PA(C2,I2,4)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL FIP(C2,I2,K)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
      DO 2 N=1,I2
      X=X+C2(N)
    2 CONTINUE
      C2(1)=C2(1)-X
      CALL FIP(C3,I3,I)
      CALL PMPY(C1,I1,C3,I3,C2,I2)
      CALL PINT(C2,I2,C1,I1)
      X=0.D0
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```
      DO 3 N=1,I2
      X=X-C2(N)
    3 CONTINUE
      XX=(2*I-1)*(2*J-1)*(2*K-1)
      IF(DABS(X).LT.1.D-7) X=0.DO
      W4=X*DSQRT(XX)
      RETURN
      END
C ***************************************************************************
C  ***    SSP SUBROUTINES PMPY,PDER,PINT,PADDM    ***
      SUBROUTINE PMPY(Z,IDIMZ,X,IDIMX,Y,IDIMY)
      REAL*8 Z,X,Y
      DIMENSION Z(1),X(1),Y(1)
      IF(IDIMX*IDIMY) 10,10,20
   10 IDIMZ=0
      GO TO 50
   20 IDIMZ=IDIMX+IDIMY-1
      DO 30 I=1,IDIMZ
   30 Z(I)=0.DO
      DO 40 I=1,IDIMX
      DO 40 J=1,IDIMY
      K=I+J-1
   40 Z(K)=X(I)*Y(J)+Z(K)
   50 RETURN
      END
      SUBROUTINE PDER(Y,IDIMY,X,IDIMX)
      REAL*8 Y,X,EXPT
      DIMENSION X(1),Y(1)
      IF(IDIMX-1) 3,3,1
    1 IDIMY=IDIMX-1
      EXPT=0.DO
      DO 2 I=1,IDIMY
      EXPT=EXPT+1.DO
    2 Y(I)=X(I+1)*EXPT
      GO TO 4
    3 IDIMY=1
      Y(1)=0.DO
    4 RETURN
      END
      SUBROUTINE PINT(Y,IDIMY,X,IDIMX)
      REAL*8 Y,X,EXPT
      DIMENSION X(1),Y(1)
      IDIMY=IDIMX+1
      Y(1)=0.DO
      IF(IDIMX) 1,1,2
    1 RETURN
    2 EXPT=1.DO
      DO 3 I=2,IDIMY
      Y(I)=X(I-1)/EXPT
    3 EXPT=EXPT+1.DO
      GO TO 1
      END
      SUBROUTINE PADDM(Z,IDIMZ,X,IDIMX,FACT,Y,IDIMY)
      REAL*8 Z,X,FACT,Y
      DIMENSION Z(1),X(1),Y(1)
      NDIM=IDIMX
      IF(IDIMX-IDIMY) 10,20,20
   10 NDIM=IDIMY
   20 IF(NDIM) 90,90,30
   30 DO 80 I=1,NDIM
      IF(I-IDIMX) 40,40,60
   40 IF(I-IDIMY) 50,50,70
   50 Z(I)=FACT*Y(I)+X(I)
      GO TO 80
   60 Z(I)=FACT*Y(I)
      GO TO 80
   70 Z(I)=X(I)
   80 CONTINUE
   90 IDIMZ=NDIM
      RETURN
      END
C ***************************************************************************
C ***************************************************************************
C
C
C   **  OBJECTIVE OF SUBROUTINE SCINT : TO INTEGRATE, IN X,THE
C       FOLLOWING FUNCTION :
C   **  SC(1)+SC(2).X +SC(3).X**2 + ...+ SC(ISC).X**(ISC-1)|.COS(A.X)
C     +   SS(1)+SS(2).X +SS(3).X**2 + ...+ SS(ISS).X**(ISS-1)|.SIN(A.X)
C
      SUBROUTINE SCINT(RCOS,ICOS,RSIN,ISIN,SC,ISC,SS,ISS,A)
      IMPLICIT REAL*8(A-H,O-Z)
```

```
      DIMENSION RCOS(1),RSIN(1),SC(1),SS(1),AA(100)
     1,A1(100),B1(100),AB(100)
      AA(1)=0.D0
      AB(1)=0.D0
      IAA=1
      IAB=1
      ICOS=0
      ISIN=0
      IF(ISC.EQ.0) GO TO 20
      DO 1 N=1,ISC
      NN=N-1
      CALL XMCAX(A1,IA1,B1,IB1,NN,A)
      CALL PADDM(RCOS,ICOS,AA,IAA,SC(N),A1,IA1)
      DO 2 M=1,ICOS
      AA(M)=RCOS(M)
    2 CONTINUE
      IF(ICOS.GT.IAA) IAA=ICOS
      CALL PADDM(RSIN,ISIN,AB,IAB,SC(N),B1,IB1)
      DO 3 M=1,ISIN
      AB(M)=RSIN(M)
    3 CONTINUE
      IF(ISIN.GT.IAB) IAB=ISIN
    1 CONTINUE
      DO 10 N=1,ICOS
      AA(N)=RCOS(N)
   10 CONTINUE
      DO 11 N=1,ISIN
      AB(N)=RSIN(N)
   11 CONTINUE
   20 IF(ISS.EQ.0) GO TO 21
      DO 4 N=1,ISS
      NN=N-1
      CALL XMSAX(A1,IA1,B1,IB1,NN,A)
      CALL PADDM(RCOS,ICOS,AA,IAA,SS(N),A1,IA1)
      DO 5 M=1,ICOS
      AA(M)=RCOS(M)
    5 CONTINUE
      IF(ICOS.GT.IAA) IAA=ICOS
      CALL PADDM(RSIN,ISIN,AB,IAB,SS(N),B1,IB1)
      DO 6 M=1,ISIN
      AB(M)=RSIN(M)
    6 CONTINUE
      IF(ISIN.GT.IAB) IAB=ISIN
    4 CONTINUE
      ICOS=IAA
      ISIN=IAB
   21 RETURN
      END
C*************************************************************************
C
C  ** SUBROUTINE XMSAX INTEGRATES  (X**M).SIN(A.X)  OVER X
C
C  **  THE RESULT OF THE INDEFINITE INTEGRAL IS OF THE FORM :
C
C    ^ A1(1)+A1(2).X + A1(3).X**2 + ...+A1(IA1).X**(IA1-1)|.COS(A.X)
C   +^ B1(1)+B1(2).X + B1(3).X**2 + ...+B1(IB1).X**(IB1-1)|.SIN(A.X)
C
C   ** THE COEFFICIENTS A1(I) AND B1(I) ARE DETERMINED BY XMSAX
C   ***********************************************************************
C   ***********************************************************************
C   ANALYTICAL EXPRESSION FOR THE COEFFICIENTS A1 AND B1 :
C    CRC TABLES, 26TH EDITION, PAGE 320, INTEGRAL NUMBER 392
C   ***********************************************************************
C   ***********************************************************************
C
      SUBROUTINE XMSAX(A1,IA1,B1,IB1,M,A)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C(100),A1(1),B1(1)
      FACTM=1.D0
      IF(M.LE.1) GO TO 25
      DO 1 I=2,M
      FACTM=FACTM*I
    1 CONTINUE
   25 IA1=M+1
      DO 2 I=1,IA1
      I1=I-1
      FI1=1.D0
      IF(I1.EQ.0) GO TO 33
      DO 3 J=1,I1
      FI1=FI1*J
    3 CONTINUE
   33 IXA=M+2-I
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```
      XA=A**IXA
      C(I)=FACTM/(FI1*XA)
    2 CONTINUE
      KK=-1
      DO 4 I=1,IA1,2
      J=IA1+1-I
      A1(J)=KK*C(J)
      IF(J.GT.1) A1(J-1)=0.D0
      KK=-KK
    4 CONTINUE
      KK=1
      IF(M.EQ.0) GO TO 6
      DO 5 I=1,M,2
      J=M+1-I
      B1(J)=KK*C(J)
      IF(J.GT.1) B1(J-1)=0.D0
      KK=-KK
    5 CONTINUE
    6 IB1=M
      RETURN
      END
C*********************************************************************
C
C ** SUBROUTINE XMCAX INTEGRATES  (X**M).COS(A.X)  OVER X
C
C **  THE RESULT OF THE INDEFINITE INTEGRAL IS OF THE FORM :
C
C   ^ A1(1)+A1(2).X + A1(3).X**2 + ...+A1(IA1).X**(IA1-1)|.COS(A.X)
C+^ B1(1)+B1(2).X + B1(3).X**2 + ...+B1(IB1).X**(IB1-1)|.SIN(A.X)
C
C  ** THE COEFFICIENTS A1(I) AND B1(I) ARE DETERMINED BY XMCAX
C
      SUBROUTINE XMCAX(A1,IA1,B1,IB1,M,A)
      REAL*8 A1,B1,A
      DIMENSION A1(1),B1(1)
      CALL XMSAX(B1,IB1,A1,IA1,M,A)
      DO 1 N=1,IB1
      B1(N)=-B1(N)
    1 CONTINUE
      RETURN
      END
C*********************************************************************
C
C**********************************************************************
C
C  *** SUBROUTINES FI,FIP,FIPP AND FI3P, DEFINING THE SHIFTED
C    LEGENDRE POLYNOMIALS AND THEIR FIRST, SECOND AND THIRD DERIVATIVES
C
      SUBROUTINE FI(COEFF,I)
      REAL*8 COEFF
      DIMENSION COEFF(8)
      IF(I.EQ.1) GO TO 1
      IF(I.EQ.2) GO TO 2
      IF(I.EQ.3) GO TO 3
      IF(I.EQ.4) GO TO 4
      IF(I.EQ.5) GO TO 5
      IF(I.EQ.6) GO TO 6
      IF(I.EQ.7) GO TO 7
      COEFF(1)=-1.D0
      COEFF(2)=56.D0
      COEFF(3)=-756.D0
      COEFF(4)=4200.D0
      COEFF(5)=-11500.D0
      COEFF(6)=16632.D0
      COEFF(7)=-12012.D0
      COEFF(8)=3432.D0
      GO TO 50
    7 COEFF(1)=1.D0
      COEFF(2)=-42.D0
      COEFF(3)=420.D0
      COEFF(4)=-1680.D0
      COEFF(5)=3150.D0
      COEFF(6)=-2772.D0
      COEFF(7)=924.D0
      GO TO 50
    6 COEFF(1)=-1.D0
      COEFF(2)=30.D0
      COEFF(3)=-210.D0
      COEFF(4)=560.D0
      COEFF(5)=-630.D0
      COEFF(6)=252.D0
      GO TO 50
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```
      5    COEFF(1)=1.D0
           COEFF(2)=-20.D0
           COEFF(3)=90.D0
           COEFF(4)=-140.D0
           COEFF(5)=70.D0
           GO TO 50
      4    COEFF(1)=-1.D0
           COEFF(2)=12.D0
           COEFF(3)=-30.D0
           COEFF(4)=20.D0
           GO TO 50
      3    COEFF(1)=1.D0
           COEFF(2)=-6.D0
           COEFF(3)=6.D0
           GO TO 50
      2    COEFF(1)=-1.D0
           COEFF(2)=2.D0
           GO TO 50
      1    COEFF(1)=1.D0
     50    RETURN
           END
           SUBROUTINE FIP(COEFF,IP,I)
           REAL*8 COEFF,C1
           DIMENSION COEFF(100),C1(100)
           CALL FI(C1,I)
           CALL PDER(COEFF,IP,C1,I)
            RETURN
           END
           SUBROUTINE FIPP(COEFF,IPP,I)
           REAL*8 COEFF,C1
           DIMENSION COEFF(100),C1(100)
           CALL FI(COEFF,I)
           CALL PDER(C1,IP,COEFF,I)
           CALL PDER(COEFF,IPP,C1,IP)
           RETURN
           END
           SUBROUTINE FI3P(COEFF,I3P,I)
           REAL*8 COEFF,C1
           DIMENSION COEFF(100),C1(100)
           CALL FI(C1,I)
           CALL PDER(COEFF,IP,C1,I)
           CALL PDER(C1,IPP,COEFF,IP)
           CALL PDER(COEFF,I3P,C1,IPP)
           RETURN
           END
C
C     ****************************************************************
C     ****************************************************************
C
C    **  SUBROUTINE  PA, DEFINING A FEW AUXILIARY POLYNOMIALS (X,X**2,ETC)
C
           SUBROUTINE PA(COEFF,IPA,I)
           REAL*8 COEFF
           DIMENSION COEFF(6)
           IF(I.EQ.1) GO TO 1
           IF(I.EQ.2) GO TO 2
           IF(I.EQ.3) GO TO 3
           IF(I.EQ.4) GO TO 4
           IF(I.EQ.5) GO TO 5
           COEFF(1)=4.D0
           COEFF(2)=0.D0
           COEFF(3)=0.D0
           COEFF(4)=-5.D0
           COEFF(5)=0.D0
           COEFF(6)=1.D0
           IPA=6
           GO TO 50
      5    COEFF(1)=0.D0
           COEFF(2)=0.D0
           COEFF(3)=1.D0
           IPA=3
           GO TO 50
      4    COEFF(1)=0.D0
           COEFF(2)=1.D0
           IPA=2
           GO TO 50
      3    COEFF(1)=1.D0
           COEFF(2)=0.D0
           COEFF(3)=-2.D0
           COEFF(4)=0.D0
           COEFF(5)=1.D0
           IPA=5
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```
      GO TO 50
    2 COEFF(1)=5.D0
      COEFF(2)=0.D0
      COEFF(3)=-6.D0
      COEFF(4)=0.D0
      COEFF(5)=1.D0
      IPA=5
      GO TO 50
    1 COEFF(1)=1.D0
      COEFF(2)=0.D0
      COEFF(3)=-1.D0
      IPA=3
   50 RETURN
      END
C  ****************************************************************
C
C  **  ADDITIONAL SUBROUTINES, USED TO EVALUATE THE COEFFICIENTS
C       INVOLVING PRODUCTS OF POLYNOMIALS AND TRIGONOMETRIC FUNCTIONS **
C
      SUBROUTINE FK(XK,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      COMMON PI
      A=(I-0.5D0)*PI
      CALL FI3P(C1,I1,J)
      CALL FIP(C3,I3,K)
      CALL PMPY(C2,I2,C1,I1,C3,I3)
      CALL FIPP(C4,I4,J)
      CALL PMPY(C1,I1,C4,I4,C3,I3)
      IF(I1.NE.0) GO TO 10
      I1=1
      C1(1)=0.D0
   10 DO 1 N=1,I1
      C1(N)=A*C1(N)
    1 CONTINUE
      CALL SCINT(C3,I3,C4,I4,C1,I1,C2,I2,A)
      X=0.D0
      IF(I4.EQ.0) GO TO 11
      DO 2 N=1,I4
      X=X+C4(N)
    2 CONTINUE
   11 X=X*DSIN(A)-C3(1)
      IF(DABS(X).LT.1.D-7) X=0.D0
      XX=2*(2*J-1)*(2*K-1)
      XK=-X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FM(XM,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100),AUX(2)
      COMMON PI
      A=(I-J)*PI
      CALL FA(C1,I1,4)
      ISS=1
      C2(1)=0.D0
      DO 1 IN=1,2
      IF(DABS(A).GT.1.D-2) GO TO 20
      AUX(IN)=0.5D0
      GO TO 3
   20 X=0.D0
      CALL SCINT(C3,I3,C4,I4,C1,I1,C2,ISS,A)
      IF(I3.EQ.0) GO TO 10
      DO 2 N=1,I3
      X=X+C3(N)
    2 CONTINUE
   10 X=X*DCOS(A)-C3(1)
      AUX(IN)=X
    3 A=(I+J-1)*PI
    1 CONTINUE
      XM=AUX(1)-AUX(2)
      IF(DABS(XM).LT.1.D-7) XM=0.D0
      RETURN
      END
      SUBROUTINE FN(XN,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100),AUX(2)
      COMMON PI
      A=(I-J)*PI
      CALL FA(C1,I1,1)
      ISS=1
      C2(1)=0.D0
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```
      DO 1 IN=1,2
      IF(DABS(A).GT.1.D-2) GO TO 20
      AUX(IN)=2.DO/3.DO
      GO TO 3
   20 X=0.DO
      CALL SCINT(C3,I3,C4,I4,C1,I1,C2,ISS,A)
      IF(I3.EQ.0) GO TO 10
      DO 2 N=1,I3
      X=X+C3(N)
    2 CONTINUE
   10 X=X*DCOS(A)-C3(1)
      AUX(IN)=X
    3 A=(I+J-1)*PI
    1 CONTINUE
      XN=(I-0.5DO)*(J-0.5DO)*PI*PI*(AUX(1)+AUX(2))/2.DO
      IF(DABS(XN).LT.1.D-7) XN=0.DO
      RETURN
      END
      SUBROUTINE FR(R,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      COMMON PI
      A=(I-0.5DO)*PI
      CALL PA(C3,I3,4)
      CALL FIP(C2,I2,J)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      ISC=1
      C2(1)=0.DO
      CALL SCINT(C3,I3,C4,I4,C2,ISC,C1,I1,A)
      X=0.DO
      IF(I4.EQ.0) GO TO 10
      DO 1 N=1,I4
      X=X+C4(N)
    1 CONTINUE
   10 X=X*DSIN(A)-C3(1)
      IF(DABS(X).LT.1.D-7) X=0.DO
      XX=2*(2*J-1)
      R=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE A3P4(A3,I,J,K,L,IA3,IP4)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      COMMON PI
      A=(J-0.5DO)*PI
      CALL FIP(C1,I1,K)
      CALL FIP(C3,I3,I)
      CALL PMPY(C2,I2,C1,I1,C3,I3)
      CALL FIPP(C4,I4,K)
      CALL PMPY(C1,I1,C4,I4,C3,I3)
      IF(I1.NE.0) GO TO 10
      I1=1
      C1(1)=0.DO
   10 DO 1 N=1,I1
      C1(N)=A*C1(N)
    1 CONTINUE
      IF(I2.GE.1.AND.IP4.EQ.0) GO TO 20
      I2=1
      C2(1)=0.DO
   20 DO 2 N=1,I2
      C2(N)=-A*A*C2(N)
    2 CONTINUE
      CALL SCINT(C3,I3,C4,I4,C1,I1,C2,I2,A)
      X=0.DO
      IF(I4.EQ.0) GO TO 11
      DO 3 N=1,I4
      X=X+C4(N)
    3 CONTINUE
   11 X=X*DSIN(A)-C3(1)
      IF(DABS(X).LT.1.D-7) X=0.DO
      XX=2*(2*I-1)*(2*K-1)
      A3=-X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FB3(B3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      COMMON PI
      B3=0.DO
      CALL FIP(C4,I4,I)
      CALL FI3P(C3,I3,L)
      CALL PMPY(C1,I1,C3,I3,C4,I4)
```

```
      CALL FIPP(C3,I3,L)
      CALL PMPY(C2,I2,C3,I3,C4,I4)
      IF(K.NE.J) GO TO 10
      CALL PINT(C3,I3,C1,I1)
      DO 1 N=1,I3
      B3=B3-C3(N)
1     CONTINUE
      A=-1.DO
      GO TO 20
10    A=(K-J)*PI
      DO 3 N=1,I2
      C2(N)=-A*C2(N)
3     CONTINUE
      CALL SCINT(C3,I3,C4,I4,C1,I1,C2,I2,A)
      IF(I3.EQ.0) GO TO 20
      DO 4 N=1,I3
      B3=B3+C3(N)
4     CONTINUE
      B3=( 1)-B3*DCOS(A)
20    K-1
      JK.NE.0) GO TO 30
      CALL PINT(C3,I3,C1,I1)
      DO 5 N=1,I3
      B3=B3+C3(N)
5     CONTINUE
      GO TO 40
30    AA=JK*PI
      DO 6 N=1,I2
      C2(N)=C2(N)*AA/A
6     CONTINUE
      CALL SCINT(C3,I3,C4,I4,C1,I1,C2,I2,AA)
      IF(I3.EQ.0) GO TO 40
      X=0.DO
      DO 7 N=1,I3
      X=X+C3(N)
7     CONTINUE
      B3=B3+X*DCOS(AA)-C3(1)
40    IF(DABS(B3).LT.1.D-7) B3=0.DO
      X=(2*I-1)*(2*L-1)
      B3=B3*DSQRT(X)
      RETURN
      END
      SUBROUTINE FR3(R3,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      COMMON PI
      A=(L-0.5DO)*PI
      CALL FIP(C3,I3,I)
      CALL FIP(C2,I2,J)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      CALL PINT(C2,I2,C1,I1)
      CALL FIP(C1,I1,K)
      CALL PMPY(C3,I3,C1,I1,C2,I2)
      CALL PA(C2,I2,5)
      CALL PMPY(C1,I1,C2,I2,C3,I3)
      ISC=1
      C2(1)=0.DO
      CALL SCINT(C3,I3,C4,I4,C2,ISC,C1,I1,A)
      X=0.DO
      IF(I4.EQ.0) GO TO 10
      DO 1 N=1,I4
      X=X+C4(N)
1     CONTINUE
10    X=X*DSIN(A)-C3(1)
      IF(DABS(X).LT.1.D-7) X=0.DO
      XX=2*(2*I-1)*(2*J-1)*(2*K-1)
      R3=X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE U3D4(U3,I,J,K,L,IU3,ID4)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100),C5(100)
      COMMON PI
      U3=0.DO
      XX=2.DO
      XA=I/2.DO-I/2
      IF(DABS(XA).GT.1.D-1) XX=0.DO
      IF(ID4.EQ.1) GO TO 1
      CALL PA(C1,I1,5)
      IAUX=J
      XXX=1.DO
      GO TO 2
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```
      1    XXX=2*J-1
           CALL PA(C2,I2,4)
           CALL FI(C3,J)
           CALL PMPY(C1,I1,C2,I2,C3,J)
           IAUX=L
      2    ISS=1
           C2(1)=0.D0
           IA=IAUX-K
           DO 3 IN=1,2
           IF(IA.NE.0) GO TO 10
           CALL PINT(C3,I3,C1,I1)
           X=0.D0
           DO 21 N=1,I3
           X=X+C3(N)
      21   CONTINUE
           C3(1)=C3(1)-X
           CALL FIP(C5,I5,I)
           CALL PMPY(C4,I4,C3,I3,C5,I5)
           CALL PINT(C3,I3,C4,I4)
           X=0.D0
           DO 12 N=1,I3
           X=X+C3(N)
      12   CONTINUE
           X=X-C3(1)
           U3=-U3+X
           GO TO 13
      10   A=IA*PI
           CALL SCINT(C3,I3,C4,I4,C1,I1,C2,ISS,A)
           X=0.D0
           IF(I3.EQ.0) GO TO 20
           DO 4 N=1,I3
           X=X+C3(N)
      4    CONTINUE
      20   XA=DCOS(A)
           CONST=X*XA
           CALL FIP(C5,I5,I)
           CALL PMPY(C2,I2,C3,I3,C5,I5)
           CALL PMPY(C3,I3,C4,I4,C5,I5)
           CALL SCINT(C5,I5,C4,I4,C2,I2,C3,I3,A)
           X=0.D0
           IF(I5.EQ.0) GO TO 11
           DO 5 N=1,I5
           X=X+C5(N)
      5    CONTINUE
      11   U3=-U3+X*XA-C5(1)-CONST*XX
           C2(1)=0.D0
      13   IA=IAUX+K-1
      3    CONTINUE
           IF(DABS(U3).LT.1.D-7) U3=0.D0
           XX=(2*I-1)*XXX
           U3=U3*DSQRT(XX)
           RETURN
           END
           SUBROUTINE ACEI4(A4,I,J,K,L,IA4,IC4,IE4,II4)
           IMPLICIT REAL*8(A-H,O-Z)
           DIMENSION C1(100),C2(100),C3(100),C4(100)
           COMMON PI
           A=(L-0.5D0)*PI
           IF(IC4.EQ.1) GO TO 32
           IF(IE4.EQ.1) GO TO 33
           IF(II4.EQ.1) GO TO 34
           CALL FI(C1,J)
           CALL FIP(C2,I2,K)
           CALL PMPY(C3,I3,C1,J,C2,I2)
           CALL PA(C2,I2,4)
           GO TO 35
      32   CALL FIP(C1,I1,J)
           CALL FIP(C2,I2,K)
           CALL PMPY(C3,I3,C1,I1,C2,I2)
           CALL PA(C2,I2,5)
           GO TO 35
      33   CALL FI(C2,J)
           CALL FI(C3,K)
           I2=J
           I3=K
           GO TO 35
      34   CALL FIP(C1,I1,J)
           CALL FIP(C2,I2,K)
           CALL PMPY(C3,I3,C1,I1,C2,I2)
           CALL PINT(C2,I2,C3,I3)
           CALL PA(C3,I3,4)
      35   CALL PMPY(C1,I1,C2,I2,C3,I3)
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```
      ISC=1
      C4(1)=0.D0
      CALL SCINT(C2,I2,C3,I3,C4,ISC,C1,I1,A)
      X=0.D0
      IF(I3.EQ.0) GO TO 10
      DO 1 N=1,I3
      X=X+C3(N)
1     CONTINUE
10    XX=DSIN(A)
      CONST=X*XX
      CALL FIP(C4,I4,I)
      CALL PMPY(C1,I1,C2,I2,C4,I4)
      CALL PMPY(C2,I2,C3,I3,C4,I4)
      CALL SCINT(C3,I3,C4,I4,C1,I1,C2,I2,A)
      X=0.D0
      IF(I4.EQ.0) GO TO 20
      DO 2 N=1,I4
      X=X+C4(N)
2     CONTINUE
20    X=X*XX-C3(1)
      XX=2.D0
      XA=I/2.D0-I/2
      IF(DABS(XA).GE.1.D-1) XX=0.D0
      X=X-CONST*XX
      IF(DABS(X).LT.1.D-7) X=0.D0
      XX=2*(2*I-1)*(2*J-1)*(2*K-1)
      A4=-X*DSQRT(XX)
      RETURN
      END
      SUBROUTINE FB4(B4,I,J,K,L)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100),C5(100)
      COMMON PI
      CALL FA(C2,I2,5)
      ISC=1
      C1(1)=0.D0
      AUX=L-0.5D0
      IAUX=1
      B4=0.D0
      CONST=0.D0
      IINT=1
      IA=J-K
      DO 1 II1=1,2
      DO 2 II2=1,2
      A=(IA+IAUX*AUX)*PI
      XA=DSIN(A)
      CALL SCINT(C3,I3,C4,I4,C1,ISC,C2,I2,A)
      X=0.D0
      IF(I4.EQ.0) GO TO 10
      DO 3 N=1,I4
      X=X+C4(N)
3     CONTINUE
10    CONST=CONST+IINT*X*XA
      CALL FIP(C5,I5,I)
      CALL PMPY(C1,I1,C3,I3,C5,I5)
      CALL PMPY(C3,I3,C4,I4,C5,I5)
      CALL SCINT(C4,I4,C5,I5,C1,I1,C3,I3,A)
      X=0.D0
      IF(I5.EQ.0) GO TO 11
      DO 4 N=1,I5
      X=X+C5(N)
4     CONTINUE
11    B4=B4-IINT*(X*XA-C4(1))
      IAUX=-IAUX
      IINT=-IINT
      C1(1)=0.D0
2     CONTINUE
      IA=J+K-1
      IINT=-1
1     CONTINUE
      A=2.D0
      X=I/2.D0-I/2
      IF(DABS(X).GE.1.D-1) A=0.D0
      X=2*I-1
      B4=(B4+A*CONST)*DSQRT(X/2.D0)
      RETURN
      END
      SUBROUTINE J4K4(XJ4,I,J,K,L,IJ4,IK4)
      IMPLICIT REAL*8(A-H,O-Z)
      DIMENSION C1(100),C2(100),C3(100),C4(100)
      COMMON PI
      IF(IK4.EQ.1) GO TO 10
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2294.            A=(K-0.5D0)*PI
2295.            CALL FI(C2,J)
2296.            CALL FINT(C1,I1,C2,J)
2297.            X=0.D0
2298.            DO 1 N=1,I1
2299.            X=X+C1(N)
2300.        1   CONTINUE
2301.            C1(1)=C1(1)-X
2302.            CALL FINT(C2,I2,C1,I1)
2303.            XXX=2*J-1
2304.            GO TO 11
2305.       10   A=(J-0.5D0)*PI
2306.            CALL FA(C1,I1,1)
2307.            CALL FINT(C2,I2,C1,I1)
2308.            XXX=1.D0
2309.       11   CALL FA(C3,I3,4)
2310.            CALL FMPY(C1,I1,C2,I2,C3,I3)
2311.            ISC=1
2312.            C4(1)=0.D0
2313.            CALL SCINT(C2,I2,C3,I3,C4,ISC,C1,I1,A)
2314.            X=0.D0
2315.            IF(I3.EQ.0) GO TO 12
2316.            DO 2 N=1,I3
2317.            X=X+C3(N)
2318.        2   CONTINUE
2319.       12   XX=DSIN(A)
2320.            CONST=X*XX
2321.            CALL FIP(C4,I4,I)
2322.            CALL FMPY(C1,I1,C2,I2,C4,I4)
2323.            CALL FMPY(C2,I2,C3,I3,C4,I4)
2324.            CALL SCINT(C3,I3,C4,I4,C1,I1,C2,I2,A)
2325.            X=0.D0
2326.            IF(I4.EQ.0) GO TO 13
2327.            DO 3 N=1,I4
2328.            X=X+C4(N)
2329.        3   CONTINUE
2330.       13   X=X*XX-C3(1)
2331.            XX=2.D0
2332.            XA=I/2.D0-I/2
2333.            IF(DABS(XA).GE.1.D-1) XX=0.D0
2334.            X=X-CONST*XX
2335.            IF(DABS(X).LT.1.D-7) X=0.D0
2336.            XX=2*(2*I-1)*XXX
2337.            XJ4=-X*DSQRT(XX)
2338.            RETURN
2339.            END
?
```