DIMENSION AE(6,6), BE(6,4), CE(3,6), BE1(6,3), CE1(6,6)

DIMENSION A(5,5), A1T(5,5), Q(6,5), AKC(3,5), BAKC(5,5), Y(5,5), QC(5,15)

DIMENSION B(5,3), C(2,5), CT(5,2), QO(5,15), T(5), R(5,5), F(6,5), PSF(5,6), AL(5), OK1(4,3), OK2(4,3), OK(4,3)

DIMENSION H(3), G(5), CL(5,3), P(5,5), A1(5,5), D(6), AL1(5), BETA(6), E(6,7), PSE(7,6), X(7), CK1(4,3), CK2(4,3)

DIMENSION CK(4,3), ETA(2), OL(5,2), A2(6,6), AK1(3,2), ALFA2(6), AT(5,5), RR(9,9), AS(6), AK(3,2)

EQUIVALENCE (QC(1,1), QO(1,1), RR(1,1), E(1,1), CE(1,1), F(1,1))

EQUIVALENCE (PSE(1,1), PSF(1,1),BE(1,1), CE(1,1))

EQUIVALENCE (Q(1,1), CK1(1,1), OK1(1,1),BE1(1,1))

EQUIVALENCE (CK2(1,1), OK2(1,1), AE(1,1), P(1,1), BAKC(1,1))

EQUIVALENCE (CK(1,1), OK(1,1), A2(1,1), CL (1,1), OL (1,1))

EQUIVALENCE (Y(1,1), A1T(1,1))

EQUIVALENCE (X(1), R(1,1), ALFA2 (1))

EQUIVALENCE (AT(1,1),AK(1,1))

EQUIVALENCE (AKC(1,1), AS(1), D(1))

WRITE (6,315) “INPUT THE VALUES N, M, IR”

READ (5, 98) N,M,IR

98 FORMAT (3I2)

WRITE (6,315) “INPUT MATRIX A (N,N)”

READ (5,58) ((A(I,J), I=1,N), J=1,N)

WRITE (6,315) “INPUT MATRIX B (N,IR)”

READ (5,58) ((B(I,J), I=1,N), J=1,IR)

WRITE (5,315) “INPUT MATRIX C (M,N)”

READ (5,58) ((C(I,J), J=1,N), I=1,M)

58 FORMAT (40 F2.1)

WRITE (6,315) “INPUT BETA(N+1)”

READ (5,68) (BETA(I), I=1,6)

68 FORMAT (6 F8.2)

CALL CONOBS (IR, B, QC, A, N)

NR=N\*IR

CALL ESALON (QC, N, NR)

DO 19 J=1, NR

IF (QC(N,J)) 29,19,29

19 CONTINUE

WRITE (6, 315) “THE SYSTEM IS NOT COMPLETELY CONTROLLABLE”

GO TO 1500

29 IC=(J-1)/IR

WRITE (6, 70) “MATRIX QC”, ((QC (I,J), J=1,NR), I=1,N)

70 FORMAT (20X, A30,15 (1X,F5.2))

CALL TRAM(A,AT,N,N)

CALL TRAM(C,CT,M,N)

CALL CONOBS (M,CT, QO, AT, N)

NM=N\*M

CALL ESALON (QO, N, NM)

DO 39 J=1,NM  
IF (QO(N,J)) 49,39,49

39 CONTINUE

WRITE (6, 315) “SYSTEM IS NOT COMPLETELY OBSERVABLE”

GO TO 1500

49 IO=(J-1)/M

WRITE (6, 90) “MATRIX QO” ,((QO(I,J), J=1, NM), I=1,N)

90 FORMAT (20X,A20 ,/10(3X, E 9.2))

DO 310 I=1,IR

DO 310 J=1,M

310 AK1 (I,J)=0

CALL ZADEH (A, N, AL)

CALL CQ (Q, N, AL)

K=1

NM=2\*N-K

CALL PRIM (RR, Q, N, NM, K)

CALL ESALON (RR, NM, NM)

IF (RR(NM, NM)) 311, 314, 311

311 WRITE (6, 315) “MATRIX A IS CYCLICAL”

DO 313 I=1,N

DO 313 J=1,N

313 A1(I,J)=A(I,J)

GO TO 399

314 WRITE (6, 315) “MATRIX A IS NOT CYCLICAL, WE APPLY THE DAVISON ALGORITHM”

315 FORMAT (A50)

K=2

320 NM=2\*N-K

CALL PRIM (RR, Q, N, NM, K)

CALL ESALON (RR, NM, NM)

IF (RR(NM, NM)) 316, 317, 316

317 IF (K-N+1) 318, 319, 319

318 K=K+1

GO TO 320

319 ID1=N

GO TO 321

316 ID1=K

321 MR=IR\*M

S=1.3

336 CALL HAZ (S, MR, AS)

DO 322 I=1,IR

DO 322 J=1,M

322 AK (I,J)=AS(J+(I-1)\*M)

CALL PROMAT (AK, C, AKC, IR, M, N)

CALL PROMAT (B, AKC, BAKC, N, IR, N)

DO 323 I=1,N

DO 323 J=1,N

323 Y(I,J)=A(I,J)+BAKC(I,J)

CALL ZADEH (Y,N, AL)

CALL CQ (Q, N, AL)

K=1

NM=2\*N-K

CALL PRIM (RR, Q, N, NM, K)

CALL ESALON (RR, NM, NM)

IF (RR(NM, NM)) 324, 325, 324

325 WRITE (6, 315) “MATRIX Y IS NOT CYCLICAL”

K=2

331 NM=2\*N-K

CALL PRIM (RR, Q, N, NM, K)

CALL ESALON (RR, NM, NM)

IF (RR(NM, NM)) 327, 328, 327

328 IF (K-N+1) 329, 330, 330

329 K=K+1

GO TO 331

330 ID2=N

GO TO 332

327 ID2=K

332 IF (ID2-ID1) 333, 338, 338

333 ID1=ID2

DO 335 I=1,N

DO 335 J=1,N

335 A (I,J)=Y (I,J)

DO 337 I=1, IR

DO 337 J=1,M

337 AK1 (I,J)=AK1 (I,J)+AK (I,J)

GO TO 334

338 DO 339 I=1,N

DO 339 J=1,N

339 A (I,J)=Y (I,J)-BAKC (I,J)

334 S=S+1.

GO TO 336

324 WRITE (6, 315) “Y HAS BECOME CYCLICAL”

DO 341 I=1,N

DO 341 J=1, N

341 A1 (I,J)=Y(I,J)

DO 342 I=1, IR

DO 342 J=1, M

342 AK1 (I,J)=AK1 (I,J)+AK (I,J)

399 CALL ZADEH (A1, N, AL1)

K=1

S=1.7

405 CALL HAZ (S, M, ETA)

CALL TRAM (A1, A1T, N, N)

CALL PROMAT (CT, ETA, G, N, M, 1)

CALL CONOBS (1, G, QO, A1T, N)

CALL ESALON (QO, N, N)

IF (QO(N,N)) 401, 402, 401

402 IF (K-10) 403, 404, 404

403 K=K+1

S=S+1.

GO TO 405

404 WRITE (6, 315) “G COULD NOT BE FOUND”

GO TO 1500

401 K=1

S=S+1.3

410 CALL HAZ (S, IR, H)

CALL PROMAT (B, H, T, N, IR, 1)

CALL CONOBS (1, T, QC, A1, N)

CALL ESALON (QC, N, N)

IF (QC (N,N)) 406, 407, 406

407 IF (K-10) 408,409, 409

408 K=K+1

S=S+1.

GO TO 410

409 WRITE (6,315) “T COULD NOT BE FOUND”

GO TO 1500

406 IF (IC-IO) 11, 13, 12

13 IF (IR-M) 11, 11, 12

11 L=IC

WRITE (6, 60) “THE NUMBER OF INTEGRATORS”, L , “L=IC”

60 FORMAT (20X,A30, I2, A5,10X)

GO TO 1

12 L=IO

WRITE (6, 80) “THE NUMBER OF INTEGRATORS”, L, “L=IO”

80 FORMAT (20X,A30, I2, A5,10X)

GO TO 2

1 DO 100 J=1,N

100 P(1,J)=G (J)

DO 200 I=2,N

DO 200 J=1,N

S=0.

DO 300 K=1, N

300 S=S+P(I-1,K)\* A1 (K, J)

200 P (I, J) = S+AL1 (N-I+2) \* G (J)

CALL PROMAT (P, B, CL, N, N, IR)

IL=N+L

JC=L+(L+1)\*IR

DO 101 I=1,IL

DO 101 J=1,JC

101 E(I,J)=0

DO 201 J=1,L

E (J,J)=1

DO 201 K=1,N

201 E (J+K, J) = AL1 (N-K+1)

DO 301 I=1,N

DO 301 J=1,IR

E (L+I, L+J) = CL (I,J)

DO 301 K=1,L

301 E(L-K+I, L+K\*IR+J) = CL (I, J)

DO 102 I=1,N

102 D(I)= BETA (L+N-I+1) - AL1 (N-I+1)

DO 103 I=1,L

103 D (N+I) = BETA (L-I+1)

CALL PS (E, IL, JC, PSE)

CALL PROMAT (PSE, D, X, JC, IL, 1)

I1=IR+L

J1=M+L

DO 41 I=1,I1

DO 41 J=1,J1

CK2 (I,J)=0

41 CK1 (I,J)=0

DO 42 I=1,IR

DO 42 J=1,M

CK2(I,J)=-ETA(J)\* X(L+I+L\*IR)

42 CK1 (I,J)=AK1 (I,J)

DO 43 I=1,IR

DO 43 J=1,L

43 CK2 (I, M+J)=-X(L+I+(L-J)\*IR)+X(J)\*X(L+L\*IR+I)

DO 44 J=1,M

44 CK2 (IR+1,J)=ETA (J)

DO 45 J=1,L

45 CK2 (IR+1, M+J)=-X(J)

L1=L-1

IF (L1) 51, 51, 50

50 DO 46 J=1, L1

46 CK2 (J+IR+1, M+J)=1.

51 DO 47 I=1,I1

DO 47 J=1,J1

47 CK (I,J)=CK1 (I, J)+CK2 (I, J)

PRINT 59, “MATRIX K”, CK

59 FORMAT (//20X, A20,// (3E13.6))

GO TO 500

2 DO 111 J=1,N

111 R (1,J)=T (J)

DO 112 I=2,N

DO 112 J=1,N

S=0.

DO 113 K=1,N

113 S=S+R(I-1,K)\*A1 (J,K)

112 R(I, J)=S+AL1(N-I+2)\*T(J)

CALL PROMAT (R, CT, OL, N, N, M)

IL=N+L

JC=L+(L+1)\*M

DO 121 I=1,IL

DO 121 J=1,JC

121 F(I,J)=0

DO 122 J=1,L

F(I,J)=1

DO 122 K=1,N

122 F(J+K,J)=AL1 (N-K+1)

DO 123 I=1,N

DO 123 J=1,M

F(L+I, L+J)=OL(I, J)

DO 123 K=1,L

123 F(L-K+I, L+K\*M+J)=OL(I,J)

DO 124 I=1,N

124 D(I)=BETA(L+N-I+1)-AL1(N-I+1)

DO 125 I=1,L

125 D(N+I)=BETA(L-I+1)

CALL PS (F, IL, JC, PSF)

CALL PROMAT (PSF, D, X, JC, IL,1)

I1=IR+L

J1=M+L

DO 141 I=1,I1

DO 141 J=1,J1

OK2 (I,J)=0

141 OK1 (I,J)=0

DO 142 I=1,IR

DO 142 J=1,M

OK1(I,J)=AK1(I,J)

142 OK2(I, J)=-H(I)\*X(L+L\*M+J)

DO 143 I=1,L

DO 143 J=1,M

143 OK2 (I, J)=-X(L+J+(L-I)\*M)+X(I)\*X(L+L\*M+J)

DO 144 I=1,IR

144 OK2(I, M+1)=H(I)

DO 145 J=1,L

145 OK2 (IR+1, M+J)=-X(J)

L1=L-1

IF (L1) 61, 61, 62

62 DO 146 J=1,L1

146 OK2 (J+IR+1, J+M)=1.

61 DO 147 I=1,I1

DO 147 J=1,J1

147 OK(I,J)=OK1(I,J)+OK2(I,J)

PRINT 59,OK

500 I2=N+L

WRITE (6,315) “INPUT MATRIX A (N,N) AGAIN”

READ (5,58) ((A(I,J), I=1,N), J=1,N)

N1=N+1

IR1=IR+1

M1=M+1

DO 130 I=1,I2

DO 130 J=1,I2

130 AE (I,J)=0

DO 131 I=1,N

DO 131 J=1,N

131 AE (I,J)=A(I,J)

DO 132 I=1,I2

DO 132 J=1,I1

132 BE (I,J)=0

DO 133 I=1,N

DO 133 J=1,IR

133 BE (I,J)=B(I,J)

DO 134 I=1,L

134 BE (N+I, IR+I)=1

DO 135 I=1,J1

DO 135 J=1,I2

135 CE (I, J)=0

DO 136 I=1,M

DO 136 J=1,N

136 CE (I,J)= C(I,J)

DO 137 I=1,L

137 CE (M+I, N+I)=1.

IF (IC-IO) 139, 160, 140

160 IF (IR-M) 139, 139, 140

139 CALL PROMAT (BE, CK, BE1, I2, I1, J1)

GO TO 150

140 CALL PROMAT (BE, OK, BE1, I2, I1, J1)

150 CALL PROMAT (BE1, CE, CE1, I2, J1, J2)

DO 138 I=1,I2

DO 138 J=1,I2

138 A2(I,J)= AE(I,J) +CE1(I,J)

CALL ZADEH (A2, I2, ALFA2)

WRITE (6, 600) “ALGORITHM CHECK”

600 FORMAT (20X)

WRITE (6,180) “BETA ( )=“ , (I, BETA (I), I=1,I2), “ALFA2( )=“, ( I, ALFA2 (I), I=1,I2)

180 FORMAT (20X,A10,I2,F8.2, 10X,A10,I2,F8.2)

1500 STOP

END