Warning: Subroutine EC06 performs functions which are adequately treated by routines in other standard subroutine libraries (for example, LAPACK). The use of this routine is not recommended, and it may be removed from future releases of this library.

1 SUMMARY

Given a **complex Hermitian matrix** $\mathbf{a}=\{a_{ij}\}_{n\times n}$, where $a_{ij}=\bar{a}_{ji}$, finds **all its eigenvalues** λ_i and **eigenvectors** $\mathbf{x}_i$, i.e. finds the non-trivial solutions of $\mathbf{Ax}=\lambda\mathbf{x}$. The eigenvectors are normalized to have unit length.

The matrix is reduced to tri-diagonal form by Householder orthogonal transformations and the reduced eigen-problem solved by EC08 using the QR method.

ATTRIBUTES — **Version:** 1.0.0. **Types:** EC06C; EC06CD. **Calls:** EC08, ME08. **Language:** EC06CD uses COMPLEX*16 **Original date:** September 1971. **Origin:** S.Marlow, Harwell.

2 HOW TO USE THE PACKAGE

2.1 Argument list

The single precision version

```
CALL EC06C(A,VALUE,X,M,IA,IX,W)
```

The double precision version

```
CALL EC06CD(A,VALUE,X,M,IA,IX,W)
```

A is a COMPLEX (COMPLEX*16 in the D version) (see §2.2) two-dimensional array with first dimension IA. The user must store the lower triangle of the matrix **A** into the lower triangle of the array A, i.e. put a_{ij} into A(i,j) for $i\geq j$. The space above the diagonal of the array A, is used by the subroutine as work space, the lower triangle set by the user will remain unchanged on return.

VALUE is a REAL (DOUBLE PRECISION in the D version) array in which the subroutine puts the eigenvalues λ_i, i=1,2,...,m. These are not necessarily in order.

X is a COMPLEX (COMPLEX*16 in the D version) (see §2.2) two-dimensional array with first dimension IX, containing the eigenvectors. The components of the eigenvector $\mathbf{x}_i$ corresponding to the eigenvalue λ_i (in VALUE(i)) are placed in X(j,i), j=1,2,...,M. The eigenvectors are normalized so that $\mathbf{x}_i^T\bar{\mathbf{x}}_i=1$ for i=1,2,...,m.

M is an INTEGER variable and should be set to m the order of the matrix.

IA is an INTEGER variable set to the first dimension of the array **A**, i.e. if the allocation for the array A was specified by

```
REAL A(1OO,50)
```

then it would be set to 100.

IX is an INTEGER variable set to the first dimension of the two-dimensional array X.

W is a COMPLEX (COMPLEX*16 in the D version) (see §2.2) array used by the subroutine for work space. It must have dimension at least 5m.

2.2 The COMPLEX argument types

To conform to the Fortran 77 standard the array arguments listed as COMPLEX (COMPLEX*16 in the D version) in §2.1 should strictly be REAL (DOUBLE PRECISION in the D version) arrays with an extra first dimension of 2, e.g.

```
REAL A(2,10,10),X(2,8,8),W(2,50)
REAL VALUE(10)
 -  -  -
CALL EC06C(A,VALUE,X,5,10,8,W)
```

Most implementations of Fortran allow such arguments to be passed in the more convenient form of COMPLEX (COMPLEX*16 in the D version).

3 GENERAL INFORMATION

Use of common: None.

Workspace: None.

Other routines called directly: EC08C/CD, ME08A/AD are called

Input/output: None.

Portability: EC06CD uses COMPLEX*16 facility.

4 METHOD

Householder reduction to tri-diagonal form is performed by ME08A/AD and the eigenvalue problem for the then reduced matrix is solved by EC08C/CD using the QR algorithm.