

# NAG Library Routine Document

## F06ZAF (ZGEMM)

**Note:** before using this routine, please read the Users' Note for your implementation to check the interpretation of *bold italicised* terms and other implementation-dependent details.

### 1 Purpose

F06ZAF (ZGEMM) performs one of the matrix-matrix operations

$$\begin{aligned} C &\leftarrow \alpha AB + \beta C, & C &\leftarrow \alpha A^T B + \beta C, & C &\leftarrow \alpha A^H B + \beta C, \\ C &\leftarrow \alpha AB^T + \beta C, & C &\leftarrow \alpha A^T B^T + \beta C, & C &\leftarrow \alpha A^H B^T + \beta C, \\ C &\leftarrow \alpha AB^H + \beta C, & C &\leftarrow \alpha A^T B^H + \beta C & \text{or} & C &\leftarrow \alpha A^H B^H + \beta C, \end{aligned}$$

where  $A$ ,  $B$  and  $C$  are complex matrices, and  $\alpha$  and  $\beta$  are complex scalars;  $C$  is always  $m$  by  $n$ .

### 2 Specification

SUBROUTINE F06ZAF (TRANSA, TRANSB, M, N, K, ALPHA, A, LDA, B, LDB, BETA, C, &  
LDC)

INTEGER M, N, K, LDA, LDB, LDC  
COMPLEX (KIND=nag\_wp) ALPHA, A(LDA,\*), B(LDB,\*), BETA, C(LDC,\*)  
CHARACTER(1) TRANSA, TRANSB

The routine may be called by its BLAS name *zgemm*.

### 3 Description

None.

### 4 References

None.

### 5 Parameters

1: TRANSA – CHARACTER(1) *Input*

*On entry:* specifies whether the operation involves  $A$ ,  $A^T$  or  $A^H$ .

TRANSA = 'N'  
The operation involves  $A$ .

TRANSA = 'T'  
The operation involves  $A^T$ .

TRANSA = 'C'  
The operation involves  $A^H$ .

*Constraint:* TRANSA = 'N', 'T' or 'C'.

2: TRANSB – CHARACTER(1) *Input*

*On entry:* specifies whether the operation involves  $B$ ,  $B^T$  or  $B^H$ .

TRANSB = 'N'  
The operation involves  $B$ .

TRANSB = 'T'

The operation involves  $B^T$ .

TRANSB = 'C'

The operation involves  $B^H$ .

*Constraint:* TRANSB = 'N', 'T' or 'C'.

- 3: M – INTEGER *Input*  
*On entry:*  $m$ , the number of rows of the matrix  $C$ ; the number of rows of  $A$  if TRANSA = 'N', or the number of columns of  $A$  if TRANSA = 'T' or 'C'.  
*Constraint:*  $M \geq 0$ .
- 4: N – INTEGER *Input*  
*On entry:*  $n$ , the number of columns of the matrix  $C$ ; the number of columns of  $B$  if TRANSB = 'N', or the number of rows of  $B$  if TRANSB = 'T' or 'C'.  
*Constraint:*  $N \geq 0$ .
- 5: K – INTEGER *Input*  
*On entry:*  $k$ , the number of columns of  $A$  if TRANSA = 'N', or the number of rows of  $A$  if TRANSA = 'T' or 'C'; the number of rows of  $B$  if TRANSB = 'N', or the number of columns of  $B$  if TRANSB = 'T' or 'C'.  
*Constraint:*  $K \geq 0$ .
- 6: ALPHA – COMPLEX (KIND=nag\_wp) *Input*  
*On entry:* the scalar  $\alpha$ .
- 7: A(LDA,\*) – COMPLEX (KIND=nag\_wp) array *Input*  
**Note:** the second dimension of the array  $A$  must be at least  $\max(1, K)$  if TRANSA = 'N' and at least  $\max(1, M)$  if TRANSA = 'T' or 'C'.  
*On entry:* the matrix  $A$ ;  $A$  is  $m$  by  $k$  if TRANSA = 'N', or  $k$  by  $m$  if TRANSA = 'T' or 'C'.
- 8: LDA – INTEGER *Input*  
*On entry:* the first dimension of the array  $A$  as declared in the (sub)program from which F06ZAF (ZGEMM) is called.  
*Constraints:*  
     if TRANSA = 'N',  $LDA \geq \max(1, M)$ ;  
     if TRANSA = 'T' or 'C',  $LDA \geq \max(1, K)$ .
- 9: B(LDB,\*) – COMPLEX (KIND=nag\_wp) array *Input*  
**Note:** the second dimension of the array  $B$  must be at least  $\max(1, N)$  if TRANSB = 'N' and at least  $\max(1, K)$  if TRANSB = 'T' or 'C'.  
*On entry:* the matrix  $B$ ;  $B$  is  $k$  by  $n$  if TRANSB = 'N', or  $n$  by  $k$  if TRANSB = 'T' or 'C'.
- 10: LDB – INTEGER *Input*  
*On entry:* the first dimension of the array  $B$  as declared in the (sub)program from which F06ZAF (ZGEMM) is called.  
*Constraints:*  
     if TRANSB = 'N',  $LDB \geq \max(1, K)$ ;  
     if TRANSB = 'T' or 'C',  $LDB \geq \max(1, N)$ .

- 11: BETA – COMPLEX (KIND=nag\_wp) *Input*  
*On entry:* the scalar  $\beta$ .
- 12: C(LDC,\*) – COMPLEX (KIND=nag\_wp) array *Input/Output*  
**Note:** the second dimension of the array C must be at least  $\max(1, N)$ .  
*On entry:* the  $m$  by  $n$  matrix  $C$ .  
If BETA = 0, C need not be set.  
*On exit:* the updated matrix  $C$ .
- 13: LDC – INTEGER *Input*  
*On entry:* the first dimension of the array C as declared in the (sub)program from which F06ZAF (ZGEMM) is called.  
*Constraint:*  $LDC \geq \max(1, M)$ .

## 6 Error Indicators and Warnings

None.

## 7 Accuracy

Not applicable.

## 8 Further Comments

None.

## 9 Example

None.

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