

# 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 Arguments

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 Parallelism and Performance

F06ZAF (ZGEMM) is threaded by NAG for parallel execution in multithreaded implementations of the NAG Library.

Please consult the X06 Chapter Introduction for information on how to control and interrogate the OpenMP environment used within this routine. Please also consult the Users' Note for your implementation for any additional implementation-specific information.

## 9 Further Comments

None.

## 10 Example

None.

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