FACULTY OF MECHANICAL ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA

SEMESTER 2-2009/2010

SME 1013 PROGRAMMING FOR ENGINEERS — **Test 2**
Date: 22 February 2010 — **Duration: 90 minutes**

1. List the order of the hierarchy of operations for the following Fortran assignment statements
   (a) `ROOT = (A + 2 * B + C) / D`
   (b) `R = SQRT(3 * T ** 2 + (M * G) ** 2)`
   (c) `X1 = ( -B + (B * B - 4 * A * C) ** 0.5)/(2 * A)`

   [6 marks]

2. Convert the following mathematical expressions into valid Fortran code:
   (a) $\sqrt{\frac{5x+25y}{25}}$
   (b) $e^{(\ln(r)+\theta)b}$
   (c) $b^2+c^2-2bc(\cos A)$
   (d) $\tan^{-1}\sqrt{\sin^2|a|}$

   [10 marks]

3. (a) An array was declared using the Fortran statement `REAL A(-4:10)`. What is the maximum number of value `A` can store?
   (b) Write a Fortran segment that will print out, ***column-by-column***, an array `B(5,10)`.

   [4 marks]

4. (a) A straight, light, uniform beam $0 < x < L$ is clamped horizontally. A concentrated load W is then applied at point $x = a$. The bending moment M at any point x along the length depends on the value of x relative to a and is dictated such that

   $$M = W(L-a)^2[aL - x(L+2a)]/L^3 \quad : \text{for} \quad 0 \le x \le a$$
   $$M = Wa^2[aL - 2L^2 + x(3L-2a)]/L^3 \quad : \text{for} \quad a \le x \le L$$

   Write a Fortran program segment to compute the bending moment every metre along a 12 m metre beam, with a concentrated load of 125 N at $x = 6.75$ m from the end $x = 0$.

   [6 marks]

   (b) A Fortran program is required to check whether a triangle is valid or otherwise, given all its three sides: `A`, `B` and `C`.
   i. Construct an `IF` structure using the condition *no two sides can be less than the third* to test for valid triangle.
   ii. If the three sides indicate a valid triangle, contruct an `IF ... ELSE ... ENDIF` block to determine the type (equilateral, isosceles or scalene) this triangle belongs to.

   [12 marks]

5. When two vectors, say $\boldsymbol{x}$ and $\boldsymbol{y}$, are perpendicular to each other they are said to be *orthogonal* i.e. when their dot product, defined thus

   $$\boldsymbol{x} \odot \boldsymbol{y} = \sum_{i=1}^{i=3} x_i y_i$$

   is zero (or very close to zero). Using arrays to store these vectors, write a Fortran program to check their orthogonality.

   [12 marks]