

## ME102 EXAM I (Sample Exam)

- (1) Solving the equation  $2x = 3x^2 - 2$  is equivalent to finding the root of
- (a)  $2x - 3x^2 - 2$
  - (b)  $-2x + 3x^2 - 2$
  - (c)  $2x + 3x^2 + 2$
  - (d)  $-2x - 3x^2 - 2$
  - (e)  $2x + 3x^2 - 2$
- (2) What is the decimal equivalent of the binary number 10011?
- (a) 11
  - (b) 12
  - (c) 19
  - (d) 22
  - (e) 25
- (3) What is the largest positive integer that can be represented with 4 bits?
- (a) 7
  - (b) 8
  - (c) 9
  - (d) 15
  - (e) 16
- (4) If a digital computer stores numbers in scientific notation with a fixed number of bits used to represent the mantissa, what term is used to refer to what occurs when the computer tries to store an irrational number like  $\pi$ ?
- (a) round off
  - (b) binary collapse
  - (c) subtractive cancellation
  - (d) overflow

Questions 5 and 6 deal with a function  $f(x)$  with the following known information:

$$f(2) = 1$$

$$f'(2) = -1$$

$$f''(2) = 2$$

- (5) What is the 0th order Taylor series approximation for  $f(0)$ ?
- (a) -2
  - (b) -1
  - (c) 0
  - (d) 1
  - (e) 2

- (6) What is the 1st order Taylor series approximation for  $f(3)$ ?
- (a) -1
  - (b) 0
  - (c) 1
  - (d) 2
  - (e) 3
- (7) What is the Taylor series remainder  $R$  for a 0th order approximation of  $f(3)$  relative to  $f(1)$  for  $f(x) = x^2 + 2$ ?
- (a) 3
  - (b) 5
  - (c) 7
  - (d) 8
  - (e) 11

Questions 8 and 9 deal with finite difference approximations for the derivative of the function  $f(x) = x^2 - 2$

- (8) Using a step size ( $h$ ) of 1, what is the centered difference approximation for  $f'(3)$ ?
- (a) 6
  - (b) 7
  - (c) 12
  - (d) 14
  - (e) 16
- (9) Using a step size ( $h$ ) of 1, what is the forward difference approximation for  $f'(3)$ ?
- (a) 6
  - (b) 7
  - (c) 12
  - (d) 14
  - (e) 16

Questions 10 through 13 deal with the following MathCAD code:

```
x := 2  
y := 3  
y := 2·x + y      z := y - 1  
a := x            x := 3  
b := 2·a          c := 1  
a := a - a  
d := if(5 > 6, 7, 8) - 2
```

Assume that the statements on the right are on the same lines as the statements to their left. Also, assume that all evaluations are performed beneath the last line of code.

- (10) x =  
(a) 0  
(b) 1  
(c) 2  
(d) 3  
(e) 4
- (11) y =  
(a) 3  
(b) 4  
(c) 5  
(d) 6  
(e) 7
- (12) z =  
(a) 2  
(b) 3  
(c) 4  
(d) 5  
(e) 6
- (13) d =  
(a) -2  
(b) 5  
(c) 6  
(d) 7  
(e) 8

- (14) What keystroke is used to create an "iterative (array)" subscript in MathCAD?
- (a) [
  - (b) ]
  - (c) ,
  - (d) ;
  - (e) .

For questions 15 through 17 select what MathCAD would display after the indicated keystrokes are entered. The word "SPACE" indicates that the spacebar is pressed once.

- (15)  $2*3^2-2 =$
- (a) 0
  - (b) 1
  - (c) 2
  - (d) 16
  - (e) 34
- (16)  $2*3 \text{ SPACE } ^2-2 =$
- (a) 0
  - (b) 1
  - (c) 2
  - (d) 16
  - (e) 34
- (17)  $\sin(45) =$
- (a) 1.000
  - (b) 0.851
  - (c) 0.806
  - (d) 0.707
  - (e) 0.5

Questions 18 through 20 deal with the following MathCAD code:

$$i := 2, 3..5 \quad j := -1..1$$

$$x := \sum_i i$$

$$y := \sum_i (i - 1)$$

$$z := \sum_j 2$$

(18) What would x equal?

- (a) 7
- (b) 10
- (c) 11
- (d) 12
- (e) 14

(19) What would y equal?

- (a) 5
- (b) 7
- (c) 8
- (d) 10
- (e) 13

(20) What would z equal?

- (a) 0
- (b) 1
- (c) 2
- (d) 4
- (e) 6

Questions 21 and 22 deal with the following MathCAD statement:

$$V := (1 \ 2 \ 3)$$

(21) Which expression below would evaluate to the value 1?

- (a)  $V_{1,0}$
- (b)  $V_{1,2}$
- (c)  $V_{0,1}$
- (d)  $V_{1,1}$
- (e)  $V_{0,0}$

(22) Which expression below would evaluate to the value 3?

- (a)  $V_{2,0}$
- (b)  $V_{3,1}$
- (c)  $V_{1,3}$
- (d)  $V_{1,2}$
- (e)  $V_{0,2}$

(23) If the MathCAD function  $\text{root}(f(x), x)$  returns a value, the value is

- (a) the exact root of  $f(x)$  closest to initial guess  $x$
- (b) the exact root of  $f(x)$  that may or may not be closest to the initial guess  $x$
- (c) an approximate value for the root of  $f(x)$  closest to the initial guess  $x$
- (d) an approximate value for a root of  $f(x)$  that may or may not be closest to the initial guess  $x$

(24) Given the MathCAD variable definition:

$$v := \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$

what would polyroots(v) return?

- (a) -2
- (b) -1/2
- (c) 0
- (d) 1/2
- (e) 2

Questions 25 through 28 deal with using the bisection method to find the root of

$$f(x) = x - 1$$

with a starting interval of  $x_l = 0$  to  $x_u = 3$

(25) What is the root estimate in the first iteration?

- (a) 0
- (b) 1
- (c) 1.5
- (d) 2
- (e) 3

(26) What should be used for  $x_t$  in the true percent relative error formula?

- (a) 0
- (b) 1
- (c) 1.5
- (d) 2
- (e) 3

(27) What is the root estimate in the 2nd iteration?

- (a) 0
- (b) 0.75
- (c) 1
- (d) 2.25
- (e) 2.50

(28) What is the magnitude of the true percent relative error in the first iteration?

- (a) 0%
- (b) 25%
- (c) 33%
- (d) 50%
- (e) 100%

- (29) The function  $f(x) = x(x+1)(x-2)(x+1)$  has a multiple root at:
- (a) 0
  - (b) 1
  - (c) 2
  - (d) -1
  - (e) -2
- (30) If the Newton-Raphson method is used to find the root of the function  $f(x) = 2x - 1$ , and if the initial guess is -5, what will the root estimate be after the first iteration?
- (a) 0
  - (b)  $1/2$
  - (c)  $-1/2$
  - (d) 1
  - (e) -1