Faculty of Information and Communication Technology

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Signature

MODULE NAME: Discrete Structures/History of computing and info models

MODULE CODE:

DCT115D/	DCTF15D/	HSP115D

Campus:

Assignment 4 **Unit4** **Due Date**: 24 Nov '21 **Total Marks**: 45 **Total pages**: 6 pages	**Examiners**: L Cronjé

Student number

Surname:	**Initials**:	Mark:

Instructions:

- Answer ALL questions.
- Use the spaces provided to answer each question.
- Make sure that your name is on the doc
- When submitting, please use your student number with the post-fix "A4" for your file name E.g 987654321**A4**.pdf
- Please submit on myTUTor (unless you receive different instructions from your lecturer)
- Please submit in pdf format

Question 1 Unit4.1 [15]

1. Write the following in the form $a = qd + r$, where $0 \leq r < d$
   a. $a = 23; d = 4$ (2)

   b. $a = -83; d = 6$ (3)

2. Calculate the following:
   a. $166\ div\ 14$ (1)

   b. $561\ mod\ 34$ (1)

3. Make use of corollary8.4.4 Epp p529 to calculate:
   a. $(850 \cdot 327)\ mod\ 21$ (3)

b. $421^6 \ mod \ 131$ (5)

Question 2 Unit4.2 [10]

1. Fill in the missing parts of the following algorithm segment: (5)

ALGORITHM 4 Computing div and mod.

procedure *division algorithm*(a: integer, d: positive integer)
$q := 0$
$r := |a|$
while _____
    $r :=$ _____
    $q :=$ _____
if $a < 0$ and $r > 0$ **then**
    $r :=$ _____
    $q :=$ _____
return (q, r) {$q = a$ **div** d is the quotient, $r = a$ **mod** d is the remainder}

2. Find and correct the mistakes in the following algorithm segment: (5)

ALGORITHM 4 Computing div and mod.

procedure *division algorithm*(a: integer, d: positive integer)
$q := 0$
$r := a$
while $r > d$
    $r := r - d$
    $q := q - 1$
if $a < 0$ and $r \geq 0$ **then**
    $r := d + r$
    $q := -(q + 1)$
return (q, r) {$q = a$ **div** d is the quotient, $r = a$ **mod** d is the remainder}

Question 3 Unit4.3 [10]

1. Find the prime factors of 2520 (3)

2. Using prime factorisation, find the greatest common divisor (GCD) of 252 and 468 (3)

3. Fill in the missing parts of the following algorithm segment: (4)

ALGORITHM 1 The Euclidean Algorithm.

procedure *gcd*(a, b: positive integers)
$x := a$
$y := b$
while _____
    $r :=$ _____
    $x :=$ _____
    $y :=$ _____
return x {gcd(a, b) is x}

Question 4 Unit4.4 [10]

1. State whether the following is true or false and give a reason for each
    a. $2 \equiv 22 (\mathrm{mod}\, 3)$ (2)

    b. $302 \equiv 262 (\mathrm{mod}\, 10)$ (2)

    c. $-40 \equiv 10 (\mathrm{mod}\, 3)$ (3)

2. If a Caesar cipher is given as: $C = (M + 4)\ mod\ 26$
    a. What will be the decrypting formula? (1)

    b. Decrypt the following message using the above-mentioned Caesar cipher: WSQIALIVI SZIV XLI VEMRFSA (2)