FACULTY OF SCIENCE AND ENGINEERING

ASSESSMENT COURSEWORK 2016/17

Manchester Metropolitan University

UNIT CODE: 6G4Z1102	**UNIT DESC:** Computer Systems Fundamentals	
ASSESSMENT ID: 1CWK50	**ASSESSMENT NAME**: coursework 50%	**WEIGHT FACTOR:** 50%

Tasks for this coursework:

- Answer all 7 questions.
- The marks awarded for each question are shown in square brackets.
- To obtain full marks **ALL** working must be shown. The report structure and presentation will also be marked.
- You must attach a completed 'Assessment Cover Sheet' to your coursework when you submit it. The Assessment Cover Sheet can be downloaded from:

  http://coursework.mmu.ac.uk

- The hand-out date is the beginning week of 5th December 2016. This coursework must be completed and submitted by 16th January 2017.

- **Your mark will be scaled down by a maximum of 10% if sufficient presentation effort has not been made in your submitted coursework.**

NAME OF STAFF SETTING ASSIGNMENT: Dr Tariq Jarad & Frank Bierbrauer

1. Given that $U = \{1, 2, 3, ..., 10\}$ is the universal set, $A = \{x : x \in N, x \text{ is odd number}\}$ $B = \{x : x \in N, x \text{ is square number}\}$ and $C = \{x : x \in N, 2 \le x < 5\}$, find the following:

   a) $|A|, |A \cap B|, |C|$; **[4]**

   b) $P(B)$; **[3]**

   c) $C', B \times C, A \cap C, C \setminus B.$ **[8]**

[15 marks for this question]

2.

   a) Draw a Venn diagram to represent the following sets: **[6]**

   $F = \{x : x \in N, x \text{ is prime number}, 0 \le x \le 15\}$;
   $G = \{x : x \in N, x \text{ is multiple of } 3, 1 \le x \le 20\}$;
   $H = \{x : x \in N, x \text{ is factor of } 36\}$.

   b) Use a Venn diagram to illustrate the following: **[4]**

   (i) $(A \cap B) \cap C'$;
   (ii) $(B \cup C) \setminus A'$.

[10 marks for this question]

3. For the three vectors $\mathbf{a} = 2\hat{i} - 3\hat{j} - \hat{k}$, $\mathbf{b} = \hat{i} - 2\hat{j} - \hat{k}$ and $\mathbf{c} = \hat{i} - \hat{j} - \hat{k}$:

   a) calculate $\mathbf{a} + 2\mathbf{c}$; **[3]**

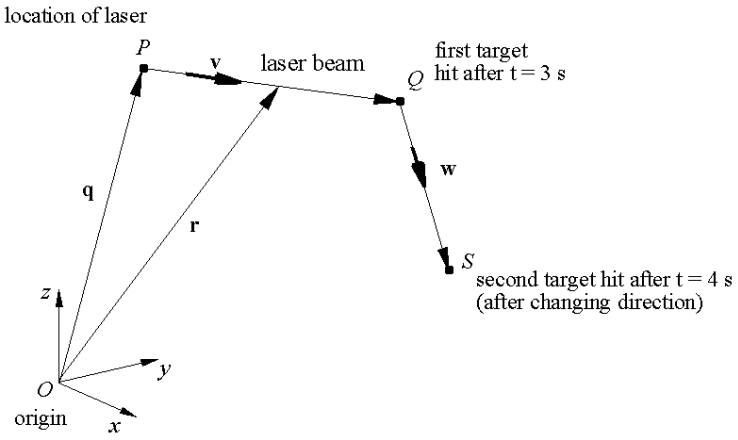
   b) the unit vector in the direction of $\mathbf{c}$; **[3]**

   c) calculate $\mathbf{a} \cdot \mathbf{c}$ and find the angle between the two vectors; **[5]**

   d) calculate $\mathbf{a} \times \mathbf{b}$. **[4]**

[15 marks for this question]

4. In a computer game, a laser gun is fired from a point given by the position vector $\mathbf{q} = (10, -10, 20)$ in the direction given by $\mathbf{v} = (20, -30, 10)$. Calculate:



a) the coordinates of the point where the laser hits a target after time $t = 3$; **[5]**

b) if the laser changes direction after hitting the first target along the vector $\mathbf{w} = (5, 10, 30)$ to hit another target after $t = 4$, what is the total distance travelled by the laser. **[5]**

[10 marks for this question]

5. You are given the following matrices:

$$U = \begin{pmatrix} 1 & 3 & 1 \\ 0 & 2 & -1 \\ 3 & -2 & 5 \end{pmatrix} \quad V = \begin{pmatrix} -1 & 5 & 2 \\ 0 & 3 & 1 \end{pmatrix} \quad W = \begin{pmatrix} 2 & -1 \\ 3 & 5 \end{pmatrix} \quad Z = \begin{pmatrix} 3 & -2 & 0 \\ -1 & 4 & 2 \end{pmatrix}.$$

a) Write down matrix elements $u_{31}, u_{21}, v_{32}, v_{12}, w_{22}$ and z_{33} if possible. Explain why if not possible. **[6]**

b) Calculate the following if possible and explain why if not possible:

(i) $V + W$; **[2]**

(ii) $V - Z$; **[3]**

(iii) UV^T; **[6]**

(iv) WZ. **[4]**

c) If a point (3, 1) is reflected about the line $y = (\tan\theta)x$ with $\theta = 120^\circ$, find the reflection line and the reflection point. **[4]**

[25 marks for this question]

6. For the three functions $h: R \to R,\ h(x) = 2x - 1,\ \ u: R \to R,\ u(x) = \frac{x}{2} - 1$ and $v: R \to R, f(x) = x^2 + 3$, where R is the set of the real numbers:

a) write down the composite functions $v \circ h$ and $v \circ u$; **[5]**

b) find the values of the composite function $v \circ h$, for $x = -1, 0, 2$. **[5]**

[10 marks for this question]

7. Given the relation below, defined on $R \to R$, where R is the set of the real numbers:

$$b(x) = \frac{2(x+1)}{x-1}.$$

a) explain when b is a function and write down the three values of $b(x)$, for $x = 0, 2, 3$, using the ordered pair representation; **[5]**

b) if the relation is a function, state whether it is a total or partial function, and classify it as an injection, surjection, bijection or a combination of these; **[4]**

c) find the inverse relation $b^{-1}: R \to R$ and determine the domain and the range that make the relation a function; **[4]**

d) explain why the values $b(1)$ and $b^{-1}(2)$ are not valid for these functions. **[2]**

[15 marks for this question]

[Total:100]