University of Ruhuna- Faculty of Technology

Bachelor of Engineering Technology and Information & Communication Technology
Level 1 (Semester 1) Examination, July 2017

Course Unit: TMS 1113 Foundation of Mathematics
Time Allowed 3 hours

Answer all Six (06) questions. Calculators are allowed to use for calculations.

All symbols have their usual meaning
[Any common values Ex: Acceleration of gravity, $g = 9.8\ ms^{-2}$]

1. All questions have only one correct answer. Underline the correct answer.

1.1. The relationship between the temperature in degrees Fahrenheit (F) and the temperature in degrees Celsius (C) is given by following equation:

$F = {}^{9}/_{5}\,C + 32$. Then 135 ^{0}F is equivalent to:

(a) 43 ^{0}C (b) 57.2 ^{0}C (c) 185.4 ^{0}C (d) 184 ^{0}C

1.2. $1\frac{1}{3} + 1\frac{2}{3} \div 2\frac{2}{3} - \frac{1}{3}$ is equal to:

(a) $1\frac{5}{8}$ (b) $\frac{19}{24}$ (c) $2\frac{1}{21}$ (d) $1\frac{2}{7}$

1.3. The solution of the inequality

$$\frac{3t+2}{t+1} \leq 1 \text{ is:}$$

(a) $t \geq -2\frac{1}{2}$ (b) $-1 < t \leq \frac{1}{2}$ (c) $t \leq -\frac{1}{2}$ (d) $-\frac{1}{2} < t \leq 1$

1.4. $(\sqrt{x})(y^{3/2})(x^2y)$ is equal to:

(a) $\sqrt{xy^5}$ (b) $x^{\sqrt{2}}y^{5/2}$ (c) $xy^{5/2}$ (d) $x\sqrt{y^3}$

1.5. The second moment of area of a rectangle through its centroid is given by $\frac{bl^3}{12}$. The approximate percentage change in the second moment of area if b is increased by 3% and l is reduced by 2% is:

(a) − 6% (b) +1% (c) +3% (d) −3%

1.6. A pendulum of length 1.2 m swings through an angle of 12^0 in a single swing. The length of arc traced by the pendulum bob is:

(a) 14.40 cm (b) 25.13 m (c) 14.40 m (d) 45.24 m

1.7. In the range $0° \leq \theta \leq 360°$ the solutions of the trigonometrical equation $9\tan^2\theta - 12\tan\theta + 4 = 0$ are:

(a) 33.69°, 146.31°, 213.69° and 326.31°

(b) 33.69°, and 213.69°

(c) 146.31° and 213.69°

(d) 146.69° and 326.31°

1.8. If $A = \begin{pmatrix} -3 & 0 \\ 7 & -4 \end{pmatrix}$ *and* $B = \begin{pmatrix} 2 & -1 \\ -7 & 4 \end{pmatrix}$. Find 2A – 3B.

(a) $\begin{pmatrix} 0 & 3 \\ 35 & -20 \end{pmatrix}$ (b) $\begin{pmatrix} 0 & -3 \\ -35 & 20 \end{pmatrix}$

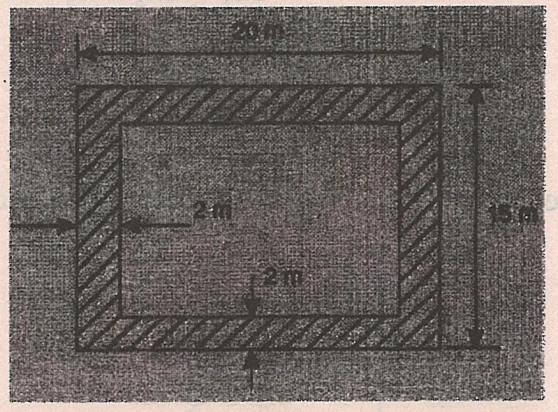
(c) $\begin{pmatrix} -12 & 3 \\ 35 & -20 \end{pmatrix}$ (d) $\begin{pmatrix} 12 & 0 \\ 35 & -20 \end{pmatrix}$

1.9. If $\cos A = \frac{12}{13}$, then sin A is equal to:

(a) $\frac{5}{13}$ (b) $\frac{13}{12}$ (c) $\frac{5}{12}$ (d) $\frac{12}{5}$

1.10. The area of the path shown shaded in following figure is:

(a) 300 m^2 (b) 234 m^2 (c) 124 m^2 (d) 66 m^2



(10 Marks)

2.

2.1 Compute the determinant of the matrix A shown below.

$$A = \begin{pmatrix} 2 & -1 & 3 \\ 4 & 6 & 1 \\ -5 & 2 & 1 \end{pmatrix}$$

2.2 For the matrices B and C shown below, compute D = B – C.

$$B = \begin{pmatrix} 2 & 7 & -5 \\ -2 & 1 & 0 \\ 6 & 3 & 4 \end{pmatrix} \quad C = \begin{pmatrix} 3 & 1 & -4 \\ 4 & 3 & 1 \\ 1 & 4 & -3 \end{pmatrix}$$

2.3 Compute G = EF for the matrices shown in below.

$$E = \begin{pmatrix} 1 & 0 & 3 \\ 2 & 1 & 2 \\ 1 & 3 & 1 \end{pmatrix} \quad F = \begin{pmatrix} 2 & 2 & 0 \\ 1 & 3 & 2 \\ 3 & 2 & 0 \end{pmatrix}$$

2.4 Compute the inverse of following matrix H.

$$H = \begin{pmatrix} 1 & 2 & -1 \\ -1 & 1 & 3 \\ 3 & 2 & 1 \end{pmatrix}$$

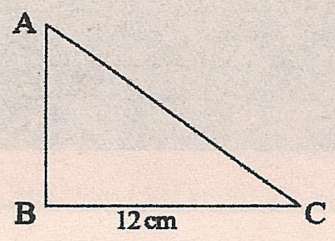
2.5 Using the above (Q.2.4) calculated inverse matrix (H^{-1}) solve the following sets of equations.

$$2x_1 + 4x_2 - 2x_3 = -16$$
$$-x_1 + x_2 + 3x_3 = 7$$
$$3x_1 + 2x_2 + x_3 = 4$$

(18 Marks)

3.

3.1 Find the length of *AC* and *AB* when angle A = $\pi/3$ and angle B = $\pi/2$.



3.2 Two ships leave a port at the same time. One travels due west at 18.4 km/h and the other due south at 27.6 km/h. Calculate how far apart the two ships are after 4 hours.

3.3 Perform the following calculations

1. 27° 34 ' + 26° 52 '
2. 72° - 15° 18 '

3.4 The angle of depression of a ship viewed at a particular instant from the top of a 75 m vertical cliff is 30°. Find the distance of the ship from the base of the cliff at this instant. The ship is sailing away from the cliff at constant speed and 1 minute later its angle of depression from the top of the cliff is 20°. Determine the speed of the ship in km/h.

3.5 Show that the following equation is correct.

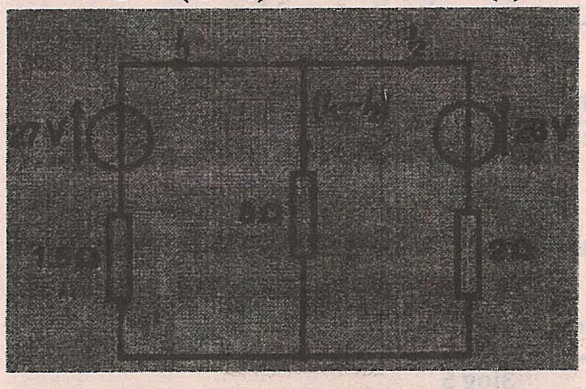
$$\frac{\cos(45 - \theta)}{\cos 45 . \cos \theta} - \tan \theta = 1$$

(18 Marks)

4.

4.1 When Kirchhoff's laws are applied to the electrical circuit shown in following figure the currents I_1 and I_2 are connected by the equations:

$$27 = 1.5I_1 + 8(I_1 - I_2) \quad (1)$$
$$-26 = 2I_2 - 8(I_1 - I_2) \quad (2)\ .$$



Solve the equations to find the values of currents I_1 and I_2.

4.2. Given that: $\frac{D}{d} = \sqrt{\frac{f+p}{f-p}}$ Express p in terms *of* D, d and f.

4.3. The roots of quadratic equation are 1/3 and −2. Determine the equation.

4.4 Solve by using the quadratic formula.

(a) $x^2 + 2x - 8 = 0$

(b) $3x^2 - 11x - 4 = 0$.

4.5 The height "s" meters of a mass projected vertically upward at time "t" seconds is

$$s = ut - \frac{1}{2}gt^2$$

Determine how long the mass will take after being projected to reach a height of 16 m,

(a) on the ascent

(b) on the descent,

when $u = 30$ m/s and $g = 9.81$ m/s^2.

(18 Marks)

5.

5.1 (a) Multiply $3x - 2y^2 + 4xy$ by $2x - 5y$

(b) Divide $4a^3 - 6a^2b + 5b^3$ by $2a - b$

5.2 Simply the followings:

(a) $\frac{x^2y}{xy^2-xy}$ (b) $(p^3)^{1/2}(q^2)^4$

(c) $\frac{(mn^2)^3}{(m^{1/2}n^{1/4})^4}$ (d) $\frac{(x^2y^{1/2})(\sqrt{x}\ \sqrt[3]{y^2})}{(x^5y^3)^{1/2}}$

5.3 Evaluate the followings:

(a) $\frac{\log 25 - \log 125 + \frac{1}{2}\log 625}{3\log 5}$

(b) If $\text{Log}_{10}\, 2 = 0.3010$; $\text{Log}_{10}\, 3 = 0.4771$, find the value of x ; $2^{3x+1} = 3^{2x-5}$

(c) $\frac{\ln e^{2.5}}{\log 10^{0.5}}$

5.4 The resistance R of an electrical conductor at temperature θ^0C is given by $R = R_0 e^{\alpha\theta}$, where α is a constant and $R_0 = 5\times10^3\ \Omega$.

(a) Determine the value of α, correct to 4 significant figures, when $R = 6\times10^3\ \Omega$ and $\theta = 1500\ ^0$C.

(b)Also, find the temperature, correct to the nearest degree, when the resistance R is $5.4\times10^3\ \Omega$.

(18 Marks)

6.

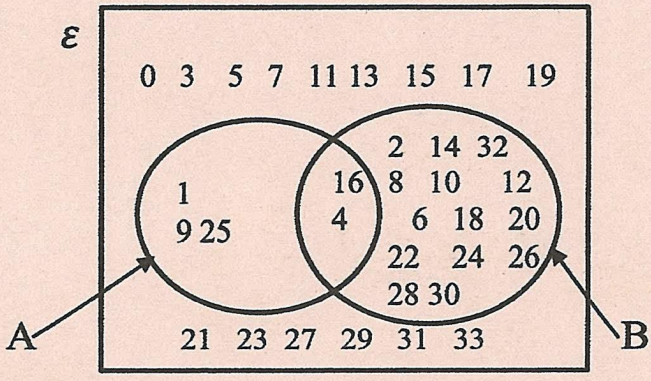
6.1 A force of 6 N is included at an angle of 45^0 to a second force of 9 N, both forces acting at a point. Find the magnitude of the resultant of these two forces and the direction of the resultant with respect to the 9 N force by both the 'nose-to-tail' methods.

6.2 Accelerations of $A_1 = 2.5\ \text{ms}^{-2}$ at 90^0 and $A_2 = 5.2\ \text{ms}^{-2}$ at 145^0 act at a point. Find $A_1 + A_2$ and $A_1 - A_2$ by:

(i) drawing a scale vector diagram and

(ii) by calculation

6.3



I. Write the elements in each set $\mathcal{E}$, A and B

II. Draw and shade $A \cap B$ on a Venn diagram, and write the set.

III. Draw and shade $A \cup B$ on a Venn diagram, and write the set.

6.4 For any sets A, B and C then prove that

$$A \times (B \cap C) = (A \times B) \cap (A \times C)$$