ATHLONE INSTITUTE OF TECHNOLOGY

SCHOOL OF ENGINEERING

SEMESTER 1 (IN-HOUSE) EXAMINATIONS 2016

Sample Exam

BSc (Hons) SOFTWARE DESIGN (Common Entry)

YEAR 1

MATHEMATICS FOR SOFTWARE DESIGN 1

Internal Examiner(s): **Dr. Mark Daly**

Instructions to candidates:
Read all questions carefully.
All questions carry equal marks.
Answer **ANY 3** out of **4** questions.

Time Allowed: 1 ¾ Hours

No. of pages including cover sheet: 2

Q.1. For each of the following functions

(i) Graph the function in the interval specified.

(ii) Estimate the value(s) of x where the graph crosses the horizontal axis.

(iii) Estimate the turning point(s) of the function in the interval.

(a) $f(x)=x^2-3x-10$ on the interval $[-4,6]$. (10 Marks)

(b) $f(x)=x^3-3x^2+4x-5$ on the interval $[-4,8]$. (10 Marks)

[20 Marks]

Q.2. (a) Determine all values of x for which the matrices below are non-singular:

(i) $\begin{pmatrix} 2 & 0 & 1 \\ 4 & -3x & 2 \\ 8 & 0 & x \end{pmatrix}$ (ii) $\begin{pmatrix} 4+x & 0 & 0 \\ 1 & 7-x & 0 \\ -5 & 6 & 8-x \end{pmatrix}$

(8 Marks)

(b) For the following matrices, determine if $C=A\cdot B$ is equal to $D=B\cdot A$:

$$A=\begin{pmatrix} 1 & -2 & -4 \\ 0 & -5 & 8 \\ 1 & -1 & 2 \end{pmatrix} \qquad B=\begin{pmatrix} -2 & 8 & -36 \\ 8 & 6 & -8 \\ 5 & -1 & -5 \end{pmatrix}$$

(12 Marks)

[20 Marks]

Q.3. (a) Calculate the first six terms in the Taylor series of the following functions about the points specified:

(i) $f(x) = \sin(x)$ about $x_o = \pi/2$. (5 Marks)

(ii) $f(x) = \ln|1+x|$ about $x_o = 0$. (5 Marks)

(b) Estimate the error in $T_5(x)$ for $\sin(\pi/3)$ about $x_0 = 0$.

(10 Marks)

[20 Marks]

Q.4. Differentiate each of the following functions of x with respect to x:

(a) $f(x)=\left(\cos^2(x)+\sin^2(x)\right)\ln|2x|$ (5 Marks)

(b) $f(x)=e^{\ln|\tan(x)|}$ (5 Marks)

(c) $f(x)=\sin\left(\tan\left(e^{\cos(x)}\right)\right)$ (5 Marks)

(d) $f(x)=\dfrac{x^8-1}{x^7+x^6+x^5+x^4+x^3+x^2+x+1}$ (5 Marks)

[20 Marks]

Taylor Series

$$f(x)=\sum_{k=0}^{\infty}\frac{f^{(k)}(x_0)}{k!}(x-x_0)^k$$

Taylor Polynomial

$$T_n(x)=\sum_{k=0}^{n}\frac{f^{(k)}(x_0)}{k!}(x-x_0)^k$$