UNIVERSITY OF BOLTON

SCHOOL OF THE BUILT ENVIRONMENT & ENGINEERING

BSc(HONS) CIVIL ENGINEERING

SEMESTER TWO EXAMINATION 2010/2011

MATHEMATICS B

MODULE NO: BLT1010

Date: Wednesday 1 June 2011 **Time: 10.00 am – 12.00 noon**

INSTRUCTIONS TO CANDIDATES:

There are FOUR questions.

Answer ANY THREE questions.

This examination paper carries a total of 60 marks.

All questions carry equal marks.

A formula sheet is provided.

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Q1)

a) Evaluate the following indefinite integrals using integration by parts:

i. (2 marks)

ii. (2 marks)

iii. (2 marks)

b) Estimate the following definite integral using:

i. The trapezoidal rule with four strips. (5 marks)

ii. Simpson's rule with four strips. (5 marks)

Calculate the exact value and comment on the percentage errors in your results. (4 marks)

Total 20 marks

Please turn the page

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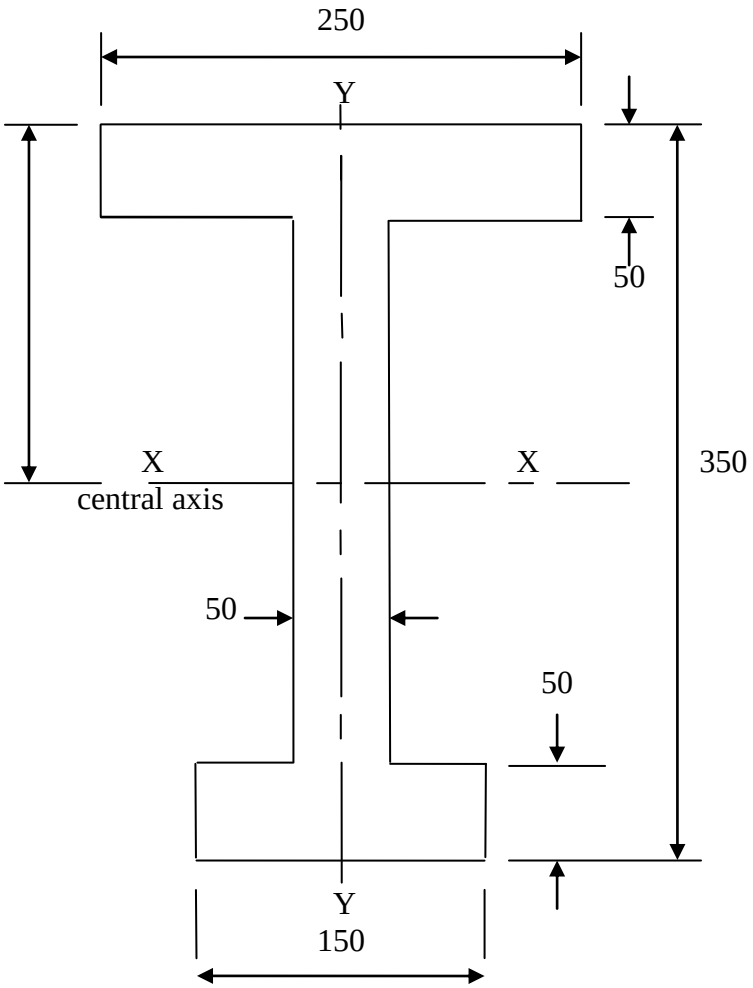
Q2) The section shown below is to be used as a strut of 7 m length.

a) Calculate the distance ‘ ’ from the centroid of the Cross Section to the top of the section. (5 marks)

b) Calculate the Second Moment of Area for this Cross Section

i. about **X – X** (10 marks)

ii. about **Y – Y**. (5 marks)



All measurements are in mm.

Total 20 marks

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Q3)

a. For the matrices

calculate the following:

i. A + B (2 marks)

ii AB (4 marks)

iii BA (4 marks)

Comment on your answers to (ii) and (iii)

b. Using matrices, solve the following system of linear simultaneous equations:

(10 marks)

Total 20 marks

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Q4)

The following table of data gives the amount of money spent , by a Civil Engineering Contractor, during the last 10 months on regular maintenance of construction plants and the cost in lost production (due to breakdown of construction plants used:

X	70	72	78	85	95	109	118	130	150	170
Y	225	230	205	225	202	190	210	204	180	190

i. By drawing up an appropriate table, find the totals ΣX, ΣY, ΣX^2, ΣY^2 and ΣXY. (5 marks)

ii. Draw a scatter diagram for the data. (5 marks)

iii. Calculate the correlation coefficient 'r' and comment on its value. (5 marks)

iv. Determine the regression equation of Y on X and indicate the line of best fit on your scatter diagram. (5 marks)

Total 20 marks

END OF QUESTIONS

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FORMULA SHEET

1. Quadratic Equations

For the equation $ax^2 + bx + c = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2. Laws of Logarithms

$\log AB = \log A + \log B$

$\log \frac{A}{B} = \log A - \log B$

$\log A^P = p \log A$

3. Matrices

For the square matrix A

$$A^{-1} = \frac{\text{Adj}\, A}{|A|}$$

4. Simpson's Rule

Area = $\frac{h}{3}\{(y_1 + y_n) + 4(y_2 + y_4 + \ldots + y_{n-1}) + 2(y_3 + y_5 + \ldots + y_{n-2})\}$

5. Trapezium Rule

Area = $h\left\{\frac{y_0 + y_n}{2} + (y_1 + y_2 + y_3 + \ldots + y_{n-1})\right\}$

6. Statistics

Relative frequency = $\frac{f}{\sum f}$ Mean : $\bar{x} = \frac{\sum fx}{\sum f}$

Standard deviation : $s = \sqrt{\frac{\sum fx^2}{\sum f} - (\bar{x})^2}$

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Least squares regresstion :

the normal equations are :

$$\sum y = m\sum x + Nc$$
$$\sum xy = m\sum x^2 + c\sum x$$

Correlation coefficient : $$r = \frac{N\sum xy - \sum x\sum y}{\sqrt{\left[N\sum x^2 - (\sum x)^2\right]\left[N\sum y^2 - (\sum y)^2\right]}}$$

7. Calculus

If $y = u.v$ then $\frac{dy}{dx} = v\frac{du}{dx} + u\frac{dv}{dx}$

If $y = \frac{u}{v}$ then $\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

If y is a function of u and u is a function of x then $\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx}$

Integration by parts: $\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$

8. Small Increments

If $w = f(x, y, z)$ then $\delta w \approx \frac{\delta w}{\delta x}\delta x + \frac{\delta w}{\delta y}\delta y + \frac{\delta w}{\delta z}\delta z$

9. Second Moment of Area

$I = \frac{bd^3}{12}$ $\qquad I_{AA} = I_{XX} + As^2$

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CALCULUS

(* the constant of integration has been omitted *)

$\int y\,dx$	y	$\frac{dy}{dx}$
$\frac{x^{n+1}}{n+1}\ n \neq -1$ $\ln x \quad n = -1$	x^n	nx^{n-1}
$x\ln x - x$	$\ln x$	$\frac{1}{x}$
$\frac{1}{a}e^{ax}$	e^{ax}	ae^{ax}
$\frac{a^x}{\ln a}$	$a^x \quad a>0$	$a^x \ln a$
$\frac{(ax+b)^{n+1}}{a(n+1)}\ n \neq -1$ $\frac{1}{a}\ln(ax+b)\ n = -1$	$(ax+b)^n$	$na(ax+b)^{n-1}$
$\ln f(x)$	$\frac{f'(x)}{f(x)}$	
$-\frac{1}{a}\cos ax$	$\sin ax$	$a\cos ax$
$\frac{1}{a}\sin ax$	$\cos ax$	$-a\sin ax$
$\frac{1}{a}\ln\lvert\sec ax\rvert$	$\tan ax$	$a\sec^2 ax$
$\frac{1}{a}\ln\left\lvert\tan\frac{ax}{2}\right\rvert$	$cosec\ ax$	$-a\,cosec\ ax\cot ax$
$\frac{1}{a}\ln\lvert\sec ax+\tan ax\rvert$	$\sec ax$	$a\sec ax\tan ax$
$\frac{1}{a}\ln\lvert\sin ax\rvert$	$\cot ax$	$-a\,\mathrm{cosec}^2 ax$
$\frac{1}{a}\cosh ax$	$\sinh ax$	$a\cosh ax$
$\frac{1}{a}\sinh ax$	$\cosh ax$	$a\sinh ax$

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$\int y\,dx$	y	$\frac{dy}{dx}$
$\frac{1}{a}\ln\cosh ax$	$\tanh ax$	$a\,\mathrm{sech}^2 ax$
$\sin^{-1}\left[\frac{x}{a}\right]$	$\frac{1}{\sqrt{a^2-x^2}}$	
$\frac{1}{a}\tan^{-1}\left[\frac{x}{a}\right]$	$\frac{1}{x^2+a^2}$	
$\sinh^{-1}\left[\frac{x}{a}\right]$	$\frac{1}{\sqrt{a^2+x^2}}$	
$\cosh^{-1}\left[\frac{x}{a}\right]$	$\frac{1}{\sqrt{x^2-a^2}}$	
$\cos^{-1}\left[\frac{x}{a}\right]$	$\frac{-1}{\sqrt{a^2-x^2}}$	

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SIGNIFICANCE OF CORRELATION COEFFICIENT

If the value obtained in higher than that shown below, it is significant at the level indicated.

	Level of significance (%)					
One tail	5	2.5	1	0.5	0.1	0.05
Two tail	10	5	2	1	0.2	0.1
Number of pairs of observations						
4	0.900	0.950	0.980	0.990	0.998	0.999
5	0.805	0.878	0.934	0.959	0.986	0.991
6	0.729	0.811	0.882	0.917	0.963	0.974
7	0.669	0.754	0.833	0.875	0.935	0.951
8	0.621	0.707	0.789	0.834	0.905	0.925
9	0.582	0.666	0.750	0.798	0.875	0.898
10	0.549	0.632	0.715	0.765	0.847	0.872
11	0.521	0.602	0.685	0.735	0.820	0.847
12	0.497	0.576	0.658	0.708	0.795	0.823
13	0.476	0.553	0.634	0.684	0.772	0.801
14	0.457	0.532	0.612	0.661	0.750	0.780
15	0.441	0.514	0.592	0.641	0.730	0.760
16	0.426	0.497	0.574	0.623	0.711	0.742
17	0.412	0.482	0.558	0.606	0.694	0.725
18	0.400	0.468	0.543	0.590	0.678	0.708
19	0.389	0.456	0.529	0.575	0.662	0.693
20	0.378	0.444	0.516	0.561	0.648	0.679

* ignoring sign