You can use this page as a cover sheet for your coursework.

Name: _____ Initials: _____

Student Number: _____ Tutor: _____

- Coursework must have your NAME and INITIALS, STUDENT NUMBER, and name of your Personal Tutor in Elect. Engineering clearly marked on the front. Work without a Student Number may not be marked.
- Use a staple or treasury tag to join sheets, NOT a paper clip.
- Marked work is returned to you via your Tutor in Elect. Engineering.
- Some questions are harder than others. Don't worry if you can't do everything. Hand in whatever you can do. Your coursework counts towards the final mark of the module.
- Coursework can be *either:* posted in **YELLOW** box in **GROUND** floor of **Mathematics Building** *or:* handed in at the end of a lecture.
- For Summary Sheets, Lecture Notes and Course Information sheet use the Course web page.
- Rules for late and excused coursework are in the Course Information Sheet.
- Remember: The material you hand in must be your own work. Copying doesn't help you learn!

Coursework Questions

1. If
$$I_n = \int x^n e^{3x}\,\mathrm{d}x,$$
show that
$$I_n = \frac{x^n e^{3x}}{3} - \frac{n}{3} I_{n-1},$$
and hence evaluate $\int x^3 e^{3x}\,\mathrm{d}x$.

[6 marks]

2. If $I_n = \int (\ln x)^n\,\mathrm{d}x$, show that
$$I_n = x(\ln x)^n - nI_{n-1},$$
and hence find $\int (\ln x)^3\,\mathrm{d}x$.

[6 marks]

3. If
$$I_n = \int_0^{\pi/2} \cos^n x\,\mathrm{d}x$$
then show that
$$I_n = \left(\frac{n-1}{n}\right) I_{n-2}.$$
(Hint: write $\cos^n x = \cos x \cos^{n-1} x$*.)*
Hence find the following integral:
$$\int_0^{\pi/2} \cos^5 x\,\mathrm{d}x$$

[8 marks]

4. Evaluate the double integral
$$\int_0^b \int_0^a e^{x+2y}\,\mathrm{d}x\,\mathrm{d}y.$$

[4 marks]

5. Find the position of the centroid of the plane figure bounded by the curve $y = 9 - x^2$ and the x and y reference axes. Begin your answer by sketching the region of the plane figure.

[8 marks]

6. The curve formed by a freely hanging chain supported at two points has the form of a hyperbolic cosine, and is called the catenary.
(a) Calculate the length of the arc of a catenary given by the equation
$$y = 2\cosh\left(\frac{x}{2}\right) - 1$$
between $x = -4$ and $x = +4$.
(b) Find the area of the surface of revolution, when the catenary given above is rotated about the x-axis. Use the same x limits. (This surface is called the catenoid.)
You may use: $\cosh 2z = 2\cosh^2 z - 1$.

[8 marks]

Total Marks: [40]

WORK TO BE HANDED IN BY: 5:15PM Tuesday November 29th, 2011

REMINDER! In-term Test Thursday December 1st, 4.00-5.00pm in Frances Bancroft Room FB 240

The tests will last 50 minutes and consist of 6 questions each worth 4 marks each. The questions will be similar to, and at the same level of difficulty as the Part A questions of the final May/June exam. (Past exam papers are available on the course web site.)

- The second test will cover **Series, Convergence and Integration upto Double integrals**.
- Sample Tests are available on the course web site.

YOU MUST BRING YOUR STUDENT CARD TO THE TEST!

WORK TO BE HANDED IN BY: 5:15PM Tuesday November 29th, 2011