Feedback on ME10305 Mathematics 2, May 20176

As with last year's paper compared with the previous year's, I endeavoured to make this paper slightly more difficult than last year's paper was because the 15/16 exam average was again deemed to be a little too high. I appear to have failed because this year's average was just under 72%, and therefore the marks will be automatically scaled downwards, possibly by 3%. There were five students who obtained 100%, while three had 99% and four had 98%. There were 14 failures, although that will increase because of scaling.

General comments.

The great majority answered the questions in numerical order. Generally, I found there was a moderate correlation between the tidiness of the handwriting and the mark gained — I don't know if there really is some connection between the two. However, I would like to urge a small subset of the class, those who are adept at hiding the solution which I wish to mark some distance away from the end of the analysis, to make the answer clearly obvious to the marker.

Q1. ODEs.

Part (a) was generally very well done. Some didn't translate the boundary conditions into the new notation. A few quoted only the fourth first-order equation — all four are required.

Part (b). Done well. Some found the common factor and did the necessary cancellation.

Part (c). The worst part. The chief error was of the form,

$$\ln v = -2\ln(t^2+1) + c \qquad \Longrightarrow \qquad v = (t^2+1)^{-2} + c.$$

Q2. Laplace Transforms.

Part (a) was very very good. The great majority used the "imaginary part of $e^{j\omega t}$" trick. Some merely quoted the answer (either from memory or from the formula book), but no marks were given for this.

Part (b). Bookwork. Mostly done correctly. A few quoted the formula book, but they got zero marks for that.

Part (c). Some seemed to take a long time to do the partial fractions here. Everything was in terms of s^2, and therefore one didn't need to set

$$\frac{3}{(s^2+1)(s^2+4)} = \frac{As+B}{s^2+1} + \frac{Cs+D}{s^2+4}.$$

Rather, one can do

$$\frac{3}{(s^2+1)(s^2+4)} = \frac{A}{s^2+1} + \frac{C}{s^2+4}$$

because there is no way that a solitary s^1 can appear. I set this one last year!

Q3. Fourier series.

Part (a) was well-received. Many declared the function to be odd, which is correct, but proceeded to find a nonzero value for A_0 — a couple of marks were deducted for this.

Part (b). Far fewer completed this one. The solution for this part shouldn't take more than four or five lines, but some seemed to find this to be a very complicated analysis.

Q4. Determinants/Gaussian Elimination.

Part (a). This follows quickly using the dirty tricks approach with row and column manipulations; look at the third and fourth columns. Nevertheless quite a few spent a long time expanding into four 3 determinants etc, and still got the answer correct!

Part (b). Very very good.

Q5. Least Squares.

The question asked for the theory to be developed and five marks were associated with that. Quite a few quoted the correct formulae, but I couldn't assign any marks for that. A few quoted the formula for a straight line and fitted that instead; clearly no marks for that either.

The chief error was in truncating data to a small number of significant figures *before* solving the matrix/vector equation. This introduces errors into the coefficients of the sought line. The general rule is to keep as many DPs as one can, and then, if necessary, truncate the final answer.

A sizeable minority made the following mistake: $x^{1/2} \times x^{1/2} = x^{1/4}$.

Q6. Numerical integration.

All three parts were generally done well.

Q7. ODE solution using eigenvalues.

Part (a). Virtually everyone got this right.

Part (b). Again a large number of solutions were correct. The chief error was of the form,

$$3x + 2y = 0 \quad \Rightarrow \quad (x, y) = A(3, -2).$$

Part (c). Very good.

Part (d). Very poorly answered.

Q8. ODE solution using substitution.

The chief error was an inability to find the first and second derivatives of $e^{-2t}z$. This should eventually lead to $z'' = 2$, which may simply be integrated twice with the two arbitrary constants added at the appropriate stage.

Q9. Laplace Transforms.

Part (a). Very good.

Part (b). Many quoted the answer — no marks.

Part (c). Quite good. This was a shift theorem question, but very few mentioned that fact, and it ought to have been.

Part (d). Well done.

Q10. Root finding.

Part (a). Very well done.

Part (b). The perturbation analysis was not received very well at all. On occasions it was claimed that Newon-Raphson diverges linearly, or converges cubically! With NR, there is always a way of simplifying the analysis to find the magnitude of the error quite quickly. That said, this was the last topic in the last lecture which was 11 days before the exam....

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