Feedback on ME10305 Mathematics 2, May 2019

This paper achieved an average of about 72.5% and therefore the marks are likely to need moderating downwards by 3%.

Five students achieved full marks and there were seven students with 99% and three with 98%. On the other hand there were 28 failures where the lowest five marks were a 4% and a pair each of 16% and 17%. If I am correct about a 3% moderation then there will be one more failure, but eight will drop below 35%.

As usual, the great majority answered the questions in numerical order.

Q1. ODEs. Average: 8.2/10

Part (a) was generally very well done. Some didn't translate the boundary conditions into the new notation. One person tried (unsuccessfully!) to solve the equations instead.

Part (b). Many found the Integrating Factor, but some neglected the minus sign, and some didn't put the equation into the standard form before finding the Integrating Factor.

Part (c). Pretty good. Very many remembered to use the "replace the e^c by A" trick and the solution then followed like a dream. For that one student who wrote the numerical value of $e^{1/2}$, it is more informative to keep it in the square root form.

Q2. Laplace Transforms. Average: 8.1/10.

Part (a) concerned teh FT of a couple of functions. Almost no-one tripped up. Some quoted from the formula book, but this doesn't attract marks. There was the usual gap between those students who used the slow method of integration by parts and those who didn't — it was the difference between a page of working and three lines.

Part (b). Bookwork. Mostly done correctly.

Part (c). The partial fractions was straightforward, but only if one realises that it is legitimate to apply the partial fractions to

$$\frac{3}{(s+1)(s+4)} = \frac{1}{s+1} - \frac{1}{s+4}$$

and afterwards replace s by s^2:

$$\frac{3}{(s^2+1)(s^2+4)} = \frac{1}{s^2+1} - \frac{1}{s^2+4}.$$

Q3. Determinants/Gaussian Elimination. Average: 8.4/10.

The highest-scoring question. Both parts were done well. Mistakes, whenever they arose, tended to be arithmetical. A few used Gauss-Jordan and therefore had a few marks knocked off because Gaussian Elimination was asked for. Some wrote the matrix down incorrectly.

Q4. Fourier Series. Average: 6.2/10.

Part (a). The sketch was occasionally drawn incorrectly. The most common error was to stretch the given function, which was defined in the range, $-1 < t < 1$, to fit the range, $-3 < t < 3$, and also therefore with just one minimum. There should have been three repetitions of what is contained in $-1 < t < 1$.

A very large number of people used symmetry arguments to obtain $B_n = 0$. The most common error, though, was the retention of t in the Fourier coefficients after supposedly evaluating them. Thus

$$A_n = \frac{1}{3} + \sum_{n=1}^{\infty} \frac{4(-1)^n}{n2\pi^2}$$

was replaced by

$$A_n = \frac{1}{3}t^3 + \sum_{n=1}^{\infty} \frac{4(-1)^n t}{n^2\pi^2}$$

where the $(-1)^n$ had come from evaluating $\cos n\pi t$ at $t = 1$, but the remain t-factor was left alone!

Part (b). Generally done well. Some didn't include the PI corresponding to A_0 even when it had been calculated!

Q5. Least Squares. Average: 7.4/10.

The question asked for the theory to be developed and four marks were associated with that. Quite a few only quoted the correct formulae, but I couldn't assign them any marks. Otherwise a piece of cake.

Q6. Iteration schemes and root finding. Average: 7.4/10.

Part (a) was excellent. For Part (b) some students employed both iteration schemes when only one was needed. Part (c) was often good, but $(4 + 5\epsilon)^{1/2}$ sometimes became $4(1 + \frac{5}{4}\epsilon)^{1/2}$ or $\frac{1}{2}(1 + \frac{5}{4}\epsilon)^{1/2}$ or even $(4^{1/2} + (5\epsilon)^{1/2})$! For the perturbation analysis of the other iteration scheme the most frequent error was,

$$(2 + \epsilon)^2 = 4 + 2\epsilon + \epsilon^2.$$

Part (d) was done well. Finally, many came to grief with Part (e).

Some errors of interpretation and analysis were made when it was assumed that ϵ^2 is larger than ϵ — it is the other way around because $\epsilon \ll 1$.

Q7. System of ODEs using eigenvalues. Average: 7.4/10

Despite the apparently high average mark, many failed to find the eigenvalues correctly. This appeared mainly to be due to not applying the checkerboard pattern of signs (which yields a three times repeated $\lambda = 1$).

Q8. Laplace Transforms. Average 7.6/10.

Much easier than last year's Q7. I was very pleasantly surprised and gratified by how well Part (d) went. But my chief observation is about how poor the explanations were for what was being done in Part (c).

Q9. Solution of an ODE by substitution. Average 7.2/10.

Some flew through this in a few lines with very compact concise writing — nice. Parts (b) and (c) relied on getting Part (a) correct.

Q10. Laplace Transforms for a pair of ODEs. Average 5.2/10,

The least good score of the exam.

Part (a). This was a result to quote.

Part (b). Very many got this right but then floundered on the partial fractions in Part (c). I had committed a typographical error in this question and I went along with the solutions using that erroneous result in those few cases where the student hadn't noticed my mistake. Apologies for the error.

Part (d). $z'(0)$ should have been nonzero despite having applied $z'(0) = 0$ earlier. This was indeed due to the unit impulse forming teh forcing function in the z-equation.

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