Feedback on ME10305 Mathematics 2, May 2023

This paper achieved an average of just above 69% which is consistent with pre-covid examinations. Normality has been resumed just in time for Curriculum Transformation to change the year 1 maths content slightly and with a change of unit code!

The distribution of marks is close to being uniform when above 50%. Three students obtained full marks and one achieved 99%, the error being significant but worth one mark. There were 53 in the nineties and a grand total of 166 in the first class range ($\geq 70\%$). No one had 39% but there were 14 who failed but were within the condonable range, i.e. between 35% and 39%, inclusive, and another 14 who failed with a mark at or below 33%. No-one had a single-figure percentage.

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

Q1. ODEs. Average: 8.0/10

Very well-received and it was the highest-scoring question. One of the more common errors was in Q1b where the integrating factor was found correctly but only the left hand side of the ODE was multiplied by it rather than both.

Q2. Laplace Transforms. Average: 7.1/10.

Parts (a) and (b) went well in general with part (a) being bookwork. Many merely quoted the formula book but no marks accrue from this. In Part (c) there was a quick way of doing the partial fractions without using two instances of "linear divided by quadratic". That said, it could be done moderately quickly without the using the quick route. It was often mangled badly.

Q3. Determinants/Gaussian Elimination. Average: 7.9/10.

Very well-done. The vast majority followed the methodology perfectly, and whenever errors occurred they tended to be just arithmetical mistakes.

Q4. Numerical Mathematics. Average: 7.1/10.

A shorter question than I usually set because I didn't present an *ad hoc* scheme. The numerical work in Part (a) was almost always perfect. There were some difficulties with the perturbation analysis and this went wrong in a spectacular number of ways.

Q5. Fourier Series. Average: 6.2/10.

Part (a). The sketch was occasionally drawn incorrectly and sometimes not at all. Some thought that it is an even function and tried to find the cosine cofficients. Some declared the function to be odd but yet computed a nonzero value for A_0 . And, of course, some integrated sin nt to yield $n \cos nt$.

Part (b). The majority of students omitted the summation for the Particular Integral despite getting the formula correct. The speed of convergence was usually correct.

Q6. Least Squares. Average: 7.3/10.

Generally well done.

Although the derivation was almost uniformly perfect, there were some who repeated the derivation for a straight line fit; this had to attract zero marks because I didn't ask for it. When marks were lost in the numerical part it was because either the arithmetic for the summations had gone astray, or the solution of a 2×2 matrix/vector system was incorrect, or sometimes both.

Q7. System of ODEs using eigenvalues. Average: 6.7/10

Parts (a) and (b) were usually tackled well but parts (c) and (d) weren't. For part (c) either the arithmetic

after the application of the initial conditions was incorrect or, surprisingly, the initial conditions weren't copied correctly from the exam paper. For part (d) one could used the solution to part (b) as a short cut (as in the lecture notes) and although the associated eigenvalue problem was only just slightly longer than for part (b), there was a lot of confusion.

Q8. ODE solution. Average 6.4/10.

This question involved a repeated $\lambda = \pm j$. The solution for the Complementary Function was generally done well although some gave $\lambda = \pm 1$ as the solution of $\lambda^2 + 1 = 0$; this meant that no marks could be gained for the Particular Integral.

The correct first step for the CF was to set

$$y_{pi} = Ct\cos t + Dt\sin t.$$

The correct analysis yielded C = 0 and D = 1 and yet a substantial minority wrote their final solution as

$$y_{pi} = t \cos t.$$

Q9. Laplace Transforms. Average 8.0/10.

The second best solution, falling short of the mark for Q1 by a couple of hundredths. It was probably the simplest possible question on the convolution theorem that I could have asked.

Q10. ODE solution by substitution. Average 4.5/10,

The least good mark in the exam. The low mark was due to many not finding the first and second derivatives of $y(t) = z(t)e^{-2t}$ correctly, which is the application of the product rule and then a second application to the results of the first one.

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