ME10304 – Mathematics 1 – Feedback on the 2019/2020 exam.

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General comments.

The average mark was roughly 68.3% with a standard deviation of 16.0%.

There were 11 marks below 40% with none of these in the condonable range, i.e. at or above 35%. The lowest mark was 8% and the highest, 95%, was obtained by four people. The question which was answered the best was Q8 on vectors — the average was 8.1/10 with 150 getting full marks. At the other end we had Q10 with an average of 4.5/10, with only 15 getting full marks but only 22 were given zero marks including non-attempts.

Question 1.	**Curve sketching.** Average mark: 6.8/10. Quite a few students spent a lot of time writing huge amounts when it isn't necessary. Some tried to find minima and maxima — again this is not necessary for this question. An astonishingly large number didn't write on the axis the value of x at which the pole or zero occurs; some marks were deducted for this.
(a)	Excellent. Some drew the curve as though the double zeroes were single zeros.
(b)	Very good.
(c)	A mixed bag. Some sketched $x\lvert\cos x\rvert$, which looks very much like the correct solution except that the double zeroes look pointy. Quite a few sketched $\lvert x\rvert\cos x$. Sometimes the envelope wasn't shown.
(d)	Generally not attempted. There was one obvious solution involing tanh, although some provided a very good alternative.
Question 2.	**Complex numbers.** Average mark: 8.0/10.
(a)	Excellent. A few students claimed that j does not have a complex conugate!
(b)	Very good. Some students took half a page to do this even though it is a one-liner! Here is the glacially slow version which I saw on a dozen scripts (noting that I am using the equivalent example from two years ago because I am lazy): $z = 2e^{j\pi/4} = a + bj \quad \Rightarrow \quad r = 2 \text{ and } \theta = \pi/4 \quad \Rightarrow \quad a^2 + b^2 = 4.$ $\text{Also } b/a = \tan\theta = 1 \quad \Rightarrow \quad b = a \quad \Rightarrow \quad 2a^2 = 4 \quad \Rightarrow \quad a = \sqrt{2}$ $\Rightarrow \quad b = \sqrt{2} \quad \Rightarrow \quad z = \sqrt{2} + \sqrt{2}j.$ The smart approach is $z = 2e^{j\pi/4} = 2\Big(\cos(\pi/4) + j\sin(\pi/4)\Big) = 2\Big(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}j\Big) = \sqrt{2} + \sqrt{2}j.$ Both methods are rigorous and perfectly correct, although the first can and almost always did yield real and imaginary components with incorrect signs.
(c)	The chief error made by many was an incorrect calculation of the argument. Some wrote $\theta = 1.287002$ which is the inverse tangent of (24/7). Others wr0te $\theta = -1.287002$, but the correct answer lies in the second quadrant, and this may be seen using a quick sketch of z in the Argand diagram.
(d)	Quite a large number of students misread the question. The expression for $\sin 4\theta$ did not have to be written in terms of cosines only. In some cases the expression for $\cos 4\theta$ wasn't processed to remove the $\sin\theta$ terms. The instructions in a question need to be heeded.

Question 3.	**Differentiation.** Average mark: 8.6/10.
(a)	All three parts of this were answered quite well.
(b)	Also answered well. A few cancelled x from the general expression for y', and therefore missed out the $x = 0$ critical point. Others thought that $x^2 - 1$ has $1, 1$ as the two roots. However, most students identified the three critical points correctly. The chief omission was a failure to categorise whether the inflexion point is ascending or descending.
Question 4.	**Partial differentiation.** Average mark: 8.0/10.
(a)	This part was done very well in general.
(b)	The number of critical points was four. Some scripts claiming only two (by assuming that the square root of 9 or of 1 has only value). Many also claimed that $(0, 0)$ is a critical point which is incorrect.
Question 5.	**Integration 1.** Average mark: 7.0/10.
(a)	While the integration by parts usually proceeded well, there were two main errors. One was the writing of the integral of $\sin t$ is $+\cos t$. The other was that correct answer, -2π, was felt to be incorrect and therefore there was often the bizarre mathematical statement that, $\int \ldots = -2\pi = 2\pi$.
(b)	This was answered well, but sometimes at enormous length....
(c)	A partial fractions integral. Mostly well-received. The most frequent error was the rewriting of $\frac{1}{2}\ln\|t+1\|$ as $\ln\|(t+1)^{1/2}\|$. The latter is in error because $(t+1)$ can be negative. A correct alternative is $\ln\|t+1\|^{1/2}$.
Question 6.	**Integration 2.** Average mark: 5.7/10.
(a)	Generally very good. A couple of dozen students differentiated rather than integrated.
(b)	V was usually correct. Very many students wrote down an incorrect formula for a surface of revolution. There must be a plus sign between the two terms in the square root — this is a consequence of having used Pythagoras's theorm in its derivation. The resulting integral was formally of 'by substitution' type, but some managed to do it by inspection — nice!
Question 7.	**Series.** Average mark: 5.4/10.
(a)	First part was good, although it is good style and more compact to cancel the common factors between the two factorials. Many people either omitted the second bit, or else didn't realise that the $(-1)^n$ shouldn't be present.
(b)	Well done. Some used Taylor's series, but no marks were given for those who didn't use the asked-for Binomial series.
(c)	A lot of people didn't get this one. If u_n is proportional to x^{2n}, then u_{n+1} is proportional to x^{2n+2}, rather than to x^{2n+1}.
(d)	Pretty good.

Question 8.	**Vectors 1.** Average mark: 8.8/10.
	The best question. Generally a walk in the park. Occasionally the cross product went astray.
Question 9.	**Vectors 2.** Average mark: 6.0/10.
	Generally parts (a) and (b) were answered very well indeed. In part (c) many people got the right answer but not by using the method that I specified in the question — no marks. Many others didn't try it.
Question 10.	**Miscellaneous.** Average mark: 4.5/10.
	Like last year I got the impression that this was just a question too far, the last one on the last exam. Part (a) was often good, although the double root at $x = 0$, and which should look like x^2 close to the origin, was often a good mimic of $\|x\|$. In part (b) there was a pattern which formed, but often missed, and in some cases the differentiations were wrong. Part (c) was very good. Part (d) was almost always very badly done.

A recurring theme this year, one which hasn't arisen before in anything like this year's numbers, was that there were so many instances where students didn't follow the instructions in the question. Questions 2, 7 and 9 were the chief places where this happened.