

## Feedback on Noncommutative Algebra examination January 2019

The exam was, I think, quite challenging in that there were some questions which, though similar to things that had been seen, definitely were “unseen”. Nevertheless, many students answered these very well (better than I had expected).

One place where some students lost marks were answers which did not hang together - I sometimes had an impression of the student writing down half-remembered pieces of an argument but not linking them together. Such a disjointed argument would get some, but maybe not a lot of, marks since it was not possible to tell whether the student did understand the parts they had written or was simply relying on memorisation.

Overall, a good performance on pretty tough material.

Q1. fine

Q2 1) Fine but note that one of the conditions refers to a direct sum of *left* ideals (‘ideals’ is not strong enough).

2) Fine but note that the dimension (2 or 4) of the division ring  $\mathbb{C}$  or  $\mathbb{H}$  over  $\mathbb{R}$  is outside the  $n^2$  (where  $n$  is the size of the matrices).

Q3 Quite a variety of proofs and ideas for proofs; marks were given for relevant statements/reasonable ideas even if they didn’t push through to a complete proof.

Q4 Schur’s Lemma - generally well done.

second part - Rather few people got the answer ( $\mathbb{C}$ ) though many showed that any endomorphism is determined by its action on 1 and deduced that it must be multiplication by a polynomial (but then did not necessarily realise that it must be a constant because it has to commute with differentiation).

Q5a) fine

b) Mixed - some people described the procedure with the matrix (which was not required - only the set-up was asked for) yet did not really say where the matrix came from. That required (implicitly or explicitly) considering the generators of the module  $M$  and then generators of the kernel of the map from  $R^n$ .

c) Fine, some arithmetic slips but these were not heavily penalised if the method was right.

d) Pretty well done, though a number of people seemed to be repeating an argument from the notes/solution sheet without giving all of it (so that what was written didn’t hang together).

Q6a), b) A few confused-seeming answers but generally done quite well.

c) Done well (considering that it involves two substantial proofs) with varying approaches, though not everyone who followed the original argument of the notes explained how the lemma proved the result.

d) Most got at least part-way there, though quite a few couldn't finish off the argument.

Q7a), b) fine

c), d) Generally well done though be careful in d) where  $x$  in the polynomial ring must be sent to  $\sigma - 1$  not to  $\sigma$ .

Q8 Well done especially since it was unseen. The computations were done carefully and drawing conclusions was mostly done well, though sometimes the conclusions were not fully justified.