

The following advice was given many years ago by an Essex professor of Electrical Engineering. The principles he describes remain as true today as they were then.

## **HOW TO DO YOURSELF JUSTICE IN EXAMINATIONS**

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I am writing this note shortly after marking a large batch of examination scripts. Fresh in my mind is an image of the many ways in which candidates can respond to the same paper: not only some doing well and some badly, but also some exhibiting their knowledge and talents effectively while others seem to do themselves less than justice. This is a good time to record some advice for students of future years. If I can help them to avoid the more obvious mistakes, I shall be well content.

### **An introductory anecdote**

The principles I am going to suggest derive mainly from recent experience as an examiner, but some of them were obvious to me even in my student days. Let me recall one striking example. Long before I joined the University, I worked for the BBC. The BBC Engineering Department had some good training schemes, and some internal examinations which had to be passed to gain promotion. On the occasion when I took the exam for 'Transmitter Engineer Grade D', one of my colleagues - let us call him Smith - was taking the exam for the third time. As usual, the paper included a question on high-voltage power plant - an important part of a big radio transmitter. Now Smith was an expert on mercury-arc rectifiers, which are often used in high-voltage plant. According to what he told me afterwards, he wrote an encyclopaedic answer to the question on this topic, and felt really pleased with himself. Unfortunately, it left him no time to do anything else. Let us suppose, charitably, that he gained a very high mark for that question; his overall mark still cannot have exceeded 20% since it was one of five questions. So he failed - for the third time. I believe his exam strategy had been the same on other occasions, and I have always remembered it as 'the mercury-arc-rectifier effect'. Now Smith is an extreme case, but he is not alone in his choice of exam strategy. In the exams I have marked this year, more than half the candidates had clearly devoted disproportionate time and space to one question at the expense of others. Some, as a result, had run out of time with the paper still unfinished. Many more, I suspect, had produced only rushed and cursory answers to the remaining questions.

### **Some general principles**

#### *(1) Preparation and attitude.*

The foundations of an exam success may be laid long before the day. Keep up with the course as you go along: don't depend on last-minute cramming. Both course work and revision should be active: don't just read books and notes, try to solve problems, to think around the subject, to create your own intellectual synthesis. Revision should start at least two months before the exam, and taper off as the day approaches. It is best to go into the exam room feeling fit and fresh: you won't do so if you have been up half the night cramming. Many students complain

of tension and anxiety at exam times. My impression is that much of this is brought on by too little preparation well beforehand, too much cramming immediately beforehand, or both. The problem of exam tension is worth some further discussion. Firstly, let us dismiss the notion

that tension is wholly unnatural and damaging. Our minds and bodies, of their very nature, are capable of running at widely different levels of activity: relaxed on occasion, steadily-paced for much of the time, while being able to draw on reserves of effort and determination for peak loads and emergencies. The easy stroll, the jog-trot, the hectic sprint, the hard slog of the marathon, all have their counterparts in everyday life. Some inner tension is a natural accompaniment to our peaks of activity: indeed, most of us need it, as a stimulus to our best efforts. The writer striving to meet a deadline, the engineer working all hours to check a big installation before cut-over, are in much the same position as a student entering an examination. Of course they all feel some tension: but this very tension can help them to rise to the occasion, so long as they concentrate on the job in hand and do not allow themselves to be sidetracked into the vicious spiral of worrying about being in a state of anxiety. Tension has its constructive, as well as its destructive, channels.

How can one encourage the constructive channel? There is no certain algorithm, but there are a few good heuristics. One which I believe is accessible and useful to most people is preparatory work as described at the beginning of this item. It is useful in many ways: for the foundation of knowledge acquired and reinforced, for the development of skills (assuming that you work in an active way), for the habit of steady work and clear thought, and not least for improving your ratio of confidence to misgivings. I have placed this item first both for its importance and for its chronological precedence. When the day arrives, however, you need to do the best you can starting from where you are: and whether your preparation has been sound or scanty, the following guidelines ought to help.

*(2) Allot your exam time.*

Read the rubric, and be clear as to how many questions you are to answer: whether there are any constraints on choice (of the type 'not less than one from each section' or similar): what proportion of marks are carried by various sections or questions: Be ready to spend a few minutes on a careful reading of the paper, both for the foregoing purposes and to enable you to understand the questions and select those to be answered. Allow some time at the end for checking, and for contingencies: and divide the remainder between the questions. For example, in a 3-hour exam with 5 questions of equal weight, you might spend 5-10 minutes reading and selecting questions, allot 30 minutes per question, and leave 20-25 minutes for contingencies. Start with a question you feel fairly sure you can answer (there will normally be, in any exam paper, at least one question of a straightforward nature on which any competent candidate can make a good start). Try to finish each question within the 30 minutes; allow perhaps 5-10 minutes overrun if after the nominal period you have nearly finished, but if it still seems intractable go on to the other questions. The unallotted time, assuming it not to be entirely eroded by overruns, is for (i) going back to attack anything not quite finished the first time round, (ii) checking answers and making any last-minute improvements or additions which occur to you.

The reasoning behind this recommendation is two-fold. Firstly, one of the very common ways in which candidates lose marks is by entirely omitting questions (or major parts of questions). This is almost always bad strategy. Even a brief answer (if reasonably appropriate) is going to gain you useful credit. It is most unlikely that devotion to one question of so much extra time that you can't even attempt another will be as cost-effective. Of course, if you really know one topic much better than another, or if you are visibly near the end of a problem but need a few more minutes, then giving somewhat more time to a potentially rewarding question is reasonable. This might possibly justify a split of say 45/15

rather than 30/30 between two questions, but not 60/0 - unless of course you find yourself completely incapable of attempting enough questions, which ought to be a very rare event.

The second consideration is that the examiner knows how much time is available, and does not expect more than a competent candidate can actually do in that time. If the question is in the form of a problem, there must be at least one approach which can be worked out well within the time. You may of course be caught out by a problem, but with questions requiring description or discussion there is no excuse whatsoever for excessively prolix answers. The best answer is the one which covers a judicious selection of relevant points, at a length appropriate to the time available. The examiner will positively welcome a clear and succinct presentation, and prefer it to a long and rambling script.

### *3 Answer the question*

Read the question carefully, and answer it appropriately. There are three ways of going wrong. The first is to misunderstand the question (perhaps through very hasty reading) and to answer, more or less precisely, a different question. In this event, the examiner will probably look back at the question to see whether it had any unintentional ambiguity; if so, he will give the candidate the benefit of the doubt, but if (as is much more common) the question looks precise even with hindsight, then the candidate will at best gain a rather poor mark, and quite possibly zero.

The second type of error is to fire a broadside at the general subject area of the question, without apparently aiming at any precise target whatsoever. The question requires (for example) a discussion of the relative merits of phase and amplitude modulation for data transmission, together with the answer to an associated problem: the candidate responds by writing down everything he can remember about data transmission, whether it bears on the question or not. The examiner is never quite sure whether this is due to a misreading of the question, a deliberate response on the part of a candidate who can't answer the question, or an unthinking response triggered by the sight of a familiar keyword. But he associates such an answer with general incompetence on the part of the candidate, and will mark it accordingly. Answers of this type are often very long, and must have taken the candidate a full or even an excessive time allotment (see point (2) above): most if not all of this time being wasted.

The third type of error is to give the wrong balance to various parts of the question, in extreme cases completely omitting some parts. It is very common for questions to require several distinct responses (such as a description, a problem solution, a discussion of several specific points). In such a case, the examiner will normally have a marking scheme which allots proportions of the total marks available to each part. Some examiners like to indicate these proportions on the paper, for the candidate's guidance, and this is now a standard practice in Electrical Engineering Science. It should be clear that, if a part is stated to carry 20% of the marks for one question, the examiner is expecting an answer which can be written in 5-6 minutes on one sheet of paper. To write a very long answer, and then run short of time on the rest of the question, is an unrewarding strategy but (like the imbalance between questions, point (2) above) of all too common occurrence.

### *(4) Present your answer clearly.*

This requires two things: (i) intellectual clarity and order, (ii) legible handwriting and intelligible sketches, calculations etc. If your answer is so confused, illegible or both that the

examiner simply cannot discern what it is that you are trying to convey, he cannot give you credit for it. Most examiners have enough patience, and sympathy, to spend a little time struggling to understand an answer, and to seek out creditable points if there are any. But they cannot go very far in this direction. An examiner who is marking hundreds of scripts to a tight time schedule must, in fairness to other candidates, avoid wasting a disproportionate time trying to decipher one obscure script. And if, as is often the case, the obscurity reflects intellectual confusion, then the answer will not attract high marks anyway.

I can almost hear the likely response: 'But this is all due to pressure of time we are scribbling away like mad to get it all down in three hours. There is no time to think it out or write it down clearly.' My response is, that quite a lot of the time pressure comes from trying to write too much. The typical confused and illegible answer is also long - maybe a 'broadside' as discussed under point (3). In such cases, 5 minutes thought might have saved 15 minutes writing, and yielded a better answer.

*(5) Don't be too easily put off.*

There is a saying among musicians that the most skilful performer is not the one who never plays a wrong note (he doesn't exist) but the one who, if something does go wrong, can recover rapidly and carry on as if nothing had happened. Similarly, the best examination candidate can recover from shocks, surprises and even errors.

Suppose that, following the advice under item (2), you read through all the questions, only to form the first impression that you can't do any of them. Maybe the examiner seems to have concentrated on your least favourite area of the syllabus: maybe all the questions look very difficult. Don't walk out in despair: I have known candidates who did this and regretted it five minutes later. Reflect that your first impression was almost certainly wrong: and have another look. Examination papers are rarely, if ever, uniform in style and difficulty: there must be some relatively straightforward topic on which you can make a start. Remember, too, that in a scientific subject specific items which you don't know or can't recall can sometimes be deduced from basic principles. Once you have done something - even if only half a question - the initial block will be overcome, and you will tackle the rest of the paper with more confidence.

Suppose that, having worked for some time on a question, you realise that something has gone wrong. Maybe you had misunderstood the question and have answered along the wrong lines. Maybe, on solving a numerical problem, you get an answer whose order of magnitude is obviously wrong: or some other check fails. Again, don't be too hasty. Check again that the apparent error is a real one, before you do anything drastic. Estimate how much time there is for a second attempt. If you have followed the timing guidelines of item (2), you will probably have some time left though not enough to answer a complete question in a leisurely manner. Decide how best to use this remaining time. According to circumstances, you might (i) write a new answer covering most of the ground as briefly as possible, (ii) re-check critical parts of a problem, (iii) sketch briefly a method of attack on a problem you haven't got time to solve, (iv) write a sentence telling the examiner that an error has occurred, and why you believe this to be the case. The amount of credit you get for a partially wrong or incomplete answer can usually be enhanced by intelligent recovery of this kind.

*(6) Check your own work.*

This is implicit in several of the foregoing principles, but it is worth separate emphasis and, of course, applies not only to examinations. The following types of check should become habitual.

(a) Read through any completed piece of written work. Look for completeness, correctness, clarity and precision in both the material and its expression. It is easy to make minor errors the first time round, but most of them should not survive re-reading.

(b) Check numerical work by a method different from its original derivation. For example, if you solve an equation numerically, check the final result by substituting back into the original equation (not by just going through the solution process again).

(c) Check general theory by testing with special cases. It is likely that some specific example is well known or easily checked, for example a degenerate set of parameters (how does this resonant circuit behave if the damping is reduced to zero?), or some aspect of asymptotic behaviour (does this waveform tend towards its d.c. value as  $t \rightarrow \infty$ ?).

(d) Check an algebraic expression with physical meaning for dimensional consistency. For example, if in working out a problem in circuit theory you obtain the equation (using conventional notation)

$$LC - \frac{1}{4CR} = \frac{L}{2R}$$

don't try to solve it: something is obviously wrong.

(e) These checks on algebraic work have their counterparts in dealing with logical expressions, algorithms, etc. Look for special cases, consistency of type, the appropriate hazards, etc.

Such checks may be applied at the end of a piece of work, to locate errors: but it is often useful to apply them as you go along, and thereby avoid most of the errors that might have been.

### **Concluding summary.**

University examiners are human beings with the usual sympathies, and are much happier if they can pass candidates than if they have to fail them. But they have a professional duty to set a standard, and to assess your attainments in relation to that standard. They cannot pass you just because they think you might have been able to do Question 5 if you had actually got around to trying it. Essentially, you can help them to pass you by showing clearly what you can do. A long and varied examining process gives you that opportunity. To do yourself justice you must make a serious and determined attempt at all, or nearly all, the examination: you must answer the questions as set, with reasonable clarity. The self discipline required to make such a systematic attempt, to check and correct your own work, to maintain composure in the face of difficulties, and thereby to demonstrate your own talent at its best, is something you are most likely to achieve if you have laid the foundations earlier in the year. It is something which, once achieved, is likely to stand you in good stead throughout your subsequent career.