

Principal Assessor Report 2002

Assessment Panel:

Engineering

Qualification area

**Subject(s) and Level(s)
included in this report**

Mechatronics Higher

Statistical information: update

Number of entries in 2001	22 from 3 centres
Pre appeal	22
Post appeal	22

Number of entries in 2002	26 from 4 centres
Pre appeal	26
Post appeal	26

General comments re entry numbers

In the first three years of the qualification there has been a steady growth in both numbers and also presenting centres. This growth is encouraging particularly in light of the very difficult trading and sector situation. This situation has existed because of both local and global factors in the Technology and Manufacturing sectors.

The new centre this year had candidates from local secondary schools studying within the FE College. Next year they hope to retain this type of candidate and also attract more traditional FE full time candidates.

8 candidates from 3 centres who had registered for the examination did not sit the paper.

General comments

Last year saw a move to a wider range of candidate ability than the previous year and this year this 'wider range' was sustained. Additionally there were some candidates of excellent ability. Encouraging for the centres (and the setters) is the fact that the top 5 candidates contained representatives from all 4 centres. Also the lowest 5 candidates represented 3 out of 4 of the centres.

The most able candidates showed a very good grasp of the subject with 6 candidates achieving over 75% and the top candidate 92%. The markers commented that the answers given by these candidates were in some cases almost 'model answers'. The Section A questions are mandatory and tested a wide range of topics with only a portion having more stretching parts. The Section B questions provided more integration in assessment and also stretched candidates more. In Section B the particular scenarios and issues presented in the examination will almost certainly never have been seen by the candidate before. Excellent performance here clearly shows candidates possessing a well developed grasp of both the principles and application of the subject.

Overall there were areas of weakness but there was no particular area of the subject where all candidates were failing either through not answering or providing incorrect responses.

Of those who failed to gain an award (up from 27.3% in 2001 to 38.5% in 2002) there were no 'near misses'. There is a large 'gap' between successful and unsuccessful candidates – anecdotal evidence from centres suggests that there are two different candidate groups: one group is very interested and/or has a natural ability or flair for the subject whilst the other group is less able, less motivated and/or struggles with the complex nature and systems approach of this technology rich subject.

Grade boundaries at C, B and A for each subject area included in the report

Upper A	85
Lower A	70
B	60
C	50

General commentary on grade boundaries

Notional percentage cut-offs for each grade

Question papers and their associated marking schemes are designed to be of the required standard and to meet the assessment specification for the subject/level concerned.

For National courses the examination paper(s) are set in order that a score of approximately 50% of the total marks for all components merits a grade C (based on the grade descriptions for that grade), and similarly a score of 70 % for a grade A. The lowest mark for a grade B is set by the computer software as half way between the C and A grade boundaries.

Comments on grade boundaries for each subject area

This year there were no examination paper issues that were considered to have affected the results. Because of the particular mark distribution this year, if the actual set marks had varied a little the end result would have been generally the same (as few candidates' marks lay on the grade boundaries). Grade boundaries were therefore set at the normal a priori marks.

During marking there was some discussion about Q4, Q5(a)(i), Q5(a)(ii), Q10, Q13(c) and Q13(f). However the overall conclusion was that no adjustment to grade boundaries was needed.

Q4 could be considered in two ways depending on the rest position of ARM1 and ARM2. Either would lead to a workable solution but any initial choice by a candidate would result in a different set of follow-on statements. Either solution was accepted if the rest of the candidate's answer was consistent. No adjustment was therefore needed.

Q5(a)(i) was not well answered but the term does have a precise meaning in the subject area. No adjustment was therefore needed. Changing usage in wider spheres may make this question a less satisfactory one to ask in future as the number of potential answers is becoming increasingly diverse.

Q5(a)(ii) similar to Q5(a)(i) above. Although setters sought to limit the scope of the question by including the phrase, "... in the context of a program development system ...", it was still possible to link this, via Q5(b) to robotic systems and thus give a wider interpretation. Markers accepted both the wider and more limited scope in answers provided that the content was acceptable. No adjustment was therefore needed.

Q10 could be considered in two ways depending on whether the working space is considered as two linear co-ordinates or a single plane. The question is worded to strongly imply the former but the latter is not excluded. Markers did not penalise the single candidate who chose to answer on the basis of the latter. No adjustment was therefore needed.

Q13(c) The Scrutineer queried the appropriateness of the term "pneumatic air" used in this question. After discussion markers and the PA decided the term was appropriate but audited candidate responses in case the term was causing problems. The actual question could be considered as not too difficult if you know the answer and most candidates would be expected to know this. Of the 18 candidates who attempted this optional question 13 (72%) answered it completely correctly. No candidate scored a half mark. It was therefore concluded that there was no basic problem with the question as worded and therefore no adjustment was needed.

Q13(f) After marking and during marker check there arose considerable discussion about the acceptability of a certain type of answer to Q13(f). The discussion ranged around the aspect of 'people' being a hazard. After agreement had been reached as to the importance of considering people as hazards, all papers for Q13(f) were checked to ensure a consistency of interpretation and marking. No adjustment was therefore needed.

Comments on candidate performance

General comments

The following sections provide specific comments on candidate performance.

Areas of external assessment in which candidates performed well

The following questions or part questions were generally well answered by most candidates who attempted them, at most centres (>65% at all centres) :

Q1(a), Q2(c), 11(a), 11(f)(i), 13(b)

These covered :

Example of particular type of sensor, changing of controlling actions, explaining given simple PLC ladder diagram, listing safety features, robotic drive system comparisons.

In addition to the above, the following questions or part questions were generally well answered by most candidates who attempted them, though not at all centres (average of all centres >65%) :

Q2(a), 3(a), 3(b), 3(d), 4, 6, 7, 9(a), 11(c), 11(f)(ii), 12(b), 13(a), 13(c)

These covered:

Types of robots, coding systems (but not BCD which was less well answered), flowchart of conveyor system plus suitable actuator, drawing a labelled block diagram of micro-controller system, movement sensor and waveforms, open/closed loop block diagram, adding functionality to PLC ladder diagram, explaining safety features, flowchart of on/off controller (10 mark part of question), robotic terms, characteristics of pneumatic medium.

These lists cover quite a large part of the mechatronics topic and quite a few were framed in 'systems' terms which is an important contextual paradigm. It was particularly pleasing to see the important area of safety was well covered (although Q13(f) was not as well answered) because as in real life this must always be kept in a practitioner's mind.

Areas of external assessment in which candidates had difficulty

The following questions or part questions were generally not well answered by most candidates who attempted them, at most centres (>55% at all centres) :

Q2(b), Q5(a), Q11(e)(ii), Q13(e), Q13(f)

These covered:

Robot's external work envelop, emulators/simulators (it is likely that questions in this area would benefit from re-framing owing to changes in terminology and the decreasing importance of distinction in our context), explaining PLC ladder diagram timers, strain gauges used in robot's end effector, programming hazards robotics.

In addition to the above, the following questions or part questions were generally not well answered by most candidates who attempted them, though not at all centres (average of all centres >50%) :

Q3(c), 7(c), 9(b), 12(a)

These covered:

BCD coding, phase shift in rotational sensors, PI & PID control (though the question did yield better responses and more attempts than the previous years' questions in this difficult topic area), basic on/off control flowchart.

Areas of common misunderstanding

There was some concern in the setting team that the revised paper format this year might lead candidates to experience some difficulties. The main changes were:

- increased use of testing more than one topic area in part A questions (enabling the exam team to test a wider range of the subject topics)
- greater diversity of question framing so that all three of the Section B questions were more divergent in their approach. Previously flowcharts, which is the only sequence or state description methodology (other than textual description), were used extensively in 2 out of the 3 optional Section B questions. This was reduced to a single question this year. This change made more room for additional topic areas to be tested more extensively – in this year's case – PLCs ladder diagramming.
- extensive use was made of a Worksheet enabling an increased question scope.

From the candidates' responses and results there is no evidence of any problems arising with these changes. Also candidates appeared to cope well with transitions 'to and fro' between answer book and worksheet.

However, the following particular areas deserve comment.

Q2(b) was not well answered which suggests that the term "external work envelope" may be misunderstood. However, quite a few sketches were of different robots and others were not 'external' so the problem appears more fundamental than wording.

Figure Q4 was interpreted in a number of ways but did not cause problems as markers were aware of the variety of potential approaches.

Q5 on emulators/simulators (discussed above) did cause problems and although the setting team consider that it was a fair question, it is likely that the format and emphasis of this question ought to change to reflect

changes in perception/naming and also a decreasing importance (in mechatronics) of the distinctions highlighted by this question.

Q9 (particularly (b)) covers a difficult topic – control systems and PI/PID control. 5 candidates got full marks (5) which shows that they acquired the knowledge and the question was answerable. Candidates from one presenting centre achieved no marks for part (b) suggesting a knowledge or understanding gap there.

Q10 was poorly answered by 2 centres despite the question being similar to questions covered in the NABs which the candidates had presumably covered by the time of the examination. The issue of the wording is also discussed in the comments on grade boundaries.

Recommendations

Feedback to centres

Generally all centres demonstrated, via their candidates, that they had covered the required subject areas.

Regarding well answered questions, these included 1, 2, 4,6 and 8 in section A. Questions not very well answered included 5, 9 and 10 (some centres) in Section A.

Approximately equal numbers of candidates answered each of three optional questions in Section B (15 v. 17 v. 18) which suggests no weakness or aversion to any of three areas/approaches represented there. Performance in each question was also well balanced when the averages are compared (Q11 = 69% of available marks, Q12 = 63%, Q13 = 61%) although these figures hide some 'textbook exemplar' responses (> 92% of available marks) from a number of excellent candidates.

Only two candidates out of 26 failed to answer 2 Section B questions, but a number of candidates either did not attempt all Section A questions or failed to gain any marks for a question.

Occasionally answers were seen in which the volume and depth of response was vastly different (too little or too much) for the available marks. Candidates should be trained to tailor and size their answers having taken account of the available marks (e.g. a 1 mark question asking to name something is unlikely to need several lines of discussion/description).

Writing was generally legible (although a few could have written larger) and the diagrams were quite good and appropriate for the timed situation. Spelling was interesting at times but not penalised where understandable.

Switching between workbook and worksheet appeared to cause no problems to candidates with only a few minor transgressions noted in the placing of answers.

Time management in answering the paper appeared generally good with more evidence of running out of answers/valid responses than running out of time.

Candidates who did not achieve a pass failed to do so by a considerable margin. There was quite a gap between the successful and unsuccessful candidates. It should be remembered that unsuccessful candidates who achieved all the continuously assessed units can re-take the external examination at a future presentation to gain the full award. Centres should consider reviewing their admissions and progression policies to ensure candidates are not being entered for assessments beyond their capability. The lowest overall mark was 28% which still showed a degree of some understanding of the topic. To boost the performance of this under-performing group it is likely that extra work with candidates will be needed.

In the majority of centres, around 25% of expected candidates failed to sit the examination – if they do not already know, centres should determine the reasons for this high absenteeism.

Finally, from the marked scripts, and particularly the evidence from the better candidates, staff within centres should be encouraged by, and commended for, the quality and depth of understanding being demonstrated by candidates. This is particularly true in the technology rich area of mechatronics, where candidates rarely have any relevant previous knowledge or experience of the subject prior to joining the course. Well done.