AM EXAMINERS’ REPORT MAY 2010

AM Graphical Communication
May 2010 Session
Examiners’ Report

Part 1: Statistical Information
The examination consists of two written papers, each of three hours duration. Each paper carries 100 marks and a candidate’s final result is determined by combining the scores obtained in Paper I and Paper II with equal weighting.

A total of 21 candidates sat for the examination.

The distribution of grades awarded in the May 2010 session is given in Table 1.

<table>
<thead>
<tr>
<th>GRADE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Abs</th>
<th>Total</th>
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<tbody>
<tr>
<td>Number</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>21</td>
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<tr>
<td>% of Total</td>
<td>4.76</td>
<td>19.05</td>
<td>33.33</td>
<td>23.81</td>
<td>4.76</td>
<td>9.52</td>
<td>4.76</td>
<td>100</td>
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</table>

Part 2: Comments regarding performance
This section gives comments on the performance of the candidates in each of the questions set in the two papers. They are intended to aid teachers and candidates in preparation for future examinations.

Paper 1
Eight questions were set and candidates had to answer any five. All questions carried a total of 20 marks.

Question 1 – Graphical statics
The question featured a heavy beam loaded with point and uniformly distributed loads (udls). The beam had to be analysed graphically to derive the support reactions and the variations of the shear force and the bending moment.

The question was attempted by thirteen candidates, making it the second most popular. A very poor performance was recorded, with only 3 candidates just topping half the full marks. This was attributed to the candidates’ inability to break up the udls correctly. In fact none of the students considered the total 30kN weight of the beam as five point 6kN loads acting on each metre length of the beam.

Some candidates even failed to recognise the force diagram as a vector diagram. The line segments used to construct such diagrams should carry arrowheads representing the sense of action of the forces.

The closer of the funicular diagram was another common pitfall. In most cases the right-hand end of the closer was incorrectly pinned to the rightmost point of the funicular diagram, corresponding with the right-hand end of the beam. Such a closer yielded wrong support reactions when transferred to the polar diagram. The right-hand end of the closer, instead, had to join up with the point in line with the right-hand reaction \( R_R \).

Plots of shear force and bending moment need to distinguish between positive and negative regions. Knowing the nature (i.e whether +ve or –ve) of these qualities is just as important as knowing their magnitude. No one candidate realised that udls effectively give rise to shear force diagrams made of inclined lines whose gradient represent the intensity of the loading. In fact all the candidates left the shear force plots in their ‘stepped’ form.
Question 2 – Conic section

The question treated the hyperbola as a section of a cone. Eleven candidates tried the question; one candidate got full marks whilst five others got more than a pass mark.

Part (i) consisted essentially of a simple exercise in orthographic projection. Given two views, the candidates had to consider suitable points between A and V and derive the required left end elevation. Points are ‘suitable’ if they serve to derive a smooth profile of the required conic section. In this sense, they needed to be strategically spread to cover the region adequately. Two major methods could be used: the generator method or the horizontal slice method. Although these methods are covered and practised since the secondary schooling, five candidates could not even get started.

Six of the eleven candidates tackled only parts (i) and (iii), leaving out part (ii) completely. These candidates must not have been familiar with the use of the focal sphere to deduce the directrix and foci of conic sections.

Question 3 – Solid resting on an oblique plane

The question tested the candidates’ knowledge about oblique planes. Through a logical sequence of parts, the question was designed to lead the candidates to produce a plan and a front elevation of a triangular prism resting on an oblique plane.

Ten candidates opted for this question, but only four achieved more than half the full marks. Of these, one candidate scored full marks.

All the candidates, but one, got as far as part (i). This consisted in drawing the curve of intersection caused by a hole drilled through the prism. All successful candidates figured out the need to assume suitable points in the given plan and locate them in the front elevation.

All candidates knew how to convert the oblique plane into an inclined perpendicular plane. A minority, however, performed the conversion whilst compromising on the expected accuracy. In these cases the transformation was affected using a vertical drop of length beneath the VT that was somewhat too short. The vertical distance employed should be of a sensible and appreciable length to minimise the errors.

The derivation of the plan and the front elevation posed difficulties to all but one candidate. It was an exercise of auxiliary projection in reverse order. Such work can become quite daunting unless the students choose suitable projection points to follow. Assuming an excessive number of such points may also prove counterproductive.

Question 4 – Loci

The question featured the quick return mechanism commonly found on shaping machines. The question attracted twelve attempts, with only four candidates scoring half the full marks or more. No candidate got full marks.

The work submitted suggests that some of the candidates found difficulty understanding the question. This is in spite of the logical step-by-step style supported by the consecutive parts of the question.

None of the candidates realised that the limits of both the productive and return strokes occur when the crank and the slotted link are perpendicular to one another. A simple construction of a tangent from pivot O to the R50 circle was all that was required to find the limiting positions of A.

Only a very small minority produced a respectable displacement diagram and progressed to the very end of the problem.
Question 5 – Cam

The question featured the design of a radial arm cam to satisfy given performance data. Like in previous examination sessions, this was the question with the largest uptake. Of the nineteen students who tried it, twelve obtained half the full marks or more. Nobody scored full marks.

The majority of the candidates had no trouble finding the zero lift level. Difficulties were however experienced to establish the inclination of the ‘lift’ axis of the displacement diagram; this was necessary before the displacement diagram could be drawn. The method involved setting the total 48mm lift as a chord length to the R105 circle. This was achieved by drawing a circle of radius 48mm, concentric with the roller at its zero lift position. The line between the R48 circle centre and the intersection with the R105 circle then represented the ‘lift’ axis of the displacement diagram. The majority of the candidates produced satisfactory performance diagrams.

Another major common pitfall concerned the rotation of the cam. It is customary, when designing a cam, to consider the cam to be stationary and rotate the follower incrementally, in a direction opposite to that of the rotation of the cam. As the question stated that the cam rotated clockwise, the follower was to be moved incrementally in the anticlockwise direction.

A number of candidates had difficulty rotating the follower incrementally. Although the majority did draw the circle concentric with the cam centre and passing through the radial arm pivot, many failed to draw the R105 arm locus for each incremental position.

Three candidates went completely off track by treating the radial arm cam as though it were an offset cam.

Question 6 – Helices

The question involved drawing the centre spindle of a compass as described in a given scheme. Twelve candidates attempted the question but only four got a pass mark or more. All of these four passes however, demonstrated outstanding performance, with three getting full marks and the other just missing it for a mark. The rest of the candidates only got insignificant scores.

The scheme explicitly indicated that the thread to the left of the centre wheel had to be right-handed. Despite this many produced a left-handed thread. Moreover many drew it as a single-start, when the question text and the scheme both implied a two-start thread. It was apparent that most of the students could not distinguish between the pitch of the thread and the lead of the thread and so could not interpret the scheme correctly.

For any thread, the pitch of the thread determines the depth of the toothed part of the thread’s cross-section. For a square thread the depth of each tooth is half its pitch. And the pitch of the helices used to draw a thread is always equal to the lead of the thread. The only four candidates who knew these concepts had absolutely no difficulty drawing the centre spindle.

Another word of advice goes to suggest, to include with the graphic solution, any arithmetical working or statements that show how the key parameters of the thread (the pitch of thread, the lead of thread and the pitch of the helices used in the thread) are derived. Thus statements like,

\[
\text{Lead of thread} = \text{Pitch of thread} \times \text{Number of starts}
\]

and the corresponding arithmetic should ideally be included to support the graphic solution of these kind of questions.

Solutions to problems on threads are naturally based on the projection of helical paths. It is recommended that these are properly annotated in two ways. Firstly, the directions of the two kinds of motion (the rotary motion and the linear motion) generating the helical paths should be clearly indicated. Secondly, the
distances representing the key parameters of the thread (such as the pitch of thread and the lead of thread) should be suitably labelled.

Question 7 - Gears

This was the least popular question, with seven candidates choosing it and five getting half the marks or more. The question concerned drawing two spur gears in mesh.

To start drawing a gear two fundamental parameters need to be known: the module and the number of teeth on the gear. The number of teeth on the wheel was given directly but the module (of either gear) and the number of teeth on the pinion were superficially hidden under the values of associated parameters like the gear ratio and the centre distance. Those who failed to score good marks found difficulty interpreting these associated parameters to derive two simple simultaneous equations in $m$ (module) and $t$ (number of teeth) and solve them.

It was observed, however, that all candidates knew the procedure and proportions to use when drawing the gears once the values of $m$ and $t$ were assumed. An improvement was definitely registered over last year’s performance.

The request to use a scale of 2:1 was not always honoured.

Question 8 - Planes

Being answered by eight candidates, this was the second least popular question. A very poor performance was registered, with only one candidate scoring more than half the full marks. All the other candidates demonstrated very poor competences in the subject area.

Part (i) was attempted by the majority of the candidates. This concerned finding the curve of intersection between a pyramidal roof and a square-section ventilator. This was best found using a combination of two methods: the generator and the horizontal slice method. Whenever the generator method does not yield accurate results, due to the generator and the projection line being almost parallel, the horizontal slice method is recommended. This was particularly true for corner 2 of the ventilator section. Here, a hexagonal section passing through 2 in the plan readily placed point 2 accurately in the elevation.

Furthermore, intersections between plane surfaces (like this case) do not require the consideration of intermediate points. The consideration of the ventilator’s four corners, along with points 1 and 4, was sufficient to derive the curve of interpenetration. Some candidates, instead, stayed taking extra points in between, reaping no additional results whatsoever.

Part (ii) asked for the dihedral angle included between the faces of the pyramidal roof. Most candidates failed to realise they needed to project in a direction perpendicular to OB (to obtain its true length), and then look straight into it in order to get the folded part roof AOB showing as a bent line. In this position the two planes AOB and COB show up as edges, giving directly the angle between them.

Part (iii) requested the development of plane OBC, using the technique of auxiliary views. Thus solutions obtained using other methods could not be credited.

Paper II

Five questions were set in all and the candidates had to answer question 1 (compulsory) and any other three. The compulsory question was allotted 34 marks whereas the other four carried 22 marks each.
Question 1 - Perspective drawing

This compulsory question featured an estimated two-point perspective drawing of a back garden/swimming pool area of a large residence. The overall performance was good with sixteen candidates scoring beyond half the full marks.

Most candidates did produce preliminary sketches, but in a few cases these were based on pictorial methods other than the two-point perspective system that was requested. Thus, sketches based on the isometric, planometric and one-point perspective systems could not be credited. These would have been appropriate had the choice of the system of drawing to use been left open. Despite their sketchy nature, these quick preliminary drawings still need to represent the proportions of size of the exercise in hand and also be faithful to the basic principles of the drawing system used. Also, if the sketches are to serve their purpose, the differences between the sketches should be readily apparent. On the other hand, they should not be elaborate and need not include the details of the final illustration.

In this type of questions, the construction of a perspective grid, representative of the proportions in hand, is the key stage towards a successful illustration. In most cases the method used to construct and divide the perspective grid was hardly recognisable.

A significant number of candidates did not make use of colour, tone and texture, as requested. On the other hand some students suggested sample materials even though this was not requested. All this goes to suggest that the some candidates did not read the question properly.

Other marks were lost for not ‘making the best use of the space available’ on the A2 drawing sheet.

Question 2 – The design of a package

Fourteen candidates chose to attempt this question, with ten achieving more than a pass mark. The question required the candidates to design a package to hold a personal player (MP4) for retail. The package had to indicate clearly the features of the products through the use of ideogrammatic symbols strategically printed on the package.

As a general comment, it was noted that the work carried out by most candidates was not orderly presented. The layout of answers should be organised in a way that the work can be easily followed in relation to the question parts.

It is the opinion of the examiners that a set of ideograms appearing on a package would ideally make use of a common style. A common shape format, say circular, a common background colour, say yellow, a common kind of border, say a thin band, would for instance, make a suitable style. Black (and white, where appropriate) symbols would then readily stand out making the package attractive and eye-catching.

The package was also meant to facilitate the display of the product. Suitable designs would incorporate a transparent cellulose acetate window or a hard plastic top cover. Such kinds of packages are commonplace in today’s technological world of gadgets. And students of graphical communication should develop an observant eye for such package design examples that are regularly presented in shop windows.

Question 3 – The design of a leaflet

The question concerned the design of an informative leaflet to accompany each package of a personal player (MP4). Attempted by only nine candidates this question attracted the lowest uptake. Of these, three were unsuccessful, obtaining less than half the full marks.

The candidates were asked to compile their answer whilst following the basic steps of the design process. In spite of this, a minority rushed to produce the final solution, ignoring completely the initial stages which
are meant to ensure a more effective design. The stages of written and graphical analysis help the designer carry out a more methodical and objective solution. Through these steps the designer identifies the requirements of the design situation and through preliminary sketches convinces himself on the most effective graphics that convey the message.

Only a small minority made good use of colour.

**Question 4 – Computer graphics**

This was the most popular question, with each of the twenty candidates who actually sat for the exam, choosing it. A good performance was recorded. Most of the candidates did well with as much as five candidates scoring full marks. Only three were unsuccessful.

The majority deciphered the data variables correctly and produced the required image represented by the given short program. Even the mirror operation was performed correctly. The most common pitfalls were registered with parts (c) and (d) which concerned the rotation (+ve and –ve) of patterns obtained in earlier parts of the question.

Only a small minority found difficulty writing the program that would produce the same result obtained in part (a) but which started from the bottom right corner of the given grid. It turned out that this merely involved changing the colour numbers and interchanging the variables that followed the DRAW commands.

**Question 5 – Graphical comparison and representation**

Attempted by 15 candidates this was the second most popular question. The performance, however, was very poor. Nobody scored full marks and only three candidates scored beyond half the full marks.

The candidates were asked, in two separate parts, to represent and compare graphically, in 3D and 2D, particular features of a sample of personal players (MP4s). In the solution of either part, the theme of MP4s was to be readily recognisable. The question also encouraged the students to present the data in an innovative and imaginative form, preferably using the least of words. These requirements were hardly met by any of the solutions.

A design is valued for its ability to convey its intended message. Thus the appropriateness of such a solution would be judged by the ease with which a potential reader recognises the topic of MP4s and gets to compare the different models without undue effort. Such ‘rapid’ understanding may be facilitated by incorporating the use of colours. Contrasting colours, for example, may be used to distinguish between the same features of different adjacent models on a single chart. On the other hand, the same colour might be employed on different charts to represent different features of the same model.

As students of graphical communication, the candidates should strive to limit the use of words and instead employ graphics. Thus a proper plot comparing the battery life of the different MP4s may be complemented by a suitable symbol that readily indicates the consumptive nature (i.e. the fact the batteries discharge with use) of batteries. And here it is only right to emphasise the need that symbols represent the actual features being studied. For instance, representing battery life is different from representing batteries. Likewise representing sound quality is different from representing sound.

Whenever plots are employed to represent/compare data, the use of a proper scale becomes necessary. The axes of the plots then need to be annotated with key subdivision data values to improve legibility.

In general the solutions presented left much to be desired and the performance was very disappointing.
General comment

The overall performance improved slightly with respect to that registered in May 2009. The standard of responses varied quite considerably. While a few candidates fared generally well, the remainder failed to produce work of the quality expected at advanced level.

The Chairperson
Board of Examiners
July 2010