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DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 3

Candidate session number

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Tuesday 10 May 2011 (morning)

1 hour 15 minutes

Examination code

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INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from one of the Options.
- Write your answers in the boxes provided.

Option A — Food science and technology

A1. The website of the McDonald's fast food company allows customers to access nutritional information for their meals. **Figure A1** shows data for a meal comprising of a cheeseburger, a large portion of french fries and a medium chocolate milkshake. The results are compared with the Guideline Daily Amounts (GDAs) for average adults. The average adult women's GDAs are: energy–2000 calories; fat–70 g of which saturates–20 g; salt–6 g.

Image and question (a) removed for copyright reasons

(This question continues on the following page)

(Question A1 continued)

(b) Outline **one** reason why a balanced diet should contain some fat. *[2]*

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(c) Explain **one** implication of excess fat intake for health. *[3]*

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A2. **Figure A2** shows a woman selling food in the street.

Figure A2: Woman selling food in the street

[Source: www.upload.wikimedia.org/wikipedia/en/4/4b/StreetFoodLAOct0904.jpg]

(a) Define *food hygiene*. *[1]*

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(b) Outline **one** consideration relating to the control of food hygiene for food which is available for purchase in the street as shown in Figure A2. *[2]*

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A3. **Figure A3** shows a tomato which has been spoiled.

Figure A3: Spoiled tomato

[Source: http://en.wikipedia.org/wiki/File:Moldytomato2500ppx.jpg]

(a) Identify the type of spoilage shown in Figure A3. *[2]*

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(b) Outline how sun drying of tomatoes preserves them. *[2]*

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A4. Explain **two** lifestyle issues which have contributed to an expanded market for organic products in some countries. *[6]*

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A5. (a) Describe *undernourishment*. *[2]*

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(b) List **two** implications of climate change that may lead to increased undernourishment in the developing world. *[2]*

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(c) Outline **one** strategy to deal with the implications of climate change to increased undernourishment. *[2]*

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A6. Dietary vitamin A deficiency causes between one quarter and half a million children to go blind each year and more than half these children die within a year of going blind. β-carotene, also called provitamin A, can be converted into vitamin A in the body preventing deficiency. **Figure A4** shows white rice and *Golden Rice*. *Golden Rice* was first created in 1999 using genetic engineering principles. It produces β-carotene which accumulates in the grains. The intensity of the golden colour is an indicator of the concentration of β-carotene. The scientists working on *Golden Rice* hope to provide the recommended daily allowance of vitamin A as β-carotene in about 150 g of rice which is the daily rice consumption of children in societies where rice is the staple food, *e.g.* Bangladesh and India.

Figure A4: White rice (left) and *Golden Rice* (right)

[Source: www.goldenrice.org/image/silver+gold.jpg]
Courtesy Golden Rice Humanitarian Board, www.goldenrice.org

(a) Explain the principles underpinning genetic modification of crops, such as *Golden Rice.* *[3]*

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(This question continues on the following page)

(Question A6 continued)

(b) Discuss **one** ethical issue underpinning public concerns about the safety of genetically modified foods, *e.g. Golden Rice.* *[3]*

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A7. Suggest **three** reasons for the increased incidence of food allergies and food intolerance in developed countries. *[9]*

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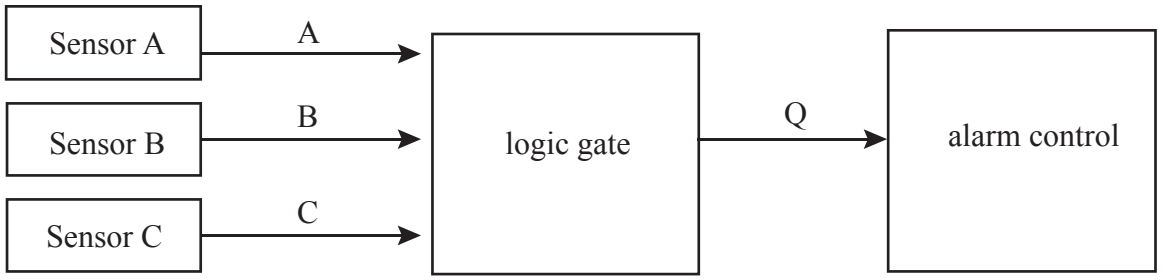
Option B — Electronic product design

B1. A security system has three sensors: A, B and C, which activate an alarm if an intruder is detected. Each sensor passes logic 1 to the logic gate if an intruder is detected in its zone. The alarm control system is activated when the logic gate provides logic 1.

Figure B1: Control circuit for a security system



(a) State the logic gate required for the security system. *[1]*

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(b) Draw the truth table for all possible combinations of inputs. *[2]*

(This question continues on the following page)

(Question B1 continued)

(c) Sensor A is a pressure pad, placed underneath a carpet in the entrance to zone A. It acts as a push switch and is closed when an intruder steps on it. Draw a circuit for sensor A. It must provide logic 1 when the switch is pressed and logic 0 at all other times. *[3]*

B2. (a) Define *dematerialization*. *[1]*

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(b) List **two** ways in which manufacturers can minimize the damage caused to the environment during the life of an electronic product. *[2]*

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B3. (a) Outline **one** difference between a digital and an analogue signal. *[2]*

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(b) Outline **one** reason why a Schmitt trigger NOT gate is more suitable than a standard NOT gate when converting an analogue signal to a digital signal. *[2]*

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B4. Discuss **one** advantage and **one** disadvantage for an Internet service provider operating a satellite-based system rather than an optical fibre-based system. *[6]*

Advantage:

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Disadvantage:

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B5. (a) Outline **one** way in which convergent technologies could enhance human communication. *[2]*

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(b) Outline **one** way in which converging technologies could be applied to national defence. *[2]*

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(c) Outline **one** way in which converging technologies could improve human health. *[2]*

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B6. (a) Explain **one** way in which modern electronic computer systems are used to monitor and perform functions in a smart home. *[3]*

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(b) Explain why the capabilities of programmable interface controllers (PICs) make them particularly suitable for controlling a smart home. *[3]*

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B7. Explain the importance of global standards for digital electronic products and the benefits for users and manufacturers. *[9]*

Option C — CAD/CAM

C1. **Figure C1** shows a ring using two forms of CAD modelling – solid modelling and wire frame modelling.

Figure C1: CAD model of a diamond ring

Image removed for copyright reasons

[Source: www.diamondgallerynaperville.com/media/upload/image/custom/diamond-half-wireframe.jpg]

(a) State **one** advantage of wire frame modelling for the manufacturer. *[1]*

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(b) Outline **one** advantage of the solid model for the client. *[2]*

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(Question C1 continued)

(c) Explain **one** implication of the use of the CAD model of the ring for cost effectiveness of production. *[3]*

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C2. (a) State **one** way in which CAM has impacted negatively on the workforce. *[1]*

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(b) Outline **one** way in which CAD supports flexible working. *[2]*

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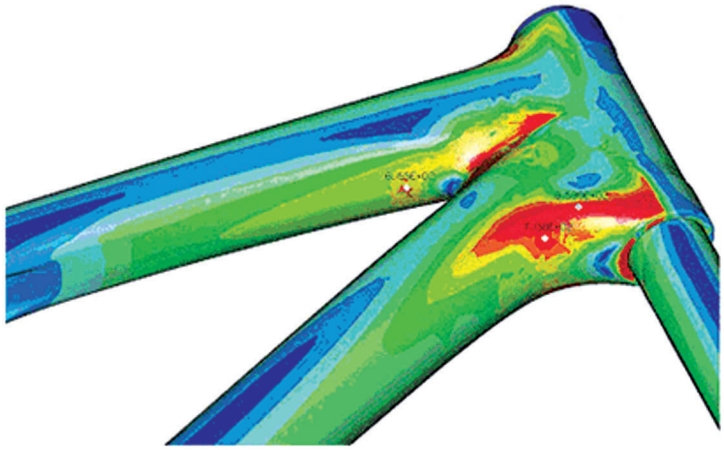
C3. **Figure C2** shows finite element analysis (FEA) data for part of a bicycle frame.

Figure C2: FEA of part of a bicycle frame



[Source: www.designworldonline.com/ArticleDetails.aspx?id=3611]
Used with the permission of Santa Cruz Bicycles.

(a) Describe what the colours on Figure C2 mean. *[2]*

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(b) Outline how the FEA image data shown in Figure C2 would be used by a designer. *[2]*

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C4. CAD software can be used to slice a solid model into thin sections. A vinyl cutter is used to cut the slices out of sticky-backed paper. The layers of paper can then be built into a 3D model. This process is called laminated object manufacture (LOM).

Figure C3: Laminated object manufacture using Boxford's RapidPro

[Source: www.boxford.co.uk/boxford/docs/products/rapid.htm]
www.boxford.co.uk. Used with permission

Discuss **two** limitations of being able to rapid prototype the object in Figure C3 using LOM rather than other rapid prototyping techniques. *[6]*

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C5. (a) Outline **one** way in which the use of a single-task robot might be considered cost-effective by a small company. *[2]*

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(b) Outline **one** way in which a multi-task robot might be considered cost-effective by a company which batch produces different components. *[2]*

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(c) Outline how a team of robots contributes to assembly-line production. *[2]*

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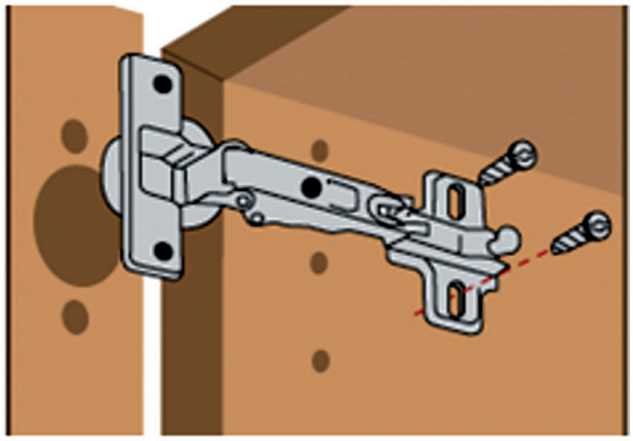
C6. Medium-density fibreboard (MDF) and knock down (KD) fittings are commonly used to make flat-pack furniture, *e.g.* kitchen cabinets. CAD/CAM can be used as a design tool to facilitate the use of KD fittings in this context (see **Figure C4**).

Figure C4: Use of KD fitting with CAD/CAM



[Source: www.westone.wa.gov.au/toolbox8/furniture/toolbox/shared/resources-dr/ask_expert/images/con-hinge.gif]

(a) Compare CAM and KD fittings to more traditional manufacturing techniques for the manufacture of the kitchen cabinet. *[3]*

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(b) Discuss **one** issue relating to the use of MDF in the manufacture of the kitchen door for the kitchen cabinet using CAM. *[3]*

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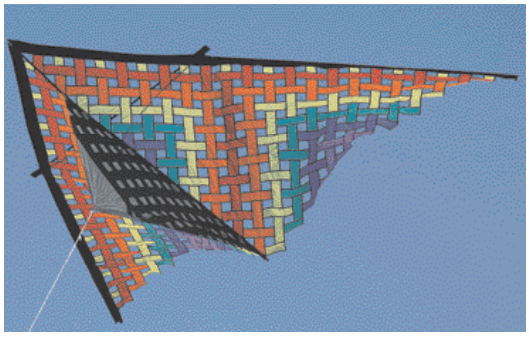
C7. Discuss **three** advantages and/or disadvantages of computer-integrated manufacture (CIM) to a car manufacturer. *[9]*

Option D — Textiles

D1. **Figure D1** shows a boy flying a kite. **Figure D2** shows a kite made of ripstop nylon.

Figure D1: Boy flying a kite

Figure D2: Kite made of ripstop nylon



[Source: http://www.cornerstonearts.org/Newsletters/April_2009.php]

(a) State **one** aspect of the specification of the material for the kite. *[1]*

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(b) Outline **one** aesthetic consideration which makes nylon a suitable material for use in the production of the kite. *[2]*

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(Question D1 continued)

(c) Explain how the characteristic of ripstop would be manufactured into the nylon for the kite. *[3]*

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D2. (a) State **one** advantage of designing smart clothing. *[1]*

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(b) Outline **one** benefit of the manufacturers of fashion clothing collaborating with electronics companies to produce wearable computing garments. *[2]*

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D3. (a) Describe the sublimation printing process. *[2]*

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(b) Outline **one** limitation of using the sublimation printing process. *[2]*

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D4. Explain **two** issues relating to the manufacture of silk substitutes. *[6]*

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D5. (a) Outline **one** benefit of manufacturers achieving the European Union (EU) flower for their textile products. *[2]*

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(b) Outline **one** environmental issue relating to the dyeing of cotton cloth. *[2]*

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(c) Outline **one** issue relating to the use of pesticides in cotton production. *[2]*

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D6. (a) Explain **one** reason why, despite the increased development of new technology, production of many textile products is still labour intensive. *[3]*

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(b) Explain **one** benefit of recycling textile products. *[3]*

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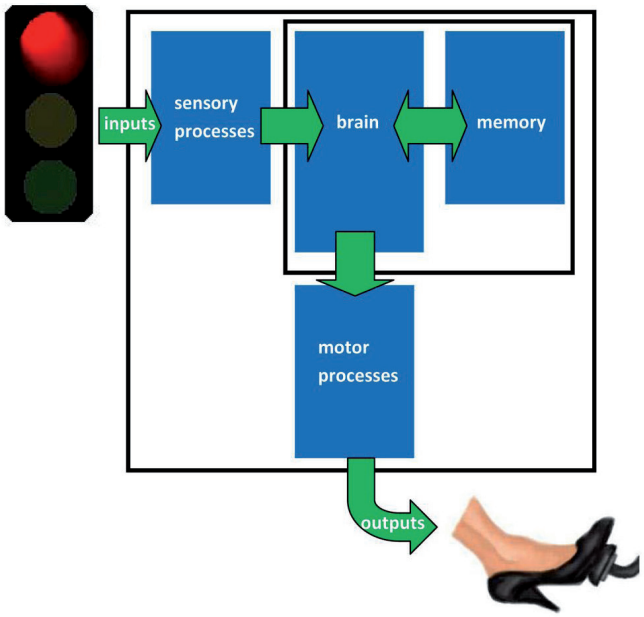
D7. Discuss **three** ways in which the use of CAD/CAM in the textile industry has helped to minimize waste. *[9]*

Option E — Human factors design

E1. **Figure E1** shows the human information-processing system in operation when a car is being driven.

Figure E1: Human information-processing system



(a) State which part of the human information-processing system is represented by a physiological action. *[1]*

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(b) Describe the sensory process in the human information-processing system. *[2]*

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(This question continues on the following page)

(Question E1 continued)

(c) Explain the function of memory in the human information-processing system. *[3]*

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E2. A student continues to wear his "favourite" pair of training shoes despite them being worn out and he has been given a new pair.

(a) State **one** aspect of the "four pleasure framework" that this is an example of. *[1]*

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(b) Outline **one** reason why the "four pleasure framework" is considered part of human factors design. *[2]*

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E3. **Figure E2** shows the Ad-specs. They are "adaptive spectacles" which have been designed for use by people in developing countries. The focal length of the lenses is easily adjusted by filling the lens with fluid using the adjustment wheels and pump. No sight test is required. For everyday use (once the focal length of the lenses has been adjusted) the pump can be removed (see **Figure E3**).

Figure E2: Ad-specs

Figure E3: Ad-specs in use with pump removed

[Source: www.adaptive-eyecare.org]
Used with permission: www.vdwoxford.org

(a) Outline **one** reason related to human factors for the size of the lenses of the Ad-specs. *[2]*

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(b) Outline **one** aspect of the design of the spectacles which has been compromised by the size of the lenses. *[2]*

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E4. **Figure E4** shows the Forest chair manufactured by Fast Italy. It is made from metal and is designed for use in the garden.

Figure E4: Forest Chair

Fast Italy forest garden armchair, designed by Robby and Francesca Cantarutti
www.gomodern.co.uk. Used with permission.

Discuss **two** physiological human factors issues in relation to the Forest chair. *[6]*

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E5. Car designers need to run tests to gather data relating to the protection of occupants in a collision.

(a) Outline **one** way in which the use of digital humans can contribute to the tests. *[2]*

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(b) Outline **one** limitation of using digital humans for the tests. *[2]*

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(c) Outline **one** way in which digital humans can increase the speed of the product cycle. *[2]*

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E6. (a) Explain **one** human factors issue in relation to the design of a railway carriage for a wheelchair user. *[3]*

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(b) Explain **one** limitation of relying on information from the Internet for the purchase of a new wheelchair. *[3]*

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E7. **Figure E5** shows an "Eye Level Cooker" manufactured by Flavel. By positioning the grill at eye-level the cooker was seen as a radical new design 40 years ago.

Figure E5: An "Eye Level Cooker"

Image: BEKO

(This question continues on the following page)

(Question E7 continued)

Discuss **three** safety issues concerning the use of the grill shown in Figure E5. *[9]*