



**PROGRAM** : BACCALAUREUS INGENERIAE  
MECHANICAL ENGINEERING SCIENCE

**SUBJECT** : DESIGN (MECHANICAL) 3A

**CODE** : OWM3A11/OWMMCA3

**DATE** : WINTER EXAMINATION  
JUNE 2018

**DURATION** : (1-PAPER) 180 Minutes

**WEIGHT** : 50:50

**TOTAL MARKS** : 100

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**EXAMINER** : DR. A. MANESCHIJN

**MODERATOR** : PROF. J. NOBRE

**NUMBER OF PAGES** : 3 PAGES

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**REQUIREMENTS** : ANSWER BOOKLETS  
NOTES - OPEN BOOK  
CALCULATOR

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**INSTRUCTIONS TO CANDIDATES:**

- ANSWER ALL THE QUESTIONS
- **QUESTION 1 IS A COMPULSORY ELO QUESTION AND MUST BE ANSWERED. A MINIMUM OF 50% MUST BE ACHIEVED FOR THIS QUESTION**
- NO WRITTEN ANSWERS IN PENCIL WILL BE MARKED – **SKETCHES MAY BE DONE IN PENCIL OR PEN**
- ONE (1) MARK PER FACT

**QUESTION 1 (Multi-disciplinary Practices):****[30]**

**[NOTE: THIS IS A COMPULSORY ELO QUESTION AND MUST BE ANSWERED. A MINIMUM OF 50% MUST BE ACHIEVED FOR THIS QUESTION.]**

A medium company called "Lawnmowers for Everyone", is established to design and manufacture electric lawnmowers, and all the staff that are to be employed by the company are in some way involved in the whole product process. It is important to know what roles they play, and what contributions they make to the "team effort". Therefore, "Lawnmowers for Everyone" will require numerous people with different skills and qualifications.

- a) Draw a diagram to show the hierarchy of the structure of the company. Use your own titles that are appropriate for the company for each element - do not copy from elsewhere. (15)
- b) For each hierarchy element of the company structure, list the main skills and qualifications that would be required for the element and state why they would be required. Use a table to present your answers (first column is the hierarchy element, second column is the skills and qualifications). (15)

**QUESTION 2 (Design Process):****[20]**

You are the Project Manager in a company that is developing two versions of an electric car. The one version is a sedan and the other is a hatchback. You have two Project Teams that are working on this development process. Each Project Team has a Project Engineer that supervises the team members, and the team members are engineers, technologists and draughtsman (the persons producing the CAD drawings for the manufacture of the cars).

- a) List the development steps, in a bullet list, from the time that you receive the contract for the development of the cars up to where all design and drawing work is completed (i.e., before the prototype is manufactured). (5)
- b) Describe the work that must be done for each step. (5)
- c) Since the main difference between the cars is the fact that one is a sedan and the other is a hatchback, state in one sentence how you would optimise the design, testing and production of the cars for the purpose of reducing development time and production costs and list, in bullet form, which elements of the cars you would consider for use on both versions. (10)

**QUESTION 3 (Systems Engineering Elements):****[20]**

For a standard vehicle security entrance boom that is powered electrically and uses a card and fingerprint identification system, similar to the UJ vehicle entrance booms, draw and annotate the functional analysis for the boom in a block diagram format. For the annotation, give each block a number and a title, and give a one sentence description for that function underneath the block diagram.

(20)

**QUESTION 4 (Standards):****[10]**

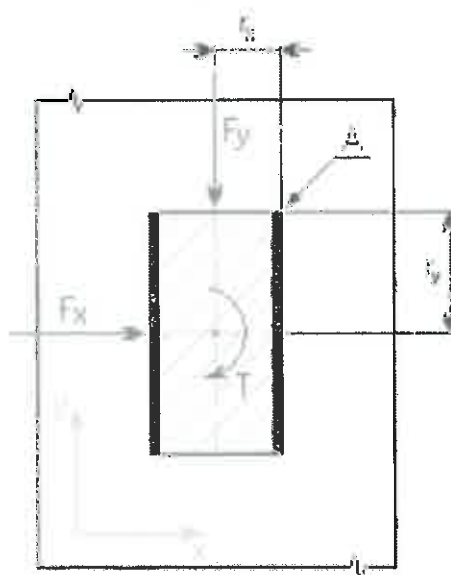
- Define what an engineering standard is and what it is used for. (4)
- List, in bullet format, the contents of an engineering standard for the design and testing of a standard 3-pin plug. (6)

**QUESTION 5 (Welding):****[20]**

The fillet welds shown in the figure below hold a steel plate in place against a flat base plate ( $t = 13 \text{ mm}$ ). The steel plate is  $19 \text{ mm}$  thick and  $40 \text{ mm}$  high. The two fillet welds are along each corner of the plate as shown by the thick black lines. A torque of  $T = 300 \text{ Nm}$  is applied to the plate.

The plate strength is  $R_m = 400 \text{ MPa}$ .

Determine a suitable weld throat thickness  $a$ , and calculate the resulting "equivalent" stress in the welds.



**Fig. 5.1 Fillet Welds**