UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	SDB23403 (V2)
COURSE TITLE	:	ERGONOMICS AND HUMAN FACTORS
PROGRAMME NAME	:	BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN MECHANICAL DESIGN
DATE	:	03 FEBRUARY 2026
TIME	:	2:00PM - 5:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

THERE ARE 8 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

Answer all of the following questions.

(a) A person, standing upright, holds a mass of 13 kg in front of his body. The moment arm of the load is 45 cm. Determine the force that back muscles exert to maintain postural stability. Assume that the back muscles have a lever arm of 9 cm and that the Center of Gravity (COG) of the upper body is located directly above the lumbar spine.

(5 marks)

(b) Describe four advantages of the Standing Work Position and briefly define four workspace design faults which increase postural stress in standing workers.

(8 marks)

(c) A 53 years old male worker weighing 55 kg lifts 25 kg bags of cement onto a conveyor belt. His spinal compression at L5/S1 is 4800 N. Determine the spinal compression tolerance limit and comment on the safety of the task. Given that the LMS for L5-S1 is 48 and use 1 for male sex where: CS = – 13331.2 – (73.7 x Age) – (962.6 x Sex) + (403 x LMS) + (79.8 x BW).

(7 marks)

Question 2

Answer all of the following questions.

(a) Manual handling is a common cause of injury in the workplace. Discuss three general principles for the control of manual handling hazards in the workplace.

(3 marks)

(b) A warehouse employee is required to lift 20 kg boxes from a 66 cm storage shelf to a 152 cm shelf. Before lifting, the horizontal distance from the employee's ankles to the center of the box is 40 cm. The vertical location of the employee's hands is 66 cm from the floor at the start of the lift and 152 cm at the destination. There is little anticipated twisting or turning (45 degrees). The boxes are not equipped with cutouts or there are no handles for easy grasping. The number of boxes to be lifted per hour is 30 or 0.5 per minute for an entire 8-hour day. The RWL for both the origin and destination of the lift is calculated due to the difference in vertical height. Given that the value for frequency multiplier (*FM)* is 0.81 and coupling multiplier (*CM)* is 0.9.

i. Use the NIOSH equation to calculate the Recommended Weight Limit (RWL) of both situations, origin and destination; where: RWL = LC x HM x VM x DM x AM x FM x CM.

(14 marks)

ii. Determine the Lifting Index (LI) and comment on the safety of this lifting task for both situations, origin and destination.

(3 marks)

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Answer all of the following questions.

(a) Fifth percentile U.S. male has forward reach of 777 mm. His shoulder is 375 mm above a horizontal work surface. Calculate the radius of the ZCR on the desktop.

(3 marks)

(b) Today, anthropometry data plays an important role in industrial design, clothing design, ergonomics and architecture. Besides, statistical data about the distribution of body dimensions in the population are used to optimize products. Discuss the two types of anthropometric data.

(4 marks)

(c) Osman is designing a new design of a golf cart. He wanted to design it so that most of the Perak population would be able to drive his golf-cart. His obtained the information on the stature and sitting height of users from other state which are similar to the group of users in Selangor and the data are shown in the following table. From this, Osman decided to use the RASH technique to accommodate 5th and 95th percentile measurements used in roof sitting height design of his golf cart.
Refer Below - Table1 : Mean and standard deviation for stature and sitting height. . Figure1 : Roof sitting height of golf cart. .

Table 1: Mean and standard deviation for stature and sitting height.

	Mean (x)	Standard Deviation (s.d.)
Stature	175 cm	6.9 cm
Sitting height	90 cm	3.8 cm

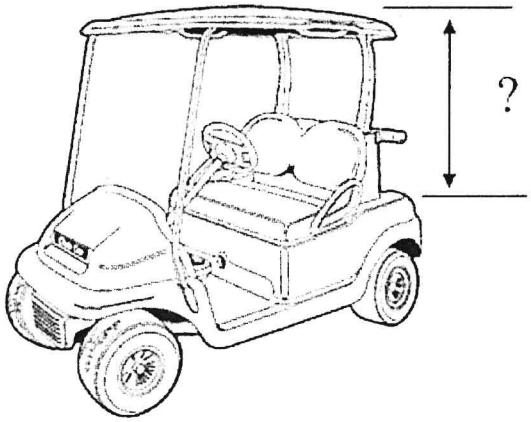

Figure 1: Roof sitting height of golf cart.

i. It is given that the values of mean and standard deviation heights of males and females in the Perak's user population are as tabulated in a following table, estimate 5th and 95th percentile values of the roof sitting height golf cart Osman's choice using scaling factors of Rapid Anthropometrics Scaled for Height (RASH) technique (please provide all answers in centimeters).
Refer Below - Table2 : Mean and standard deviation for males and females. .

(10 marks)

Table 2: Mean and standard deviation for males and females.

	Mean (x)	Standard Deviation (s.d.)
Males	1720 mm	85 mm
Females	1600 mm	75 mm

ii. By using the results of the data above, plot the Normal Distribution Curve graphs.

(3 marks)

Question 2

Answer all of the following questions.

(a) The process colour guidelines can provide the human factors professionals with a checklist of the important usability concerns related to colour. Discuss three of each guideline for colour selection in general.

(6 marks)

(b) Light has an enormous effect on our physical and mental well-being. Improper lighting conditions can cause visual discomfort resulting in issues. Discuss three effects of over-exposure of light for workers.

(6 marks)

(c) Discuss four factors that must be considered for proper lighting design at workplaces in order to perform visual tasks.

(8 marks)

Question 3

Answer all of the following questions.

(a) The National Institute for Occupational Safety and Health (NIOSH) has recommended that all worker exposures to noise should be controlled below a level equivalent to 85 dBA for eight hours to minimize occupational noise induced hearing loss. Discuss four basic principles of noise control in industries.

(8 marks)

(b) When someone is carrying out investigations of the noise produced by machines in offices and factories, supplementary information should be obtained to complement the sound level measurements. Explain three supplementary information for noise measurement.

(6 marks)

(c) Noise can distract workers and is a major source of dissatisfaction with the environment. Describe three effects of noise below 85 dB (A) on human performance and health.

(6 marks)

Question 4

A worker sprays cabinet doors at a cabinet manufacturer. Doors are suspended on an overhead conveyor and pass by the worker at a rate of one door every 90 seconds. Each door is 0.67 X 1.0 m, and of similar design. The doors pass by the worker at a height such that the bottom of the door is at the worker's mid-chest level.
The worker sits on a high stool in a completely open room. A hand-held pneumatic spray gun is used to paint the doors. The worker paints in an irregular sweeping motion. Each door takes approximately 45 seconds to paint. The spray gun weighs 2 kg, has a pistol grip handle, and has two paint lines (hoses) feeding into the bottom of the handle from a pressurized, master paint reservoir. Each paint line weighs 1 kg for 3m of hose. The worker also wears a cartridge respirator which weighs 0.6 kg made from vulcanized rubber with two cartridge filters.

(a) Identify and explain three major ergonomics or work design problems and briefly justify.

(6 marks)

(b) By using simple sketching, discuss six important parameters to quantify, measure or evaluate and determine the method used to quantify these parameters.

(14 marks)

END OF EXAMINATION PAPER