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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2022/2023**

COURSE NAME	:	HUMAN FACTOR ENGINEERING
COURSE CODE	:	BDD 41103
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ANY <b>FIVE (5)</b> FROM <b>SIX (6)</b> QUESTIONS PROVIDED  2. THIS FINAL EXAMINATION IS A CONDUCTED VIA <b>CLOSED BOOK</b> 3. STUDENTS ARE <b>PROHIBITED</b> TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS PAPER CONSISTS OF **EIGHT (8)** PAGES

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**TERBUKA**

- Q1** (a) Human factors and ergonomics (commonly referred to as human factors engineering or HFE) is the application of psychological and physiological principles to the engineering and design of products, processes, and systems. According to the International Ergonomics Association (IEA), there are three main objectives of ergonomics: efficiency and effectiveness, desirable human values, and human performance. Differentiate each of the three main objectives of ergonomics by providing detailed explanations. Use appropriate examples to support your explanations. (9 marks)
- (b) Karim Ali works as design consultant has given a task to design classroom furniture for BITARA College. The classroom furniture design includes setting up a new chair and table for students in the classroom.
- (i) Identify the anthropometric data required for designing classroom furniture. (4 marks)
- (ii) Construct and explain the body measurements diagram required for designing classroom furniture. (7 marks)
- Q2** (a) Manual handling injuries can have serious implications for the employer and the person who has been injured. They can occur almost anywhere in the workplace and heavy manual labour, awkward postures, repetitive movements of arms, legs and back or previous/existing injury can increase the risk. **Figure Q2(a)** shows a low-back biomechanical model of static coplanar lifting and given the following the kinematic and anthropometric data as shown in **Table 1**. Taking a moment around L5/S1 joint and equating it to zero, analyze and evaluate the muscle force ( $F_m$ ), Spine compressive force ( $F_c$ ), and spine shear force ( $F_s$ ). (8 marks)

**Table 1:** Kinematic and anthropometric data

Items	Value
Load in hand	310 N + 140 N
Upper body weight above L5/S1 joint	170 N + 180 N
Distance of erector spinae muscle from the center of spine (E)	3.3 cm + 3.2 cm
distance of the load from the center of spine at L5/S1 (h)	18.6 cm + 11.4 cm
distance of the upper body center of gravity from center of spine at L5/S1 joint (b)	12.5 cm + 7.5 cm
Upper body angle with horizontal ( $\alpha$ )	36.4° + 18.6°

- (b) One of our production lines operators, namely Zahariah Ali had experienced with physical signs and symptoms due to chronic musculoskeletal injuries at the workplace where the causes appear to be related to aspects of repetitive work. Based on Occupational Safety and Health Act 1994 (Act 514), the employer is obligated to protect the employees in relation to safety, health and welfare through the following procedures. From these cases, the employers should identify and assess the employees in term of the ergonomic risk factors (ERFs) so that they can recognize problems before they progress into more serious injuries. Evaluate and assess the ergonomic risk factors (ERFs) at workplace by providing detail explanations how they can be achieved. Use appropriate examples to support your explanations.

(8 marks)

- (c) In 2008, under Department of Occupational Safety and Health (DOSH) Malaysia has establish the Guidelines for Manual Handling at Workplace. These Guidelines are intended to assist employer, employee, occupational safety and health practitioner and others in identifying and recognizing the risk involving manual handling tasks as well as to provide information on how to choose the effective options to reduce the risks. Create and develop a flowchart process overview of initial manual handling risk assessment according to this guideline.

(4 marks)

- Q3** (a) Heat stress can increase stress and fatigue which can lead to serious health conditions for workers working in hot environments and may increase workplace accidents. Explain and describe **TWO (2)** heat stress prevention that can be reduce stress and fatigue for workers working in hot environments.

(4 marks)

- (b) Occupational hearing loss is one of the most common work-related illnesses and is permanent. People with hearing loss may find it hard to have conversations with friends and family. Fortunately, occupational hearing loss can nearly always be prevented. Proposed and recommend **SIX (6)** best ways to reduce hearing loss at workplace.

(6 marks)

- (c) Naufal has workers as opearator with manual assembly process that required he movements need to and reach above the shoulder and bending his hips and waist while access materials such as labels or bubble wrap rolls beneath the work surface as shown in **Figure Q3(c)**. He forced to bend down to access the materials, which is one of the most problematic work positions, particularly if any weight or physical manipulation below the waist is involved. Design and propose an ergonomic workstation in term of eliminating extreme movements and bending posture while perfoming his work activity.

(10 marks)

**Q4**

Dhanush had experienced with hand discomfort due to repetitive use of hand tools particularly that compress the palm of the hand and are held with a pinch or precision grip that may result in the development of carpal tunnel syndrome and other musculoskeletal disorders of the hand, wrist, and arm. **Table 2** shows the hand discomfort data taken from interviewing Dhanush based on his experienced hand discomfort due to repetitive use of hand tools.

**Table 2:** Hand discomfort data for Dhanush due to repetitive use of hand tools

Area	Experience ache, pain and discomfort	Uncomfortable level	Interference level
A	4 times	Slightly	Not at all
B	3 times	Moderate	Substantially
C	Several times	Moderate	Slightly
D	1-2 times	Very	Slightly
E	Once Every day	Very	Substantially
F	2 times	Slightly	Not at all

**Table 3:** Weighting rating scores and multiplying frequency score

<b>Frequency score (0,1.5 , 3.5, 5, 10)</b>	Never = 0 ; 1-2 times/week = 1.5 ; 3-4 times/week = 3.5 Once Every day = 5 ; Several times every day = 10
<b>Discomfort score (1,2,3)</b>	Slightly = 1 ; Moderate = 2 ; Very = 3
<b>Interference score (1,2,3)</b>	Not at all = 1 ; Slightly = 2 ; Substantially = 3

- (a) Determine and explain **FOUR (4)** work factors can affect the health and performance of Dhanush as a hand tool user. (4 marks)
- (b) Using Cornell Hand Discomfort Questionnaires (CHDQ) as shown in **Figure Q4(b)**, assess and analyze hand discomfort data experienced by Dhanush. (6 marks)
- (c) By using weighting rating scores and multiplying frequency score as shown in **Table 3**, evaluate and analyze the final score. (6 marks)
- (d) Proposed and develop **FOUR (4)** tips for better power tool ergonomics for Dhanush in future as a hand tool user. (4 marks)

**Q5**

You are certified to become an Ergonomic Trained Person (Level 2) that recognized by Department Occupational Safety & Health (DOSH), Malaysia. From the previous result findings on Initial Ergonomic Risk Assessment (ERA) report, you are advised to assess the advanced ERA for the forceful exertion risk factors using the NIOSH Lifting Equation method. NIOSH Lifting Equation method was developed to help predict the risk of lifting injuries. **Table 4** shows the data for critical measurements of the lifting task. The Lifting Equation defines a Lifting Index (LI) based on the Recommended Weight Limit (RWL) for specific lifting tasks that most workers could perform in an eight-hour day without increasing the risk of developing low back pain.

**Table 4:** Critical measurements of the lifting task

Item	Value	Factor
Horizontal Distance (H)	40cm	0.63
Vertical Multiplier (VM)	50cm	0.93
Distance Multiplier (DM)	100cm	0.87
Asymmetric Multiplier (AM)	60 degrees	0.81
Frequency Multiplier (FM)	One hour (lifting while standing) with 30 sec time between lifts	0.91
Coupling Multiplier (CM)	Fair (lifting while standing)	1.0
Weight	23kg	

- (a) Determine and justify when should be used the NIOSH Lifting Equation method in advanced ERA. (4 marks)
- (b) The Lifting Equation defines a Recommended Weight Limit (RWL), a recommendation of the heaviest load a healthy worker could lift without increasing the risk of developing low back pain. Develop and create the formula to calculate RWL with six critical measurements of the lifting task. Use appropriate sketch to support your explanations. (6 marks)
- (c) Based on **Table 4**, evaluate and analyze the Recommended Weight Limit (RWL) for NIOSH Lifting Equation method (6 marks)
- (d) Based on result **Q5(c)**, develop and recommend the **FOUR (4)** suggestions to improve manual lifting at workplace. (4 marks)

- Q6** An ergonomic assessment, also called an ergonomic risk assessment (ERA), is an objective measure of the risk factors in your work environment that may lead to musculoskeletal disorders or injuries among your workforce. In Malaysia, an ergonomics assessor known as an Ergonomic Trained Person (ETP) that recognized by Department of Occupational Safety & Health (DOSH).
- (a) Describe and explain **FOUR (4)** duties and responsibilities of an Ergonomics Trained Person (ETP). (4 marks)
- (b) There are two approaches for initiating an Ergonomic Risk Assessment (ERA) including proactive and reactive approach. Create and develop a framework for ERA by providing detail explanations how they can be achieved. (6 marks)
- (c) Compare and differentiate between Initial ERA and Advanced ERA in term of an Ergonomic Trained Person (ETP). (4 marks)
- (d) All ERA activities, information and outcomes should be finalized and documented in the form of a report. Construct and determine the content of Initial ERA and Advanced ERA report. (6 marks)

- END OF QUESTION -

FINAL EXAMINATION

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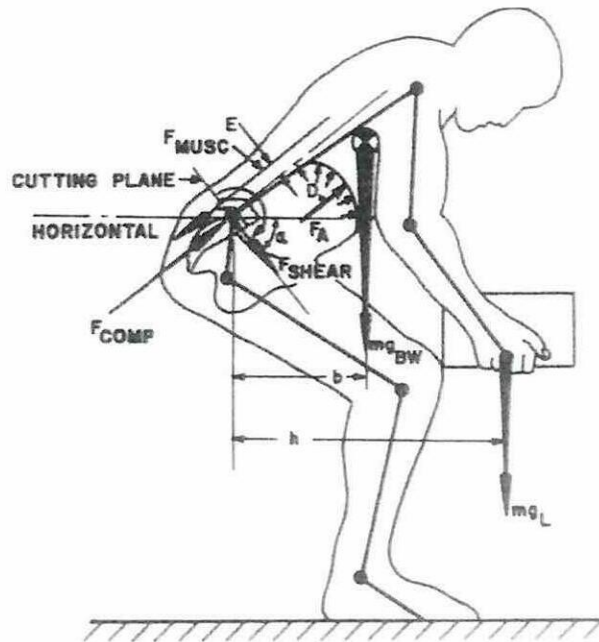


Figure Q2(a)

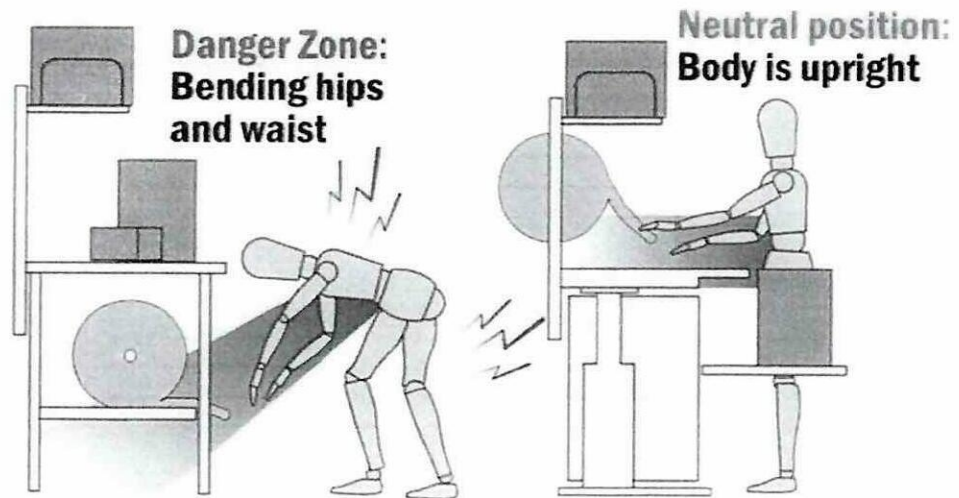
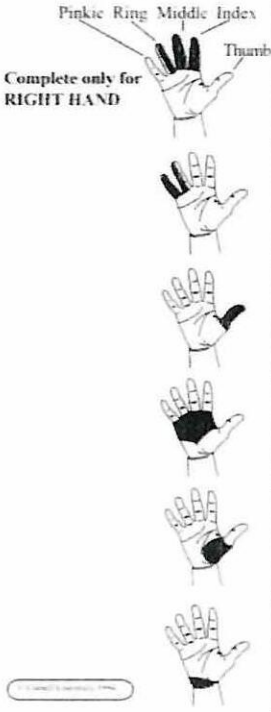


Figure Q3(c)

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<p>The shaded areas in the diagrams below show the position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.</p>				<p>During the last work <u>week</u> how often did you experience ache, pain, discomfort in:</p>				<p>If you experienced ache, pain, discomfort, how uncomfortable was this?'</p>				<p>If you experienced ache, pain, discomfort, did this interfere with your ability to work?'</p>																																																																																																																																																															
<p>Complete only for RIGHT HAND</p> 				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; padding: 5px;">Area A (Shaded area)</td> <td style="width: 10%; padding: 5px;">Never</td> <td style="width: 10%; padding: 5px;">1-2 times last week</td> <td style="width: 10%; padding: 5px;">3-4 times last week</td> <td style="width: 10%; padding: 5px;">Once every day</td> <td style="width: 10%; padding: 5px;">Several times every day</td> <td style="width: 10%; padding: 5px;">Slightly uncomfortable</td> <td style="width: 10%; padding: 5px;">Moderately uncomfortable</td> <td style="width: 10%; padding: 5px;">Very uncomfortable</td> <td style="width: 10%; padding: 5px;">Not at all</td> <td style="width: 10%; padding: 5px;">Slightly interfered</td> <td style="width: 10%; padding: 5px;">Substantially interfered</td> </tr> <tr> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> <td style="text-align: center;">□</td> </tr> </table>				Area A (Shaded area)	Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered	□	□	□	□	□	□	□	□	□	□	□	□	<table border="1" style="width: 100%; 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**Figure Q4(b)**