



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION SEMESTER II SESSION 2023/2024

COURSE NAME : MATERIAL SELECTION

COURSE CODE : BBM 10103

PROGRAMME CODE : BBD

EXAMINATION DATE : JULY 2024

DURATION : 2 HOURS 30 MINUTES

INSTRUCTIONS : ANSWER ALL QUESTIONS
THIS FINAL EXAMINATION IS
CONDUCTED VIA
 Open book
 Closed book
STUDENTS ARE **PROHIBITED** TO
CONSULT THEIR OWN MATERIAL
OR ANY EXTERNAL RESOURCES
DURING THE EXAMINATION
CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

TERBUKA

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Q1 (a) State the different type of ferrous alloy between low carbon, medium carbon and high carbon.

(6 marks)

(b) State **THREE (3)** differences and **THREE (3)** similarities between BCC and FCC structures.

(9 marks)

(c) Explain the relationship in mechanical design for the material selection process and sketch the drawing.

(10 marks)

Q2 (a) State **TWO (2)** grades of carbon steels with the description for the designation of AISI standard.

(6 marks)

(b) State the advantages of non-ferrous materials for braze, bronze and tin.

(9 marks)

(c) **Table Q2** shows a set of mechanical properties data consisting of tensile strength, elongation and yield strength for the common bike frame materials. Select one of the given materials for the sport model bike frame (mountain bike) and given a reason for the selection.

Table Q2 This table shows mechanical properties of common bike frame materials.

Characteristic \ Material	Al 6061	Ti6Al4V	Carbon Fiber
Young's modulus / N/m ² x 10 ³	68,9	115	50 - 150
Yield Strength / N/m ²	260 - 290	880 - 1100	Varies
Tensile Strength / N/m ²	300 - 320	950 - 1170	250 - 400
Elongation / %	17	10	2,5
Density / kg/m ³	2,7	4,43	1,800
Weldability and Machinability	Excellent	Fair	Fair
Cost / € per kg	1,5	45	Varies

(10 marks)

Q3 (a) State **THREE (3)** requirements of the material properties for cutting tool selection to prolong the cutting tool life.

(6 marks)

(b) Metal cutting is a chip forming machining process with the excessive material from the workpiece is removed by using a cutting tool. State **FOUR (4)** factors that affect the material selection of cutting tool for a specific machining application.

(8 marks)

(c) An automotive brake disc or rotor is a device for slowing or stopping the motion of a wheel while it runs at a certain speed. **Table Q3** show a set of properties for material selection of automotive brake disc consisting of stainless steel, titanium and carbon fibre. Based on **Table Q3**, select a material for automotive brake disc and justify your selection.

Table Q3. The properties of material selection for automotive brake disc

Mechanical Properties	Stainless Steel 410	Titanium 6Al-4V (Ti-6Al-4V)	Epoxy/HS Carbon Fibre. UD Prepreg. UD Layup
Density (Kg m ⁻³)	7.65x10 ³	4.41x10 ³	1.55x10 ³
Youngs Modulus (Gpa)	190	110	129
Yield Strength (Mpa)	1000	827	1740
Tensile Strength (Mpa)	1250	896	1740
Shear Modulus (Gpa)	73	43	3.74
Toughness (Kj/M ²)	10.7	59.7	25.5
Max Service Temperature °C	357	350	140
Min Service Temperature °C	-150	-273	-123
Thermal Conductivity Wm.°C	15.6	7.1	0.75
Specific Heat Capacity J Kg.°C	481	528	902
Thermal Shock Resistance °C	58.4	763	1501
Thermal Distortion Resistance MW m	0.933	0.788	0.228

(11 marks)

- Q4** (a) Explain the type of polymer material with **TWO (2)** samples products (6 marks)
- (b) State a comparison between ceramic, metal and polymer in term thermal expansion, wear resistance and hardness by illustrating the answers in a table form. (9 marks)
- (c) The people used the footwear to perform their daily physical activities such as walking and running. The materials used for sport shoes will potentially cause injury and affect performance. **Figure 4** and **Table 4** show the properties of the sport shoes material used by three sport shoes brands. By considering health hazard, select the best sport shoes brand and justify your answer

Table 4. The material property for sole of sport shoes materials

Property	Reebok	China Huakang	Bare Foot
Force	79.70+13.52	75.41+13.83	111.30+ 20.34
Impulse	61.5+19.49	52.45+10.49	92.28+ 13.15
Pressure	312.06+49.46	310.21+22.53	503.11+262.19
Static friction	0.783±0.053	0.783±0.053	0.783±0.053
Dynamic friction	0.841±0.049	0.841±0.049	0.841±0.049

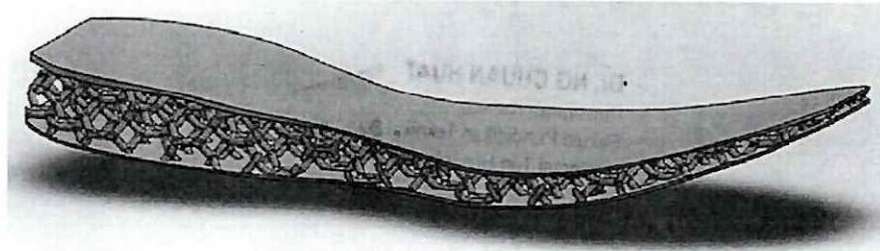


Figure 4. The properties of sole for the sport footwear material selection

(10 marks)

– END OF QUESTIONS –