Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	MACHINING TECHNOLOGY 2
COURSE CODE	:	BBM 20503
PROGRAM CODE	:	BBA
DATE	:	JANUARY/FEBRUARY 2022
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS. 2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CODUCTED VIA **CLOSE BOOK**.

THIS QUESTION PAPER CONSIST OF **SEVEN (7)** PAGES

Q1 (a) Explain the key difference between these two types of manufacturing process: machining and additive manufacturing.

(4 marks)

(b) Give two (2) reasons why CNC machines with similar axis may have different configurations.

(6 marks)

(c) Figure Q1(c) shows a feature control frame (FCF) that is used to represent a feature. Based on the figure, answer the following questions.

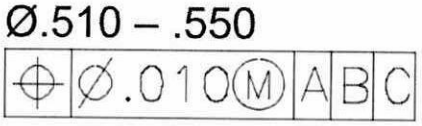

Figure Q1(c): A Feature Control Frame Example

(i) Explain how the FCF given affects the product inspection process from the perspective of circular theory.

(5 marks)

(ii) State the feature of size for both the pin and the hole under Maximum Material Condition (MMC).

(4 marks)

(iii) If the tolerance in Figure Q1(c) is for a pin with 0.535 in diameter, state the total allowable tolerance.

(3 marks)

(iv) If the tolerance in Figure Q1(c) is for a hole with 0.540 in diameter, state the total allowable tolerance.

(3 marks)

Q2 (a) Figure Q2(a)(i) and Figure Q2(a)(ii) below shows two types of CNC machine configuration.

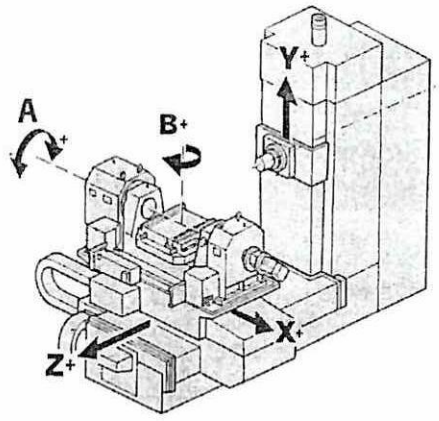

Figure Q2(a)(i): CNC Machine Configuration

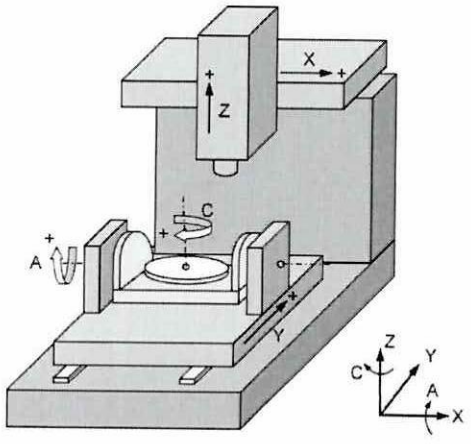

Figure Q2(a)(ii): CNC Machine Configuration

(i) Name the type of CNC machining center in both Figure Q2(a)(i) and Figure Q2(a)(ii).

(2 marks)

(ii) Explain the number of axis control the machine in the Figure Q2(a)(i) is capable of handling.

(3 marks)

(iii) A machine shop received order to produce 200 parts as indicated in Figure Q2(a)(iii). Each single part weights 300 kilograms. Select the suitable type of CNC machines for the job among the machines in Figure Q2(a)(i) and Figure Q2(a)(ii) and give two (2) justifications of using such a machining center from the workpiece specification perspective.

(5 marks)

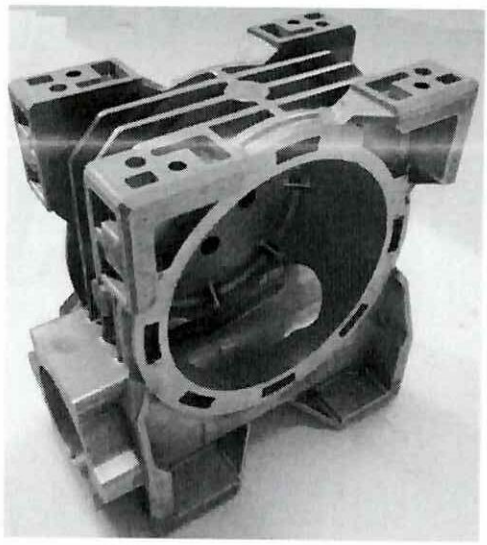

Figure Q2(a)(iii): Ordered Parts

	Mikron HCE 400	*Cincinnati Milacron HMC-400EP*	*Yamazaki H500*	*Makino A55*
X-axis	610 mm	22.4″ (570 mm)	720 mm	560 mm
Y-axis	508 mm	20.3″ (515 mm)	650 mm	560 mm
Z-axis	559 mm	20.5″ (520 mm)	650 mm	560 mm
Pallet working area		400 × 400 mm	500 × 500 mm	400 × 400 mm
Max. workload	360 kg	882 lb. (400 kg)	1000 kg	400 kg
Rapid traverse *X–Y–Z*	18 m/min	945 ipm (24 m/min)	24 m/min	30 m/min
Feed rate (max.) *X–Y–Z*	12.7 m/min	0.1–945 ipm (2.5–24,000 mm/min)	8 m/min	30 m/min
Spindle taper	No. 40	No. 40	ISO 50	No. 40
Speed range	7500 rpm	75–8000 rpm	35–6000 rpm	50–12 000 rpm
Power (Max.)	11 kW	15 hp (11 kW)	15 kW	22 kW
Tool-changer capacity	24 tools	30 tools	40 tools	40 (60, 128, 208) tools
Max. tool weight		15.4 lb (7 kg)	27 kg	8 kg
Max. tool dia. (full storage)		2.95″ (75 mm)	135 mm	70 mm
Max. tool dia. (alt. storage)		3.94″ (100 mm)		140 mm
Max. tool length		11.8″ (300 mm)	470 mm	300 mm
Tool-change time (metal- to-metal)		5 seconds	6.5 seconds	3.4 seconds
Accuracy positioning (*X*, *Y*)		± 0.0002″ (± 5 microns)		± 2 microns
Positioning (*Z*)		± 0.0002″ (± 5 microns)		± 2 microns
Repeatability		± 0.0006″ (± 1.5 microns)		± 1 micron
Dynamic contouring		± 0.0006″ (15 microns)		

Figure Q2(b): CNC VMC Machine Specification

(b) Figure Q2(b) illustrates an example of machine specification of four types of vertical machining center (VMC) from four different manufacturers.

Table Q2(b)(i): Industrial Component Machining Requirements

Name	Aerospace Cockpit Component
Size	525 mm x 350 mm
Weight	35 kg
Tooling Requirement	End-mill (3 types), ball-mill (2 types), drill (2 types)
Other Requirements	High-speed machining with fast tool change for large volume production

Table Q2(b)(ii): Machining Competency Training Requirements

Name	Machined Components (various)
Size	Small component with length below 200 mm
Weight	Less than 10 kg
Manual Tooling Requirement	End-mill (4 types), ball-mill (4 types), drill (4 types)
Other Requirements	Low power consumption is required

(i) Name the machine that can perform high-speed machining in Figure Q2(b). Explain in brief your answer from the perspective of machining speed range.

(3 marks)

(ii) An aerospace production engineer wish to purchase a new CNC VMC for the machining of a new automotive component. The machining requirement for the component is as indicated in Table Q2(b)(i). Based on these requirements, which machining center is the most suitable choice in Figure Q2(b)? Explain your answer from the perspective of the given machine specification.

(6 marks)

(iii) A lecturer from a vocational training college wish to purchase a new CNC VMC for the purpose of machining skill competency training. The machining requirement for various components during the training is as detailed in Table Q2(b)(ii). Based on these requirements, which machining center is the most suitable choice in Figure Q2(b)? Explain your answer from the perspective of the given machine specification.

(6 marks)

Q3 (a) Explain the function of a post processor in a computer-aided manufacturing (CAM) software.

(4 marks)

(b) Explain the difference of part programming using the conversational programming approach and using the CAM software.

(6 marks)

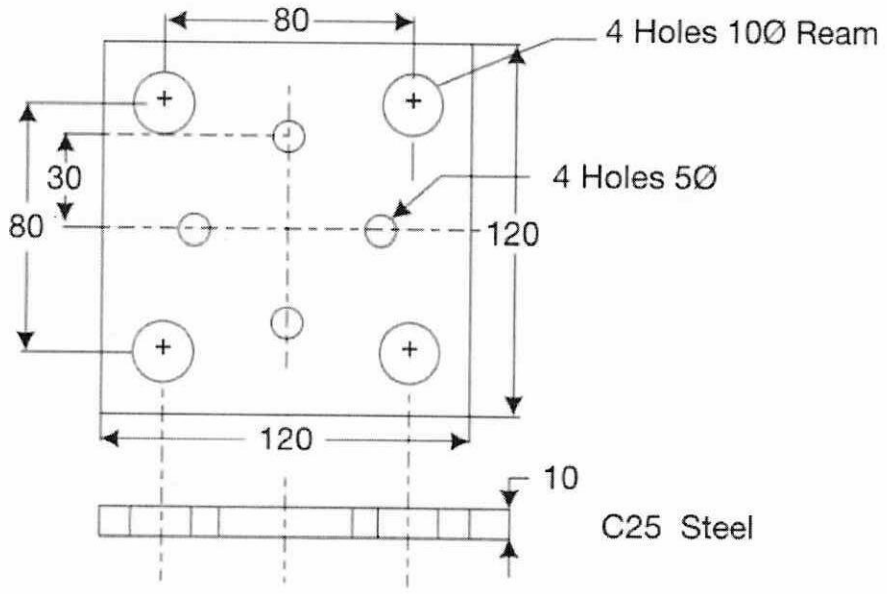

Figure Q3(c): Machine Component Design

(c) Figure Q3(c) shows a component to be machined. Derive the part programming to machine the component using canned cycles for drilling, with the following assumptions:

- Address T02 holds the 5 mm drilling tool
- Address T03 holds the 10 mm drilling tool
- Address G81 represents the start of drilling canned cycle
- Address G80 represents the end of drilling canned cycle
- All units are in mm

(15 marks)

Q4 (a) Recommend the suitable type of automatic tool changer (ATC) magazine for different usage scenario below.

(i) A mini vertical CNC machine that requires only 6 tool slots for small parts production.

(2 marks)

(ii) A horizontal CNC machine that requires only 10 tool slots during production.

(2 marks)

(iii) A vertical CNC machining center that produces 5 different products and involve more than 30 tools.

(2 marks)

(b) Justify the suitable cutting tool material for machining a 12" × 12" block if the requirements are decided as below.

(i) To be used for surface finishing cut.

(3 marks)

(ii) Affordable tool at low cutting speed of 0.5 m/s.

(3 marks)

(iii) Diamond-shaped tool insert with high wear resistance.

(3 marks)

(c) Explain two (2) reason why temperature control is important during a machining process.

(4 marks)

(d) Electro Discharge Machining (EDM) is a type of non-traditional machining that is based on the principles of the spark theory.

(i) State the main difference between the machining process of EDM wire and EDM die sinker.

(2 marks)

(ii) Provide one similarity and one difference between EDM and electrochemical machining (ECM).

(4 marks)

-END OF QUESTIONS-