Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	MACHINING TECHNOLOGY 2
COURSE CODE	:	BBM 20503
PROGRAM CODE	:	BBA
DATE	:	JULY 2021
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	(1) ANSWER **ALL** QUESTIONS. (2) MANUALLY WRITTEN ANSWERS ONLY (3) FOLLOW THE GIVEN ELECTRONIC SUBMISSION INSTRUCTIONS

THIS QUESTION PAPER CONSIST OF **NINE (9)** PAGES

Q1 (a) Name the type of suitable manufacturing process to produce the product as indicated in the figure below.

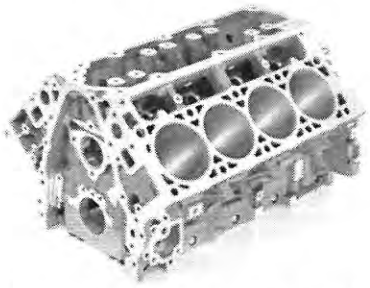


Figure Q1(a)(i): Engine Block

(i) Engine block as in Figure Q1(a)(i).

(2 marks)

Figure Q1(a)(ii): Precision Gear

(ii) Precision gear as in Figure Q1(a)(ii).

(2 marks)

Figure Q1(a)(iii): Aerospace Structural Component

(iii) Aerospace structural component as in Figure Q1(a)(iii).

(2 marks)

(b) Explain the relationship between computer-aided design (CAD), computer-aided manufacturing (CAM) and computer-aided testing (CAT) from the perspective of circular theory of geometric dimensioning and tolerancing (GD&T).

(4 marks)

(c) Figure Q1(c) below shows the design of a mechanical component that are labeled with GD&T feature control frames (FCFs). The component consist of a hole and a pin. The unit of measurement is in inches. Based on the figure, answer the following questions.

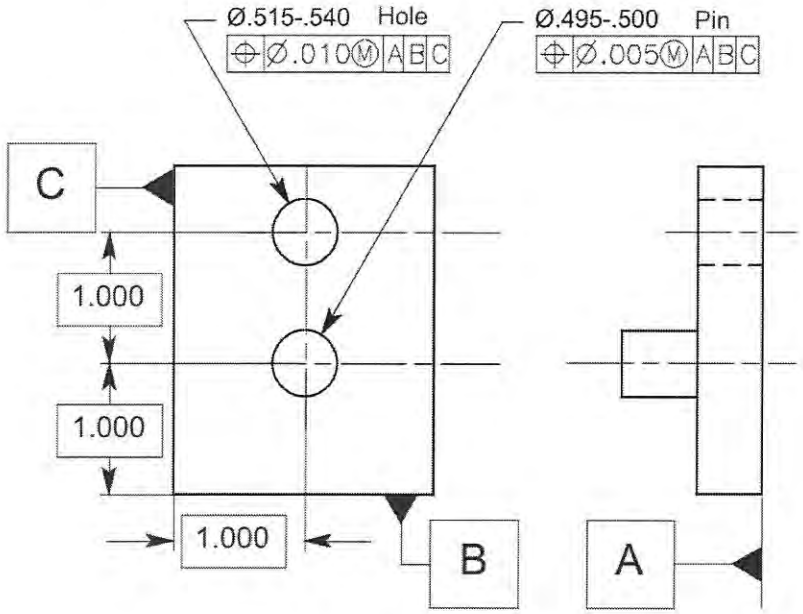


Figure Q1(c): Mechanical Component

(i) State the name of the GD&T feature control in the FCF.

(2 marks)

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

(4 marks)

(iii) State the diameter of allowable tolerance zone if the feature size for hole is 0.530.

(2 marks)

(iv) State the diameter of allowable tolerance zone if the feature size for pin is 0.495.

(2 marks)

(v) A quality control (QC) technician inspect a sample of actual part produced to see whether it conforms to the standards required. The QC technician found that the diameter of the pin and hole produced are 0.495 inch and 0.525 inch respectively. In terms of position of the pin and hole, feedback from the coordinate measuring machine (CMM) indicates that the position for the pin and hole is at coordinate of (1.010,1.000) and (1.000,2.030) (conventional Cartesian coordinate system is applied). Evaluate whether the actual part produced is acceptable in accordance to specifications.

(5 marks)

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

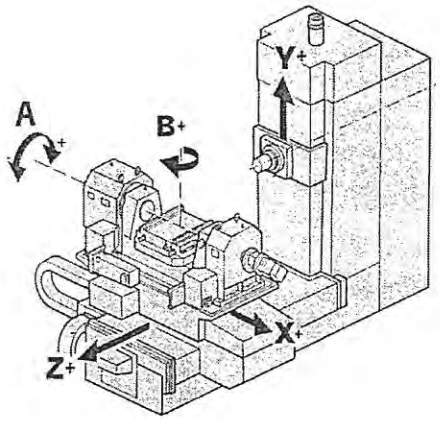


Figure Q2(a)(i): CNC Machine Configuration

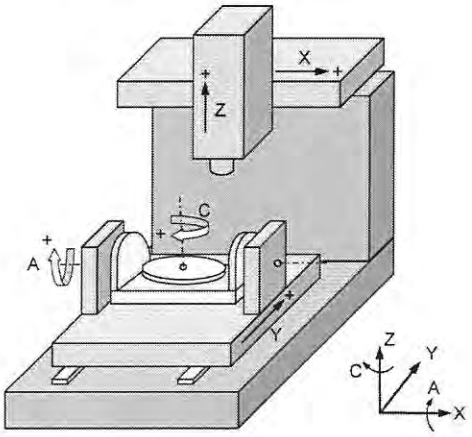


Figure Q2(a)(ii): CNC Machine Configuration

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

(2 marks)

(ii) Name the machining accessories that are attached to B, X and Y in Figure Q2(a)(i).

(3 marks)

(iii) A machine shop received order to produce 200 parts as indicated in Figure Q2(a)(iii). Each single part weights 150 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)

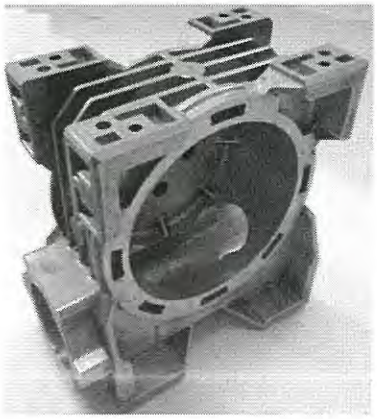


Figure Q2(a)(iii): Ordered Parts

	Bridgeport EZ-TRAK DX	*Cincinnati Milacron Arrow 500 VMC*	*Chiron FZ22S*	*Makino GF6*
X-axis	813 mm	20″ (510 mm)	750 mm	1050 mm
Y-axis	368 mm	20″ (510 mm)	520 mm	600 mm
Z-axis	127 mm	20″ (510 mm)	630 mm	560 mm
Work surface	1473 × 279 mm	27.5 × 20.5″ (700 mm × 520 mm)	1150 × 570 mm	1400 × 600 mm
Max. workload	272 kg	1103 lb (500 kg)	1200 kg	1500 kg
Rapid traverse *X-Y-Z*	2540 mm/min	944 ipm (24 m/min)	30 m/min	12 m/min
Feed Rate (Max.) *X-Y-Z*	2540 mm/min	590 ipm (15 m/min)	30 m/min	12 m/min
Spindle taper	No. 30	No. 40	ISO 40	No. 50
Speed range	60–4200 rpm	60–6000 rpm	20–10 500 rpm	10–4000 rpm
Power (Max.)	1.5 kW	17.5 hp (13 kW)	18 kW	7.5 kW
Tool changer capacity		21 tools	40 tools	20 tools
Max. tool weight		15 lb (6.8 kg)	8 kg	15 kg
Max. tool dia. (Full storage)		3.14″ (80 mm)	75 mm	145 mm
Max. tool dia. (Alt. storage)		6.3″ (160 mm)	105 mm	200 mm
Max. tool length		15″ (385 mm)	250 mm	400 mm
Tool change time (metal-to-metal)		7 seconds	3.5 seconds	5.5 seconds
Accuracy positioning (*X*, *Y*)	± 25 microns	± 0.00011″ (± 3 microns)		± 1.5 microns
Positioning (*Z*)	± 25 microns	± 0.00016″		± 1.5 microns
Repeatability	± 20 microns	(± 4 microns)		± 1 micron
Dynamic contouring		± 0.00004″ (± 1 micron) ± 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	Automotive Seat Attachment
Size	1000 mm x 250 mm
Weight	30 kg
Tooling Requirement	End-mill (3 types), ball-mill (2 types), drill (2 types)
Other Requirements	High-speed machining with fast feed rate preferable

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

Name	Machined Components (various)
Size	Small component with length below 450 mm
Weight	Less than 20 kg
Manual Tooling Requirement	End-mill (4 types), ball-mill (4 types), drill (4 types)
Other Requirements	Low power consumption

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

(3 marks)

(ii) An automotive 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.

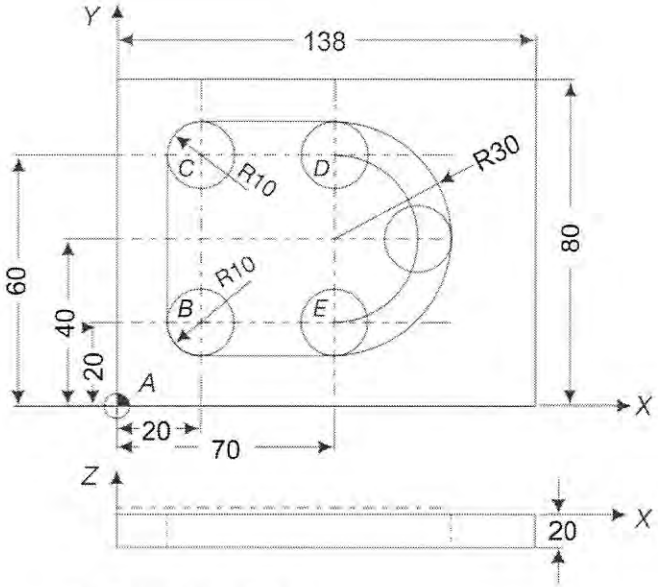
(6 marks)

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

(4 marks)

(b) Explain the concept of an ethernet-based distributed network control of CNC Machines using an illustration.

(6 marks)

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N001 G92 X0 Y0 Z0
N002 G90
N003 G00 X20.0 Y20.0 Z2.5 T01 S3000 M03
N004 G01 Z-30.0 F120
N005 Y60.0
N006 X70.0
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Figure Q3(c): Machine Component Design with Partial CNC Part Programming Coding

(c) Figure Q3(c) shows a machine component to be machined with the corresponding partial CNC part programming codes. The pocket is assumed to be cut through the workpiece using a 20 mm diameter slot drill. All units are in mm.

(i) Explain the meaning of the code address N003.

(4 marks)

(ii) Complete the part programming codes until end of program.

(6 marks)

(iii) Modify the code if the pocket is to be milled using a 20 mm diameter slot drill first, then followed by a 20 mm end mill. Assume that the end mill is attached as the second tool in the tool register.

(5 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 fluid for machining a 12" x 12" block if the material is decided as below.

(i) Aluminium.

(3 marks)

(ii) Magnesium.

(3 marks)

(iii) Copper.

(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) Explain the spark theory in the context of a EDM wire cutting process.

(4 marks)

-END OF QUESTIONS-