Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	CNC TECHNOLOGY AND CAD/CAM
COURSE CODE	:	BNM 30204
PROGRAMME CODE	:	BNM
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**
		3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Computer numerical control (CNC) is often referred to as a system of programmable automation in which a machine tool is controlled by a prepared program containing coded alphanumeric data.

(i) Explain **THREE (3)** basic components of CNC system.

(6 marks)

(ii) Distinguish **THREE (3)** major differences between CNC and direct numerical control (DNC) systems.

(6 marks)

(b) The technology of CNC is applied to a wide variety of processing operations including metal machining processes by CNC lathe and CNC milling machines.

(i) **Figure Q1 (b) (i)** shows a typical example of a horizontal CNC lathe machine. Based on **Figure Q1 (b) (i)**, describe the function of main components of CNC lathe machine, namely headstock, foot pedals, chuck, tools turret, and tailstock.

(5 marks)

(ii) Use sketches with proper labels and explanations to show the differences between up-milling and down-milling in CNC milling operation in terms of cutting tool and workpiece feed directions.

(8 marks)

Q2 (a) A face milling cutting tool will be used in plain milling operation using CNC milling machine according to the scheduled machining condition of a cutting speed at 260 mm/min, and the number of spindle rotations should not exceed 480 revolution/min. Identify the suitable diameter of face milling cutting tool based on the scheduled machining condition. A list of common formulas for CNC milling operation is given in **Table Q2 (a)**.

(8 marks)

(b) Write a CNC program of drilling operation with suitable command function codes for the following blocks of instruction:

(i) The cutting tool is positioned at X25, Y12, Z0 by rapid movement.

(1 mark)

(ii) The cutting tool is then advanced by -10 mm in Z direction at a feed rate of 500 mm/min with coolant ON.

(1 mark)

(iii) The cutting tool is retracted back by +10 mm with rapid movement and coolant OFF.

(1 mark)

(c) Construct a CNC milling program with suitable command function codes to produce a part as shown in **Figure Q2 (c)**.

(14 marks)

Q3 (a) A cylindrical workpiece of 100 mm long and 10 cm in diameter will be turned to a diameter of 5 cm using CNC lathe machine. The cutting conditions are as follows: cutting speed is 2 m/s, and feed is 0.45 mm/rev. A list of common formulas for CNC turning operation is given in **Table Q3 (a)**.

(i) Calculate machining time.

(2 marks)

(ii) Calculate material removal rate.

(5 marks)

(b) There are several important terminology and abbreviations used in CNC programming.

(i) Explain **FOUR (4)** basic terminology used in programming language of CNC program.

(8 marks)

(ii) Distinguish the use of G, M, F, S and T command function codes in a CNC program.

(10 marks)

Q4 (a) Apart from CNC lathes and CNC milling machines, list **THREE (3)** machine tools that apply computer-aided design and manufacturing (CAD/CAM) technology in manufacturing industry.

(3 marks)

(b) CAD/CAM allows a computer-aided design (CAD) system to draw the geometry of parts on a computer, and integrate them with a computer-aided manufacturing (CAM) software for a CNC program development of a part. Explain **FOUR (4)** important CAD/CAM approaches to part programming.

(8 marks)

(c) CNC machining operations often tends to produce some undesirable waste, which negatively impacts the environment. Identify **THREE (3)** methods to minimize liquid waste in the form of spent coolant generated from CNC milling process.

(6 marks)

(d) One of the functions of green machining is seen as being the need to move from a linear transformation of material into ones utilising cyclical transformations systems. Outline **FOUR (4)** relative merits of cyclical transformation of material over linear transformation within the context of resource conservation.

(8 marks)

- END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2022 / 2023 PROGRAM CODE : BNM
COURSE NAME : CNC TECHNOLOGY AND CAD/CAM COURSE CODE : BNM 30204

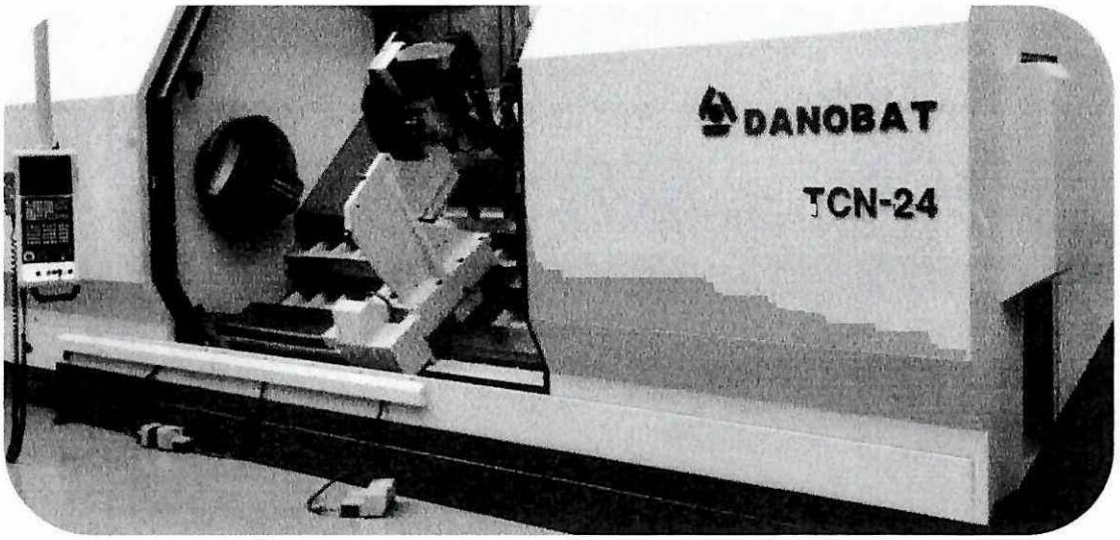


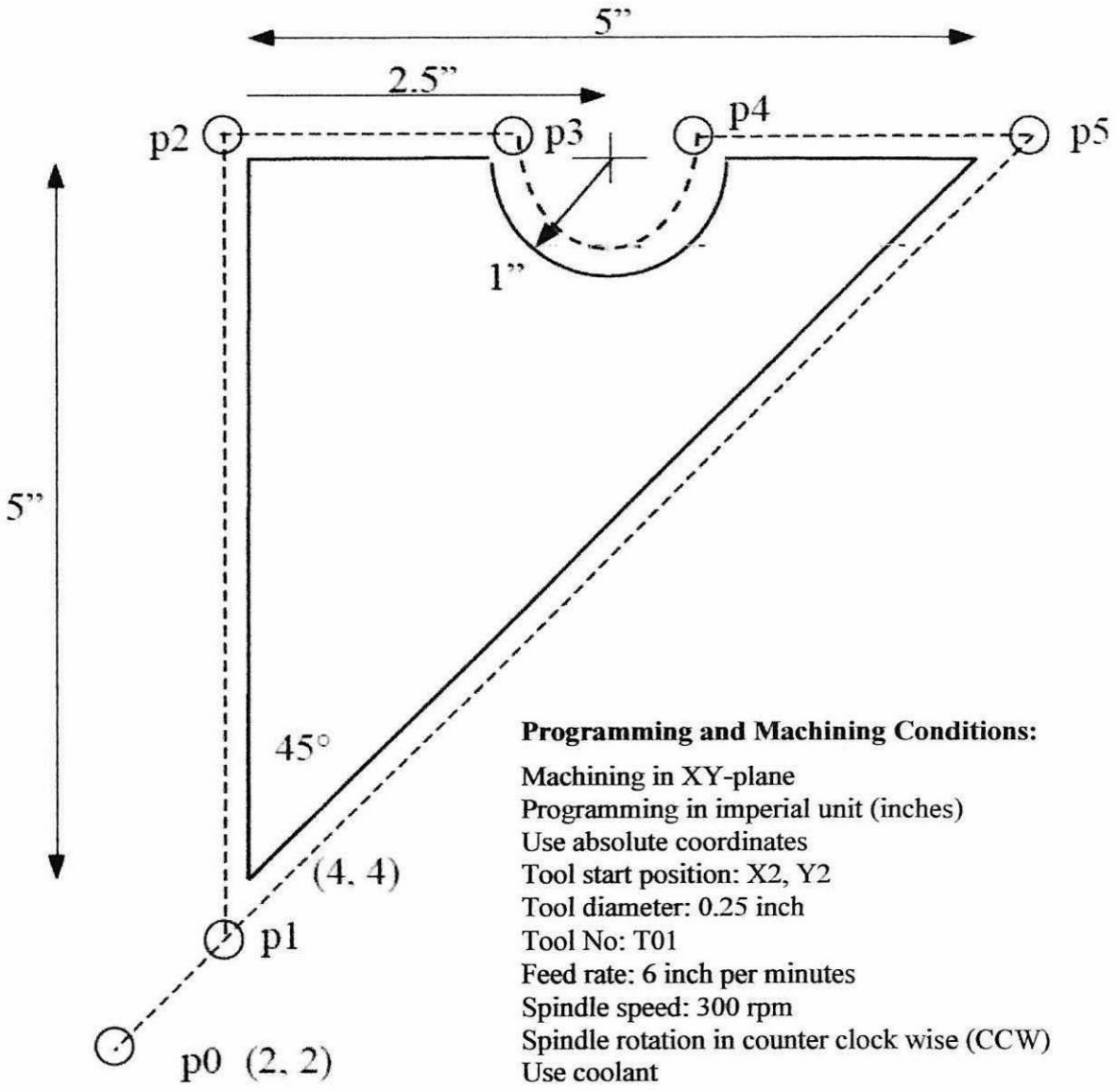
Figure Q1 (b) (i): Horizontal CNC Lathe Machine

Table Q2 (a): Common Formulas for CNC Milling Operation

Mathematical Formula		
Feed Rate	:	$f_r = Nn_tf$
Circumferential Cutting Speed	:	$V_c = \pi dn$
Material Removal Rate	:	$MRR = wdf_r$
Machining Time	:	$Tm = (L + A) / f_r$

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2022 / 2023
COURSE NAME : CNC TECHNOLOGY AND CAD/CAM
PROGRAM CODE : BNM
COURSE CODE : BNM 30204



Programming and Machining Conditions:

Machining in XY-plane
Programming in imperial unit (inches)
Use absolute coordinates
Tool start position: X2, Y2
Tool diameter: 0.25 inch
Tool No: T01
Feed rate: 6 inch per minutes
Spindle speed: 300 rpm
Spindle rotation in counter clock wise (CCW)
Use coolant

Tool path:
p0 → p1 → p2 → p3 → p4 → p5 → p1 → p0

Figure Q2 (c): Part Drawing

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2022 / 2023
COURSE NAME : CNC TECHNOLOGY AND CAD/CAM
PROGRAM CODE : BNM
COURSE CODE : BNM 30204

Table Q3 (a): Common Formulas for CNC Turning Operation

Mathematical Formula		
Rotational Speed	:	$N = V / \pi D_o$
Depth of Cut	:	$d = (D_o - D_f) / 2$
Feed Rate	:	$F_r = NF$
Machining Time	:	$T_m = L / F_r$
Material Removal Rate	:	$MRR = VFd$