

CONFIDENTIAL



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

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

- COURSE NAME : CNC TECHNOLOGY AND CAD/CAM
- COURSE CODE : BNM 30204
- PROGRAMME CODE : BNM EXAMINATION
- DATE : JULY / AUGUST 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

TERBUKA

CONFIDENTIAL

- 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 II / 2022 / 2023
COURSE NAME : CNC TECHNOLOGY AND CAD/CAM

PROGRAM CODE : BNM
COURSE CODE : BNM 30204

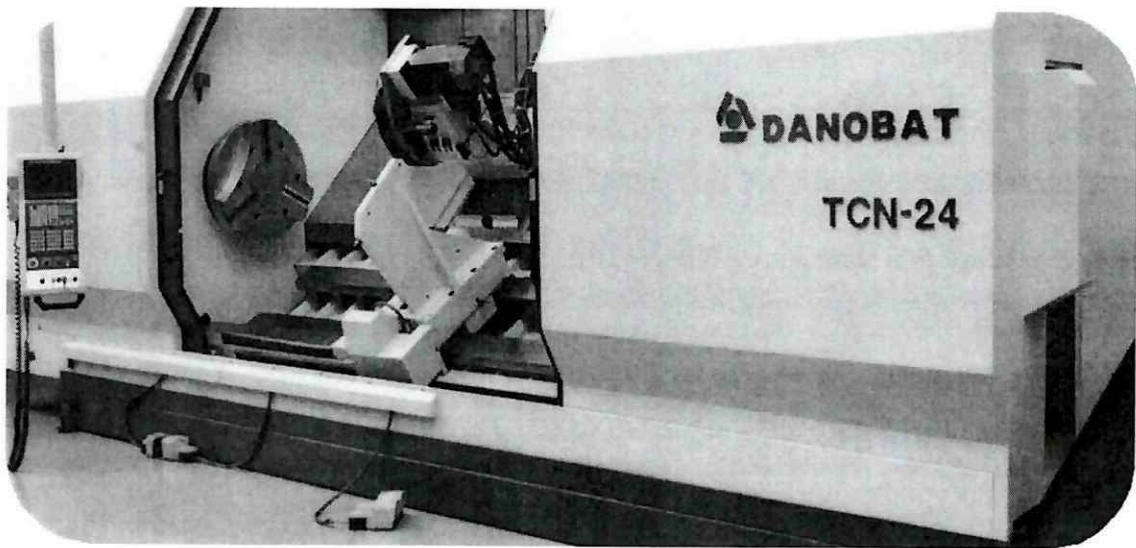


Figure Q1 (b) (i): Horizontal CNC Lathe Machine

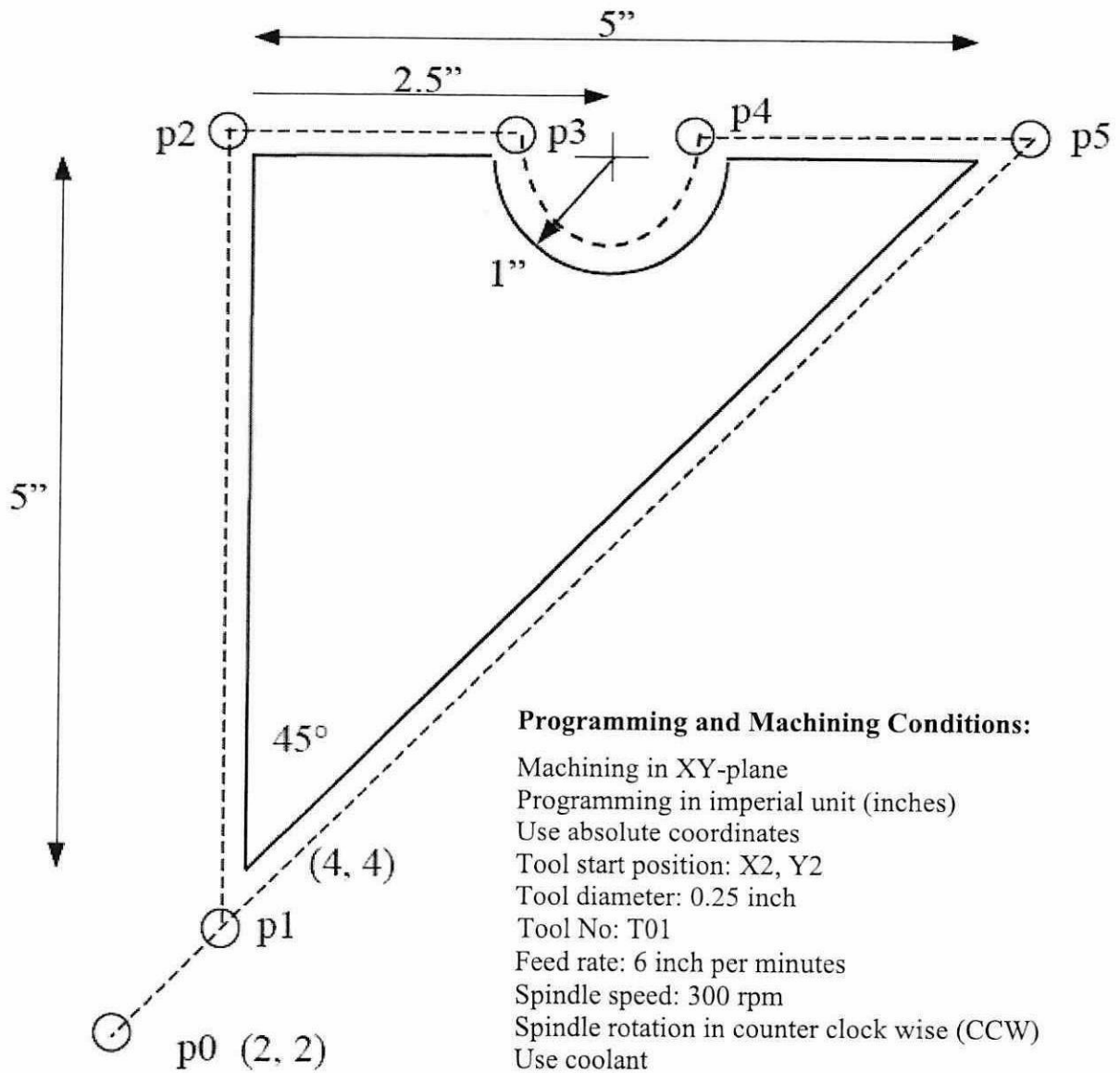
Table Q2 (a): Common Formulas for CNC Milling Operation

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

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2022 / 2023
 COURSE NAME : CNC TECHNOLOGY AND CAD/CAM

PROGRAM CODE : BNM
 COURSE CODE : BNM 30204



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

Figure Q2 (c): Part Drawing

FINAL EXAMINATION

SEMESTER/ SESSION : SEM II / 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	: $MRR = VFd$