COURSE OUTLINE: MAC307 - MACHINING CENTRE

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Course Code: Title	MAC307: MACHINING CENTRE CNC TECHNOLOGY
Program Number: Name	6347: GENERAL MACHINIST L3
Department:	MECHANICAL TECHNIQUES PS
Semesters/Terms:	20F, 21F, 22F
Course Description:	This course is designed to provide Level III General Machinist Apprentices the ability to to describe numerically controlled machining centres techniques and demonstrate procedures for entering and verifying a program to perform linear and circular machining operations.
Total Credits:	6
Hours/Week:	3
Total Hours:	48
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
Course Evaluation:	Passing Grade: 50%, D A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.
Other Course Evaluation & Assessment Requirements:	Other Course Evaluation Requirements: Smart watches, smart phones and similar devices are not allowed during tests or quizzes and must be removed. Grade Definition Grade Point Equivalent A+ 90 - 100% 4.00 A 80 - 89% B 70 - 79% 3.00 C 60 - 69% 2.00 D 50 - 59% 1.00 F (Fail)49% and below 0.00 CR (Credit) Credit for diploma requirements has been awarded. S Satisfactory achievement in field /clinical placement or non-graded subject area. U Unsatisfactory achievement in field/clinical placement or non-graded subject area. X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course. NR Grade not reported to Registrar`s office. W Student has withdrawn from the course without academic penalty.
Books and Required Resources:	Technology Of Machine Tools by Steve F. Krar, Arthur R. Gill, Peter Smid, Robert J. Gerritsen Publisher: McGraw - Hill Edition: 8 ISBN: 9781260565782

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.

Course Outcomes and Learning Objectives:

Course Outcome 1	Learning Objectives for Course Outcome 1
1. Describe safe working procedures when setting up and operating CNC machining centres.	1.1 Identify potential safety hazards which may occur during CNC machine set-up and operating procedures. Demonstrate safe working habits including: - protective clothing - protective equipment and gear - good housekeeping - start-up procedures - shut-off procedures - securing workplace/cutting tools - stabilizing workplace/cutting tools - lubricants - fire protection
Course Outcome 2	**Learning Objectives for Course Outcome 2**
2. Describe operating principles of CNC machining centres. (2 hrs)	2.1 Identify the capabilities, operating principles, and controls of CNC machining centres: - types of equipment - editing capability - program path ability - processing power - high speed machining - CNC controls - tapeless controls - PC/DNC systems Describe the major features and functions of CNC machining centres and the manufacturing process: - CPU - input devices - work envelope - tool changer - holding devices - safety interlock - engineering drawing - CNC part program - input media - CNC machine tool - finished part - repeatability Describe the common means of producing part program files: - manual programming - CAM systems - conversational programming
Course Outcome 3	**Learning Objectives for Course Outcome 3**
3. Describe use of job documentation to determine job requirements. (2 hrs)	3.1 Identify job documentation required to complete the job. Develop job set-up sheets by identifying: - axis alignment

	- locating points - workholding methods - program zero Develop tooling list by identifying: - tools - tool holders - type of tool material - set-up dimensions - tool numbers - tool offsets - cutter radius compensation register - workpiece materials
Course Outcome 4	**Learning Objectives for Course Outcome 4**
4. Describe the application of machining centres. (2 hrs)	4.1 Describe the methodology of programming parts as opposed to conventional machining: - differential - cam - helical - thread
Course Outcome 5	**Learning Objectives for Course Outcome 5**
5. Describe machining centre operations. (2 hrs)	5.1 Describe fixed cycles: - centre drilling - drilling - counterboring - reaming - tapping Describe fixed cycle terms and sequences: - initial level - R point level - Z level - machining increment - rapid approach - rapid retract - dwell time - feed rate directions Describe the advanced additional specialized CNC techniques: - HSM - thread milling - live tooling - 4th and 5th axis
Course Outcome 6	**Learning Objectives for Course Outcome 6**
6. Describe manual operating systems for CNC machining centres. (3 hrs)	6.1 Describe manual interruption on a machining centre: - single block operation - feedhold - emergency stop Describe manual data input (MDI) on a machining centre:

	- line command execution - set-up applications Describe program data override: - rapid motion override - spindle speed override - feedrate override - dry run operation - manual absolute setting - practical applications Describe interfacing to peripherals: - RS-232C Interface - PC/DNC - USB - wireless
Course Outcome 7	**Learning Objectives for Course Outcome 7**
7. Describe circular interpolation on a machining centre. (2 hrs)	7.1 Describe circular interpolation planes: - X - Y plane - Z - X plane - Y - Z plane - arc centre modifiers Describe circular interpolation commands: - arc modifiers - radius - quadrants - circles - cutter radius compensation
Course Outcome 8	**Learning Objectives for Course Outcome 8**
8. Develop a plan for CNC machining centres. (10 hrs)	8.1 Interpret documentation to determine: - workpiece material specifications - method of routing instructions - special fixturing requirements Plan sequence of machining by identifying: - order of machining - tooling selection - workpiece set-up
Course Outcome 9	**Learning Objectives for Course Outcome 9**
9. Describe the setting up and application of workholding devices for CNC machining centre operations. (10 hrs)	9.1 Describe the setting up of a vise or fixture on a machining centre: - alignment to axis - locators for multiple parts - clamping pressures - establish program zero - part geometry considerations Describe the use of dimensioning practices: - raw stock pre-machining

	- pre-machining - castings - locating points - clamping areas - multiple parts - fixture offsets - quantity of parts
Course Outcome 10	**Learning Objectives for Course Outcome 10**
10. Demonstrate procedures for entering and verifying programs for a CNC machining centre to perform linear and circular machining operations. (15 hrs)	10.1 Demonstrate the use of preparatory commands (G-codes): - modality of G-codes - recognize conflicting commands - order in a block Demonstrate the use of M-codes: - typical M-codes - M-codes in a block Demonstrate the use of codes to specify word and block structures: - program identification - block number - N-word - starting number - increments - end of block - block description - status block (safe block) - message block (program comments) - conflicting words - modal programming values - execution priority Demonstrate the use of codes to specify dimensions: - metric/inch selection - absolute/incremental selection - absolute data input - incremental data input - syntax - zero suppression and decimal point - leading and trailing zeros input Demonstrate the use of codes to specify: - tool number - tool length offset - tool radius offset Demonstrate the use of codes to invoke speeds and feeds: - spindle function - S-code - spindle rotation direction - spindle stop

		- spindle orientation - spindle speed (RPM) - feedrate control - feedrate function - feedrate per minute - feedrate override and feedhold - feedrate override and functions Demonstrate the use of codes to establish reference points: - machine reference point - manufacturers` setting - workpiece reference point - program zero application - position register command - fixture offsets Demonstrate the use of codes to execute rapid positioning: - rapid traverse motion - positioning mode - tool path - workpiece approach - single axis motion - multi-axis motion - straight angular motion - type of motion and time comparison - rapid motion path - axis motion completion Demonstrate use of codes to establish zero return commands: - zero return commands - return to machine zero Demonstrate the use of codes to create contouring programs: - cutter path determination - linear interpolation - circular interpolation - rough and finished shape - helical circular interpolation Describe cutter radius compensation: - compensation right - compensation left - radius offset table - radius wear offset - radius setting Demonstrate procedures to enter and verify a program to mill a workpiece that includes drilling and profiling. Demonstrate downloading of a program that includes: - feeds - speeds - overrides

	- axis selection - mode selection

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Attendance, Participation and Attitude	5%
Final Test and Practical Project	50%
Mid term	25%
Quiz 1	10%
Quiz 2	10%

Date: September 3, 2020

Addendum: Please refer to the course outline addendum on the Learning Management System for further information.