Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Mechanical Engineering	**Semester**	IV
Course Code	20ME42P	**Type of Course**	Programme Core
Course Name	**CNC Programming and Machining**	**Contact Hours**	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	**Credits**	6
CIE Marks	60	**SEE Marks**	40

1. Rationale: In recent years the manufacturing environment has undergone dramatic change. For achieving market goals, it is essential to produce quality parts in less time. Evolution of information technology, variety manufacturing concepts with zero lead time demand and quality consciousness have supported fast adaption of computerized numerical control (CNC) machines. As in human beings' mental ability is becoming more important than physical ability to do the manual work, similarly CNC programming in the same way has more importance along with selection and use of CNC tooling. In this course therefore an attempt has been made to develop skills required for programming, tooling etc for CNC machine. CNC machines normally are not limited to machine tools only but realm of CNC has widened in almost all areas of manufacturing, processes and support activities. It is therefore very important for Diploma mechanical engineers to master CNC technology.

2. Course Outcomes/Skill Sets: At the end of this course, student will be able to:

CO-01	Identify various components of a CNC machine and list the use of those components for any given CNC operation.
CO-02	Study a given production drawing and list the right tools needed to produce a product as per the drawing.
CO-03	Write a CNC turning and milling program for a given production drawing, simulate the program and execute the program in production mode.
CO-04	Develop and/or import a 3-D model of a given component drawing, generate the CNC programming codes using CAM software and execute the program in production mode.

3. Course Content

Week	**CO**	**PO***	**Lecture (Knowledge)**	**Tutorial (Activity)**	**Practice (Skill)**
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	01	01	1.Introduction to CNC Machines- Advantages of CNC machines over Conventional machines 2.Explain the Construction features of CNC machine- Machine Structure, bed, spindle motor and drive, axes motor and ball screws using Multimedia 3. Explain Guide ways, LM guides, console, control switches, coolant system, hydraulic system using Multimedia	Ref Table 1	1. Demonstrate Personal, Conduct, Shop etiquettes and general safety practices in CNC machine Comply safe handling of CNC machines, tools and Equipment. 2.Demonstration of CNC machine and its parts - bed, spindle motor and drive, axes motor and ball screws, guide ways, LM

					guides, console, control switches, coolant system, hydraulic system, 3. Identification of safety switches, machine over travel limits and emergency stop. Machine starting & operating in Reference Point, JOG and Incremental Modes
2	01,02	01	1.Explain Axis convention of CNC machine 2. Explain Cutting tool materials, cutting tool geometry – insert types, holder types, insert cutting edge geometry. 3. ISO nomenclature for turning tool holders, boring tool holders, indexable inserts. - Tool holders and inserts for radial grooving, face grooving, threading, drilling	Ref Table 1	1.Conduct a preliminary check of the readiness of the CNC machine viz., cleanliness of machine, referencing – zero return, 2.Functioning of lubrication, coolant level, correct working of sub-system
3	01,02	01,04	1.Explain Automatic tool exchanger using Multimedia 2. Explain the importance of Tool length compensation, Tool nose Radius compensation and Tool Wear compensation. 3. Explain Machine Zero and Work Zero	Ref Table 1	1.Perform Work and tool setting: - Job zero/work coordinate system and tool setup and live tool setup 2. CNC machining centre operation in various modes: JOG, EDIT, MDI, SINGLE BLOCK, AUTO 3. Setting the tool offsets, entry of tool nose radius and orientation in CNC console
4	03	01,04	1.Explain Programming sequence and format - Absolute and Incremental System 2.Explain G codes and M codes 3. Explain Linear interpolation and Circular Interpolation	Ref Table 1	1. Geometry Wear Correction. Geometry and wear offset correction in CNC Console 2. Program checking in dry run, single block modes
5.	03	01	1.Explain cutting Parameters – Feed, Speed and depth of cut w.r.t CNC machine as per Catalogue 2. Explain Canned Cycle, Mirroring and Subroutines	Ref Table 1	1.Learn various numerical keys, Address Keys, functional Keys of operational console
6.	03	01,04	Write the Part Program for Facing, Turning, Step turning and Taper turning (Write Program for 3 models and execute any one on the machine)	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine

					3.Set the machine with necessary tools and Job 4. Execute the Program in Auto mode to produce the Job.
7.	03	01,04	Write the Part Program for Turning, Profile turning and Thread cutting (Write Program for 3 models and execute any one on the machine)	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine 3.Set the machine with necessary tools and Job 4.Execute the Program in Auto mode to produce the Job
8.	03	01,04	Write a CNC milling program for Pocket machining (Write Program for 3 models and execute any one on the machine)	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine 3.Set the machine with necessary tools and Job 4.Execute the Program in Auto mode to produce the Job
9	03	01,04	Write a part program for drilling 4 holes in a plate Six holes along PCD on a circular plate	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine 3.Set the machine with necessary tools and Job 4.Execute the Program in Auto mode to produce the Job
10.	03	01,04,07	Write a Program using Mirroring Write a Program using Subroutines	Ref Table 1	1.Input the Program into the Simulator and operate the Simulator 2.Transfer the simulated Program to machine 3.Set the machine with necessary tools and Job 4.Execute the Program in Auto mode to produce the Job

11	04	01,04,07	Generate the Part Program for Component requiring Turning, Step turning Profile turning and Thread cutting by using CAM software (Program for 3 models and execute any one on the machine)	Study the latest technological changes in this course and present the impact of these changes on industry	1.Transfer the simulated Program to machine 2. Set the machine with necessary tools and Job 3. Execute the Program in Auto mode to produce the Job
12	04	01,04,07	Generate a CNC program for component having Pocket machining using CAM software (Program for 3 models and execute any one on the machine)		1. Transfer the simulated Program to machine 2. Set the machine with necessary tools and Job 3. Execute the Program in Auto mode to produce the Job
13			Demonstrate the manufacturing of following components on CNC machines using YouTube Videos 1. CNC Turning 2. Rollers 3. Spacers 4. Brackets Discuss and Prepare a Report on the videos Presented for each manufactured component		Demonstrate the manufacturing of following components on CNC machines using YouTube Videos 1. Spindles 2. Frames 3. Engine Block 4. Ball Bearings Discuss and Prepare a Report on the videos Presented for each manufactured component
Total in hours			**39**	**13**	**52**

- ***PO= Program Outcome as listed and defined in year 1 curriculum**
- **Course Co-Ordinator must prepare PO – CO mapping with strength (Low/Medium/High) before course planning**

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl.No.	Suggestive Activities for Tutorials
01	Discuss the steps for choosing the Right CNC machine tool using various parameters like operator experience, Material to be cut, Part difficulty and complexity, LM guides, Control systems, Cost per part, Availability of space. www.hwaheonasia.com
02	Presentation on Macros and Parametric Programming in CNC by discussing basic macro skill-Macro capability, common features and applications- Macro structure www.thomasnet.com
03	Discuss and present a report on influence of coolant in CNC by explaining Purpose- delivery methods of coolants- Types of coolants- Health and safety issues- Properties- Recycling and disposal of cutting lubricants www. Industr.com
04	Each student has to Present minimum 5 CNC Programming on Machining involving Turning, Milling and Drilling. (Course coordinator has to ensure no repetition of the Programs)

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill test reduced to 20l tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Tutorial sessions through Rubrics	1-13		10	10
				Total CIE Marks	60
	Semester End Examination (Practice)		180	100	40
				Total Marks	**100**

5. Format for CIE written Test

Course Name	**Operation Management**	Test	I/II/III	Sem	IV
Course Code	**20ME41P**	Duration	80 Min	Marks	30
Note: Answer any one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions		Cognitive Levels(R/U/A)	Course Outcome	Marks
I	1				
	2				
II	3				
	4				
III	5				
	6				
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.					

5 . (a) CIE Skill Test -4 **Duration: 240 Min**

SL. No.	CO	Particulars/Dimension	Marks
1	02,04	**One Question on Writing CNC program For Turning Model ,Simulation and Preparation of the MODEL on CNC Machine** • Writing CNC program—30 Marks • Editing the program—30 Marks • Simulation and Preparation of the MODEL on CNC Machine - 30 Marks	**90**
2	02,04	**Portfolio evaluation based on the average of all Practice Sessions (1-6 Weeks)**	**10**
Total Marks			**100**

5 . (b) CIE Skill Test -5 **Duration: 240 Min**

SL. No.	CO	Particulars/Dimension	Marks

1	02,03	One Question on Writing CNC program For Milling Model ,Simulation and Preparation of the MODEL on CNC Machine • Writing CNC program—25 Marks • Editing the Program—15 Marks • Simulation and Preparation of the MODEL on CNC Machine-10 Marks	50
2	02,04	One Question on Generating CNC Turning Program/Milling Program, Using CAM Software, Simulation and Preparation of the MODEL on CNC Machine. • Preparation of Solid Model for a given Drawing using software - 25 marks • Generate Turning Program/Milling Program, Using CAM Software - 05 Marks • Interface with the CNC machine and produce the model -10 Marks	40
3	02,03,04	**Portfolio evaluation based on the average of all Practice Sessions (7-12 Weeks)**	**10**
Total Marks			**100**

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
	Average Marks= (8+6+2+2)/4=4.5						**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	Automation, Production Systems, and Computer- Aided Manufacturing by Mikell P. Groover Prentice-Hall International publication
2	CAD/CAM Principles and Applications P N Rao McGraw Hill Education
3	CNC Machines. Pabla B.S., Adithan M. New Age International, New Delhi,2014(reprint)
4	Computer Numerical Control-Turning and Machining centers. Quesada Robert Prentice Hall 2014

8. LIST OF SOFTWARES/ LEARNING WEBSITES:

1. http://www.nptel.ac.in
2. http://www.youtube.com/watch?v=M3eX2PKM1RI
3. http://www.youtube.com/watch?v=EHQ4QIDqENI&list=PLBkqkLQO2nAt5MNLo
4. http://www.youtube.com/watch?v=hJFLcvtiNQ I
5. http://www.youtube.com/watch?v=BIM1AyxfYkw .
6. http://www.mtabindia.com
7. http://www.swansoftcncsimulator.com

9. SEE Scheme of Evaluation **Duration: 180 Min**

SL. No.	**CO**	**Particulars/Dimension**	**Marks**

1	02,03	One Question on Writing CNC program For Turning Model ,Simulation and Preparation of the MODEL on CNC Machine • Writing CNC program—30 Marks • Simulation and Preparation of the MODEL on CNC Machine-20Marks **OR** One Question on Writing CNC program For Milling Model ,Simulation and Preparation of the MODEL on CNC Machine • Writing CNC program—30 Marks • Simulation and Preparation of the MODEL on CNC Machine-20 Marks	50
2	02,04	One Question on Preparing a Solid Model and Generating CNC Turning Program/Milling Program, Using CAM Software, • Preparation of Solid Model for a given Drawing using software – 20 marks • Generate CNC Turning Program/Milling Program, Using CAM Software - 10Marks	30
3	01,02,03,04	Viva voce	20
Total Marks			**100**

10. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
01	CNC Turning Centre (Tutor or Productive)	Minimum diameter 25 mm, Length 120 mm with ATC. (Approximate)	01
02	CNC Milling Centre (Tutor or Productive) X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, With ATC.(Approximate)	X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, With ATC.(Approximate)	01
03	Simulation software likes: CNC Simulator Pro, Swansoft CNC, etc.		20 user
04	Latest version of CAD/CAM integration software like MASTER CAM, NX CAM OR EDGE CAM		20 user
05	Desk top computer	Latest configuration	20 no