Certification Course on CNC Programing for LATHE & Milling Machine

Resource Person: Sri U. Pradeep Kumar

Co-ordinator: Sri R. Rama Krishna Reddy

Date(s) of Event: 23/11/20 to 15/12/20

Organizing department: Mechanical Engineering

K.S.R.M.COLLEGEOFENGINEERING

(UGC-AUTONOMOUS)

Kadapa,Andhra Pradesh,India–516 005

ApprovedbyAICTE,NewDelhi&AffiliatedtoJNTUA,Ananthapuramu.

Cr./KSRMCE/(Department of ME)/2020-2021

Date: 19/11/2020

To

The Principal,

KSRM College of Engineering,

Kadapa.

Respected Sir

Sub: KSRMCE-(Department of ME) permission to conduct certification course on "**CNC Programing for LATHE & Milling Machine**" -Request-Reg.

It is brought to your kind notice that, with reference to the cited, the ME department is planning to conduct Certification Course on "**CNC Programing for LATHE & Milling Machine**" for B.Tech, V Sem Students from **23,Nov 2020 to 15,Dec 2020**. In this regard I kindly request you to grant permission to conduct the certification course. This is submitted for your kind perusal.

Thanking you sir,

Forwarded to Principal sir

Yours Faithfully

Sri. R. Rama Krishna Reddy

Asst.Prof,Dept.ME

KSRMCE,Kadapa.

To the Director for Information

To All Deans/HoD's/IQAC

Permitted

V. S. S. Murthy

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Cr./KSRMCE/(Department of ME)/2020-2021

Date: 19/11/2020

Circular

All the B.Tech VI Sem ME students are here by informed that department of MECHANICAL is going to conduct certificate course on "**CNC Programing for LATHE & Milling Machine**" interested students may register their names on or before 21-11-2020, 5 PM

For any queries contact faculty coordinator:

Sri R.Rama Krishna Reddy , Asso.Prof, Dept.ME, KSRMCE, Kadapa.

Hod

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

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Department of Mechanical Engineering

Certification Course on "**CNC Programing for LATHE & Milling Machine**"

List of Participants

S.NO	ROLL NO	NAME OF THE STUDENT	EMAIL ID'S
1	189Y1A0311	CHEEMALA ARAVIND REDDY	189Y1A0311@ksrmce.ac.in
2	189Y1A0312	CHILAKALA ASHOK	189Y1A0312@ksrmce.ac.in
3	189Y1A0313	DASARI BHARATH KUMAR REDDY	189Y1A0313@ksrmce.ac.in
4	189Y1A0314	DUDDELA SANDEEP KUMAR	189Y1A0314@ksrmce.ac.in
5	189Y1A0315	DUDYALA RAVI KUMAR	189Y1A0315@ksrmce.ac.in
6	189Y1A0316	GADWAL SHAIK MOHAMMED NASEERUDDIN	189Y1A0316@ksrmce.ac.in
7	189Y1A0317	GOVINDU VIKAS	189Y1A0317@ksrmce.ac.in
8	189Y1A0318	GOWRIGALLA ASHOK	189Y1A0318@ksrmce.ac.in
9	189Y1A0319	GUGULA SAI KUMAR	189Y1A0319@ksrmce.ac.in
10	189Y1A0320	JUTURU VIKAS	189Y1A0320@ksrmce.ac.in
11	189Y1A0321	KAMPARAJU RAVI SANKAR	189Y1A0321@ksrmce.ac.in
12	189Y1A0322	KANDUKURI JANARDHAN REDDY	189Y1A0322@ksrmce.ac.in
13	189Y1A0323	KATIKA YASHWANTH REDDY	189Y1A0323@ksrmce.ac.in
14	189Y1A0324	KUMMETHA CHANDRASEKHAR REDDY	189Y1A0324@ksrmce.ac.in
15	189Y1A0325	KURAKU HARI KRISHNA	189Y1A0325@ksrmce.ac.in
16	189Y1A0326	KURUVA MAHESH BABU	189Y1A0326@ksrmce.ac.in
17	189Y1A0327	LINGAREDDY SIVA VENKATA SAI REDDY	189Y1A0327@ksrmce.ac.in
18	189Y1A0328	MAJJARI VENKATA BHASKAR	189Y1A0328@ksrmce.ac.in
19	189Y1A0329	MALKAPURAM THIRUMALESH	189Y1A0329@ksrmce.ac.in
20	189Y1A0330	MOGAL MOHINUDDIN BAIG	189Y1A0330@ksrmce.ac.in
21	189Y1A0332	MUMMADI CHINNA SUBBA REDDY	189Y1A0332@ksrmce.ac.in
22	189Y1A0333	MUTUKUNDU SOMA SEKHAR REDDY	189Y1A0333@ksrmce.ac.in
23	189Y1A0334	NAGURU SAMPATH KUMAR	189Y1A0334@ksrmce.ac.in
24	189Y1A0335	NERSUPALLI SAI KUMAR REDDY	189Y1A0335@ksrmce.ac.in
25	189Y1A0340	PASUPURATHI RAJASEKHAR REDDY	189Y1A0340@ksrmce.ac.in

26	189Y1A0341	PATAN ASHRAF ALI KHAN	189Y1A0341@ksrmce.ac.in
27	189Y1A0342	PATAN SAMEER KHAN	189Y1A0342@ksrmce.ac.in
28	189Y1A0343	PATHAN ARBAAZ KHAN	189Y1A0343@ksrmce.ac.in
29	189Y1A0344	PATHAN NADEEM KHAN	189Y1A0344@ksrmce.ac.in
30	189Y1A0345	PEDDANAGGARI SIVAGIRINATH REDDY	189Y1A0345@ksrmce.ac.in
31	189Y1A0346	PERAM VARUN KUMAR REDDY	189Y1A0346@ksrmce.ac.in
32	189Y1A0347	POOJARI RAJKUMAR	189Y1A0347@ksrmce.ac.in
33	189Y1A0348	POTHUTEJESWARREDDY	189Y1A0348@ksrmce.ac.in
34	189Y1A0349	PRODDUTURU NAGA DASTAGIRI	189Y1A0349@ksrmce.ac.in
35	189Y1A0362	SHAIK ZUBAIR	189Y1A0362@ksrmce.ac.in
36	189Y1A0363	SHAIK ZUBAIR HUSSAIN	189Y1A0363@ksrmce.ac.in
37	189Y1A0364	SHAIKLALAHAMEDGARI KHALEEL AHAMED	189Y1A0364@ksrmce.ac.in
38	189Y1A0365	SHARON SAMUEL	189Y1A0365@ksrmce.ac.in
39	189Y1A0366	SIDDAREDDY LINGAMAIAH	189Y1A0366@ksrmce.ac.in
40	189Y1A0367	SOORABOINA VENKATESH	189Y1A0367@ksrmce.ac.in
41	189Y1A0368	SYED GHAYAZ AHMED	189Y1A0368@ksrmce.ac.in
42	189Y1A0369	TALUPULA AVINASH	189Y1A0369@ksrmce.ac.in
43	189Y1A0370	THAMBALA VEERESH	189Y1A0370@ksrmce.ac.in
44	199Y5A0301	ALAMURU MABU BASHA	199Y5A0301@ksrmce.ac.in
45	199Y5A0303	ATHMAKURU MAHESHBABU	199Y5A0303@ksrmce.ac.in
46	199Y5A0304	BIJILI SATISH KUMAR	199Y5A0304@ksrmce.ac.in
47	199Y5A0305	BODAGALA SAIBHARATH	199Y5A0305@ksrmce.ac.in
48	199Y5A0306	BOGGULA OBULA REDDY	199Y5A0306@ksrmce.ac.in
49	199Y5A0307	CHANDOLI SREENIVASULU	199Y5A0307@ksrmce.ac.in
50	199Y5A0308	CHEPURI AMARENDRA KUMAR	199Y5A0308@ksrmce.ac.in
51	199Y5A0309	GAJJALA VEERA PRASAD	199Y5A0309@ksrmce.ac.in
52	199Y5A0310	GUJJULA VAMSI	199Y5A0310@ksrmce.ac.in
53	199Y5A0312	JINKALA SUBHAN	199Y5A0312@ksrmce.ac.in
54	199Y5A0313	KAIPA VAMSI KRISHNA	199Y5A0313@ksrmce.ac.in
55	199Y5A0314	KAMISETTY BHARGAV	199Y5A0314@ksrmce.ac.in
56	199Y5A0315	KETHAVATH SIVARAM NAIK	199Y5A0315@ksrmce.ac.in
57	199Y5A0316	KONDURU VENKATESH	199Y5A0316@ksrmce.ac.in

Coordinator

HOD

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

Syllabus

CNC PROGRAMMING FOR LATHE & MILLING MACHINE

Course Objectives

- Evaluate manufacturing assignment based on critical thinking and problem solving skills. Become a good communicator and effective team member.
- Practice writing complex "G" code programs for CNC turning centers that meet the part specification
- Interpret and demonstrate complex "G" code programs for CNC milling centers that meet the part specification
- Prepare "G: code programs to perform secondary operations including tapping, countersinking, counter boring, and threading.
- Describe and illustrate common problems with tooling and fixtures in CNC programming and machining.

UNIT-1

Lathe cutting tool-different types, shapes and different angles (clearances and rake), specification of lathe tools Drills-different parts, types, size etc., different cutting angles, cutting speed for different material. Boring tool. Lubricant and coolant-types, necessity, system of distribution, selection of coolant for different material: Handling and care. Knurling meaning, necessity, types, grade, cutting speed for knurling.

UNIT-2

Introduction to CNC technology -CNC machines & controls. History & development of CNC technology. Conventional Vs. non-conventional machine tool. Numerical control on CNC machine tools. CNC Control and types of CNC control. Calculation of technological data for CNC machining. CNC clamping system. Implementation of JH for CNC. Basic health and safety. CNC programming basics. Introduction to manual NC programming. Manual NC programming for lathe & milling machines. Application Numerical Control, Advantages, & Disadvantages.

UNIT-3

Introduction to CNC programming, Introduction and demonstration of line programs CNC programming for lathe & milling machine using ISO codes into the CNC simulator.CNC programming for lathe and milling machines using different machining cycles into the CNC simulator. Procedures Associated with part programming, Cutting process parameter selection, Process planning issues and path planning, G & M Codes, Interpolations, Canned Cycles and Subprograms, Tool compensations. Machining of programmed exercise on CNC lathe & milling machines

UNIT-4

Plan and optimize programs for CNC turning operations. Calculate parameters like speed feed etc. and set references for the various operations. Prepare operation and operation sequence for the lathe operations like turning, grooving etc. Prepare & set CNC lathe operations and test run programmed.

UNIT-5.

Plan and optimize programs for CNC Milling operations. Calculate parameters like speed feed , depth of cut etc. set a references for the various operations. Various methods of work process like edge finding block center etc. Prepare & set CNC Milling operations and test run programmed

Learning Outcomes

- Explain applications and advantages of CNC machines and technology
- Demonstrate and explain various CNC control Calculate technological data for CNC machining
- Understand the importance and use of PPE's
- Prepare and understand line program for various profiles Identify and set parameters for various simulators
- Prepare programs , demonstrate , simulate and operate CNC lathe machines for various machining operations
- Prepare programs , demonstrate , simulate and operate CNC milling machines for various machining operations
- Define and explain Modern CNC systems and explain its importance in manufacturing

TEXT BOOKS:

1. CNC Programming skills ; Program Entry ane Editing on Fanuc Machines **By S.K Sinha**
2. Easy CNC Programming hand book: HMC , VMC, MULTI AXIS **Sanjay Sharma**
3. CNC Programming For Lathe & Milling : Siemens sinumerik Control **Harshal Dhawas.**

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Department of Mechanical Engineering

Certification Course on "CNC Programing for LATHE & Milling Machine"

Schedule

Timing: 4:00pm – 6:00pm

S.No	Date	Course Coordinator	Topic Covered
1	23-11-2020	Sri R.Rama Krishna Reddy	Lathe cutting tool-different types, shapes and different angles
2	24-11-2020	Sri U. Pradeep Kumar	Boring tool. Lubricant and coolant-types, necessity, system of distribution
3	25-11-2020	Sri R.Rama Krishna Reddy	Handling and care. Knurling meaning, necessity, types, grade, cutting speed for knurling.
4	26-11-2020	Sri U. Pradeep Kumar	Introduction to CNC technology -CNC machines & controls. History & development of CNC technology.
5	27-11-2020	Sri R.Rama Krishna Reddy	CNC Control and types of CNC control. Calculation of technological data for CNC machining. CNC clamping system
6	28-11-2020	Sri U. Pradeep Kumar	Application Numerical Control, Advantages, & Disadvantages
7	30-11-2020	Sri R.Rama Krishna Reddy	CNC programming for lathe & milling machine using ISO codes into the CNC simulator
8	01-12-2020	Sri U. Pradeep Kumar	Procedures Associated with part programming, Cutting process parameter selection
9	03-12-2020	Sri R.Rama Krishna Reddy	Canned Cycles and Subprograms, Tool compensations. Machining of programmed exercise on CNC lathe & milling machines
10	04-12-2020	Sri U. Pradeep Kumar	Plan and optimize programs for CNC turning operations. Calculate parameters like speed feed etc.
11	07-12-2020	Sri R.Rama Krishna Reddy	Prepare operation and operation sequence for the lathe operations like turning, grooving etc.
12	09-12-2020	Sri U. Pradeep Kumar	Prepare & set CNC lathe operations and test run programmed.
13	11-12-2020	Sri R.Rama Krishna Reddy	Plan and optimize programs for CNC Milling operations. Calculate parameters like speed feed , depth of cut etc
14	14-12-2020	Sri U. Pradeep Kumar	Various methods of work process like edge finding block center etc.
15	15-12-2020	Sri R.Rama Krishna Reddy	Prepare & set CNC Milling operations and test run programmed

Coordinator

HoD

Professor & Head
Department of Mechnical Engineering
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Department of Mechanical Engineering

Activity Report

Name of the Event	: Certification Course on "**CNC Programing for LATHE & Milling Machine**"
Duration of the Event	: 23-11-2020 to 15-12-2020
Scheduled Time	: 4.00 to 6.00PM
Target Audience	: B.Tech V Sem Students
Course coordinator	: R. RAMA KRISHNA REDDY

Activity Description:

CNC Programing for LATHE & Milling Machine is one of the important tools to learn programming using G codes M codes .Dept of Mechanical Engineering Organized a certificate couse on **CNC Programing for LATHE & Milling Machine** .Head of the dept, Faculty & Participations of the course inaugurated with all good spirit. Resources persons begin the first day, first session on **CNC Programing for LATHE & Milling Machine**. The content of the program is the main part of the entire program and consists of multiple program segments. Each program segment is composed of several words, and each word is composed of the address code and several numbers. The common ones are the program segments composed of G and M commands and the coordinate points of each axis, and the function definition of the feed is added.

At the beginning of the program, the program number is mainly defined , the part processing coordinate system is set, processing tool is selected, the spindle starts automatically, the coolant is turned up, etc. At the end of the program, the tool post needs to return to the reference point or machine tool reference point, finally valedictory. Students were issued participation certificates by the Head of the Department.

Coordinator

HOD

Principal

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

PRINCIPAL
K.S.R.M. COLLEGE OF ENGINEERING
KADAPA - 516 003. (A.P.)

K.S.R.M. COLLEGE OF ENGINEERING

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Kadapa, Andhra Pradesh, India– 516 003

Certificate Course on

CNC Programming for Lathe & Milling Machines

23/11/2020 to 15/12/2020

Organized by

DEPARTMENT
OF
MECHANICAL ENGINEERING

K.S.R.M.COLLEGEOFENGINEERING

(UGC-AUTONOMOUS)

Kadapa,Andhra Pradesh,India–516 005

ApprovedbyAICTE,NewDelhi&AffiliatedtoJNTUA,Ananthapuramu.

Department of Mechanical Engineering

Certification Course on **CNC Programing for LATHE & Milling Machine**

Attendance Sheet

S.No	Name of the Student	Roll List	23/11/20	24/11	25/11	26/11	27/11	28/11	30/11	01/12	03/12	04/12	07/12	09/12	11/12	14/12	15/12/20
1	CHEEMALA ARAVIND REDDY	189Y1A0311	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	CHILAKALA ASHOK	189Y1A0312	✓	✓	✓	A	✓	✓	A	✓	✓	✓	A	✓	✓	✓	✓
3	DASARI BHARATH KUMAR REDDY	189Y1A0313	A	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓
4	DUDDELA SANDEEP KUMAR	189Y1A0314	A	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
5	DUDYALA RAVI KUMAR	189Y1A0315	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	A	✓	✓	✓	✓
6	GADWAL SHAIK MOHAMMED NASEERUDDIN	189Y1A0316	A	✓	A	✓	✓	A	✓	✓	✓	✓	A	✓	✓	✓	✓
7	GOVINDU VIKAS	189Y1A0317	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	GOWRIGALLA ASHOK	189Y1A0318	A	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9	GUGULA SAI KUMAR	189Y1A0319	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	JUTURU VIKAS	189Y1A0320	✓	✓	A	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
11	KAMPARAJU RAVI SANKAR	189Y1A0321	✓	✓	✓	✓	✓	✓	A	✓	✓	A	✓	✓	✓	✓	✓
12	KANDUKURI JANARDHAN REDDY	189Y1A0322	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓

13	KATIKA YASHWANTH REDDY	189Y1A0323	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
14	KUMMETHA CHANDRASEKHAR REDDY	189Y1A0324	✓	A	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
15	KURAKU HARI KRISHNA	189Y1A0325	✓	✓	✓	✓	✓	✓	A	A	✓	✓	✓	✓	✓	✓	✓	✓
16	KURUVA MAHESH BABU	189Y1A0326	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	A	
17	LINGAREDDY SIVA VENKATA SAI REDDY	189Y1A0327	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
18	MAJJARI VENKATA BHASKAR	189Y1A0328	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
19	MALKAPURAM THIRUMALESH	189Y1A0329	✓	A	✓	A	✓	✓	✓	A	✓	✓	A	✓	✓	✓	✓	✓
20	MOGAL MOHINUDDIN BAIG	189Y1A0330	✓	A	✓	✓	✓	A	✓	✓	A	✓	✓	✓	✓	✓	✓	A
21	MUMMADI CHINNA SUBBA REDDY	189Y1A0332	✓	✓	✓	✓	A	✓	A	✓	✓	✓	✓	✓	A	✓	✓	✓
22	MUTUKUNDU SOMA SEKHAR REDDY	189Y1A0333	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓
23	NAGURU SAMPATH KUMAR	189Y1A0334	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	A	✓	✓
24	NERSUPALLI SAI KUMAR REDDY	189Y1A0335	✓	✓	✓	A	✓	✓	A	✓	✓	✓	✓	✓	A	✓	✓	✓
25	PASUPURATHI RAJASEKHAR REDDY	189Y1A0340	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
26	PATAN ASHRAF ALI KHAN	189Y1A0341	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	
27	PATAN SAMEER KHAN	189Y1A0342	✓	A	✓	A	✓	✓	✓	✓	A	✓	✓	A	✓	✓	✓	
28	PATHAN ARBAAZ KHAN	189Y1A0343	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
29	PATHAN NADEEM KHAN	189Y1A0344	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
30	PEDDANAGGARI SIVAGIRINATH REDDY	189Y1A0345	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	
31	PERAM VARUN KUMAR REDDY	189Y1A0346	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	A	✓	
32	POOJARI RAJKUMAR	189Y1A0347	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	
33	POTHUTEJESWARREDDY	189Y1A0348	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	A	✓	✓	

34	PRODDUTURU NAGA DASTAGIRI	189Y1A0349	✓	A	✓	✓	✓	✓	✓	✓	A	✓	✓	A	✓	✓		
35	SHAIK ZUBAIR	189Y1A0362	✓	✓	✓	✓	✓	✓	A	✓	A	✓	A	✓	A	✓	✓	
36	SHAIK ZUBAIR HUSSAIN	189Y1A0363	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	A
37	SHAIKLALAHAMEDGARI KHALEEL AHAMED	189Y1A0364	✓	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	A	✓	✓	
38	SHARON SAMUEL	189Y1A0365	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	
39	SIDDAREDDY LINGAMAIAH	189Y1A0366	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	
40	SOORABOINA VENKATESH	189Y1A0367	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	A	✓	✓	A	✓	
41	SYED GHAYAZ AHMED	189Y1A0368	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	
42	TALUPULA AVINASH	189Y1A0369	✓	✓	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	✓	A	
43	THAMBALA VEERESH	189Y1A0370	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	A	✓	
44	ALAMURU MABU BASHA	199Y5A0301	✓	✓	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	A	✓	
45	ATHMAKURU MAHESHBABU	199Y5A0303	✓	✓	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	A	L	
46	BIJILI SATISH KUMAR	199Y5A0304	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
47	BODAGALA SAIBHARATH	199Y5A0305	✓	✓	✓	A	✓	✓	✓	A	✓	A	✓	A	✓		✓	
48	BOGGULA OBULA REDDY	199Y5A0306	✓	A	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	
49	CHANDOLI SREENIVASULU	199Y5A0307	✓	A	✓	✓	✓	A	✓	A	✓	✓	✓	✓	✓	✓	✓	
50	CHEPURI AMARENDRA KUMAR	199Y5A0308	✓	A	✓	✓	✓	A	✓	A	✓	A	✓	✓	✓	✓	A	
51	GAJJALA VEERA PRASAD	199Y5A0309	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	
52	GUJJULA VAMSI	199Y5A0310	✓	A	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	
53	JINKALA SUBHAN	199Y5A0312	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	A	
54	KAIPA VAMSI KRISHNA	199Y5A0313	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	✓	✓	A	✓	
55	KAMISETTY BHARGAV	199Y5A0314	✓	✓	✓	A	✓	✓	✓	A	✓	A	✓	✓	✓	✓	A	

56	KETHAVATH SIVARAM NAIK	199Y5A0315	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
57	KONDURU VENKATESH	199Y5A0316	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Coordinator

HOD

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

What is a CNC Machine?

CNC : Computerised Numerical Control

(Computer + Numerical Control)

- Numerical control is a programmable automation in which process is controlled by Numbers, Letters, and symbols.
- CNC Machining is a process used in the manufacturing sector that involves the use of computers to control machine tools like lathes, mills and grinders.

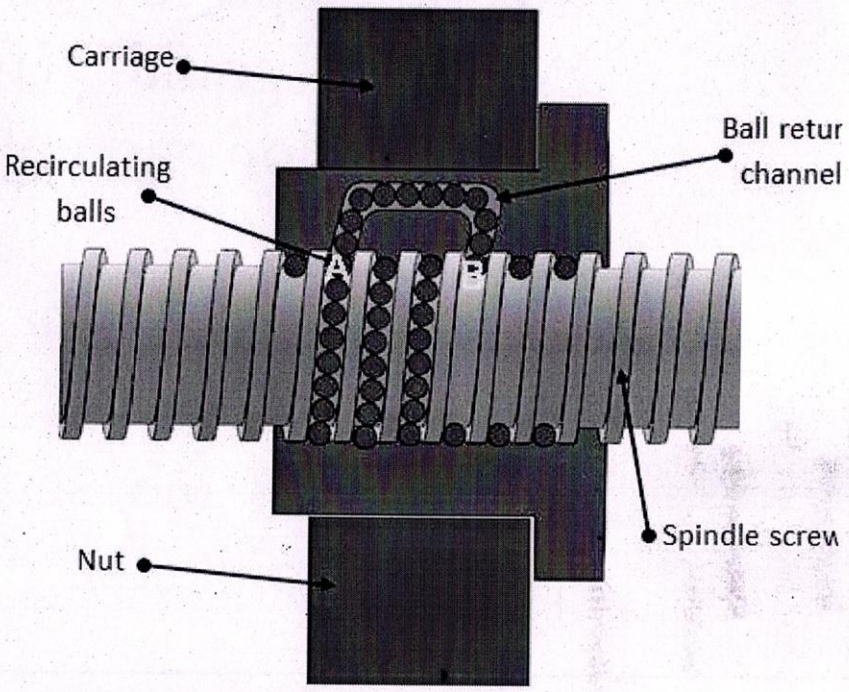
Why is CNC Machining necessary?

- To manufacture complex curved geometries in 2D or 3D was extremely expensive by mechanical means (which usually would require complex jigs to control the cutter motions)
- Machining components with high Repeatability and Precision
- Unmanned machining operations
- To improve production planning and to increase productivity
- To survive in global market CNC machines are must to achieve close tolerances.

Ball screw / ball bearing screw / recirculating ballscrew Mechanism

- It consists of a screw spindle, a nut, balls and integrated ball return mechanism a shown in Figure .

- The flanged nut is attached to the moving part of CNC machine tool. As the screw rotates, the nut translates the moving part along the guide ways.



Ballscrew configuration

- However, since the groove in the ball screw is helical, its steel balls roll along the helical groove, and, then, they may go out of the ball nut unless they are arrested at a certain spot.

- Thus, it is necessary to change their path after they have reached a certain spot by guiding them, one after another, back to their "starting point" (formation of a recirculation path). The recirculation parts play that role.

- When the screw shaft is rotating, as shown in Figure, a steel ball at point (A) travels 3 turns of screw groove, rolling along the grooves of the screw shaft and the ball nut, and eventually reaches point (B).

- Then, the ball is forced to change its pathway at the tip of the tube, passing back through the tube, until it finally returns to point (A).

- Whenever the nut strokes on the screw shaft, the balls repeat the same recirculation inside the return tube.

- When debris or foreign matter enter the inside of the nut, it could affect smoothness in operation or cause premature wearing, either of which could adversely affect the ball screw's functions.

- To prevent such things from occurring, seals are provided to keep contaminants out. There are various types of seals viz. plastic seal or brush type of seal used in ball-screw drives.

Characteristics of ball screws

- **High mechanical efficiency**

In ball screws, about 90% or more of the force used to rotate the screw shaft can be converted to the force to move the ball nut.

Since friction loss is extremely low, the amount of force used to rotate the screw shaft is as low as one third of that needed for the acme thread lead screw.

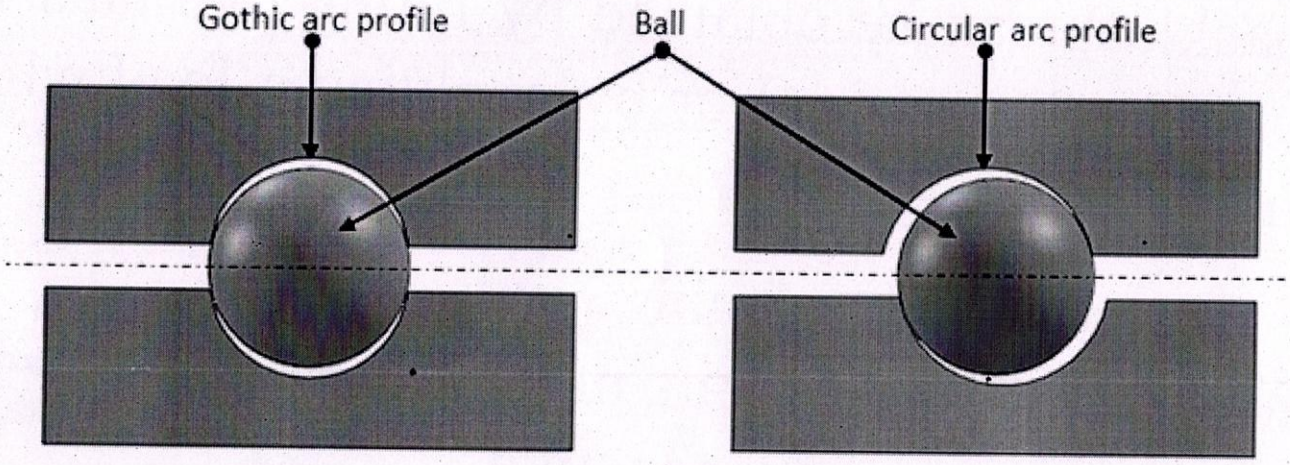
- **Low in wear**

Because of rolling contact, wear is less than that of sliding contact. Thus, the accuracy is high.

Ball screws move smoothly enough under very slow speed. They run smoothly even under a load.

- **Thread Form**

The thread form used in these screws can either be gothic arc type (fig.a) or circular arc type (fig.b). The friction in this kind of arrangement is of rolling type. This reduces its wear as comparison with conventional sliding friction screws drives.



Thread forms (a) Gothic arc (b) Circular arc

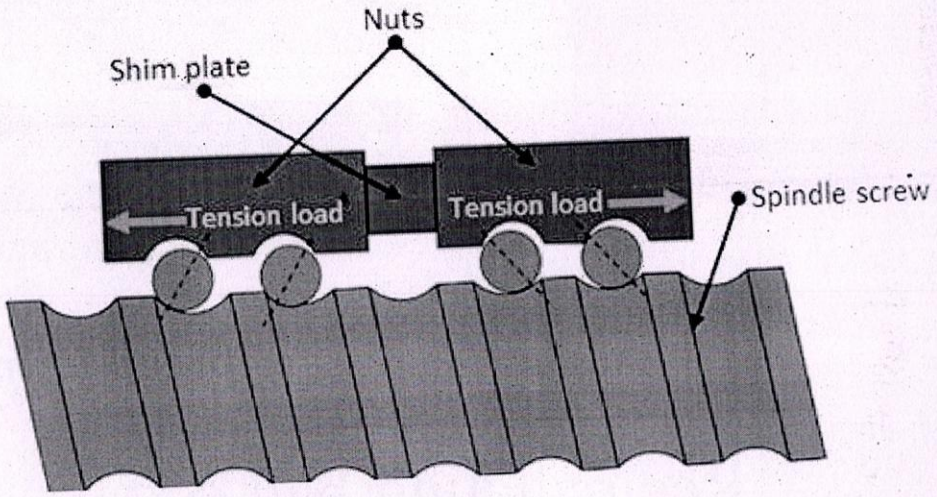
Recirculating ball screws are of two types. In one arrangement the balls are returned using an external tube. In the other arrangement the balls are returned to the start of the thread in the nut through a channel inside the nut.

- **Preloading**

In order to obtain bidirectional motion of the carriage without any positional error, the backlash between the nut and screw should be minimum.

Zero backlash can be obtained by fitting two nuts with preloading (tension or compression) or by applying a load which exceeds the maximum operating load.

Figure shows double nut preloading system. A shim plate (spacer) is inserted between two nuts for preloading. Preload is to create elastic deformations (deflections) in steel balls and ball grooves in the nut and the screw shaft in advance by providing an axial load.



Double nut preloading system

As a result the balls in one of the nuts contact the one side of the thread and balls in the other nut contact the opposite side.

Effects of preload

- Zero backlash: It eliminates axial play between a screw shaft and a ball nut.
- It minimizes elastic deformation caused by external force, thus the rigidity enhances.
- In case mounting errors, misalignment between the screw shaft and the nut may occur this further generates distortion forces.
- This could lead to the problems such as,
  - Shortened service life
  - Adverse effect on smooth operation
  - Reduced positioning accuracy
  - Generation of noise or vibration
  - Breakage of screw shaft

Advantages of ball screws

- Highly efficient and reliable.
- Less starting torque.
- Lower co efficient of friction compared to sliding type screws and run at cooler temperatures
- Power transmission efficiency is very high and is of the order of 95 %.
- Could be easily preloaded to eliminate backlash.
- The friction force is virtually independent of the travel velocity and the friction at rest is very small; consequently, the stick-slip phenomenon is practically absent, ensuring uniformity of motion.
- Has longer thread life hence need to be replaced less frequently.
- Ball screws are well -suited to high through output, high speed applications or those with continuous or long cycle times.
- Smooth movement over full range of travel.

Disadvantages of ball screws

- Tend to vibrate.
- Require periodic overhauling to maintain their efficiency.
- Inclusion of dirt or foreign particles reduces the life of the screws.
- Not as stiff as other power screws, thus deflection and critical speed can cause difficulties.
- They are not self-locking screws hence cannot be used in holding devices such as vices.
- Require high levels of lubrication.

Applications of ball screws

- Ball screws are employed in cutting machines, such as machining center and NC lathe where accurate positioning of the table is desired
- Used in the equipment's such as lithographic equipment or inspection apparatus where precise positioning is vital
- High precision ball screws are used in steppers for semiconductor manufacturing industries for precision assembly of micro parts.
- Used in robotics application where precision positioning is needed.
- Used in medical examination equipment's since they are highly accurate and provide smooth motion.

DIFFERENCES BETWEEN CNC MACHINES TOOLS AND CONVENTIONAL MACHINE TOOLS

➢ Constructional details:

- Basically conventional machine have 2 axes, known as X & Y axis.
- There is also a Z axis long which only the bed moves vertically.
- The spindle along with the tool does not move as it is fixed with the machine body .

But in case of CNC machine, there are minimum 3 axes with Spindle moving parallel to Z axis.

- CNC machines have more rigid construction when compared to the conventional machine.

- The slide ways, guide and spindles of the CNC machine all look over proportioned when compared to the conventional machine.

The structure of the CNC machine is therefore designed to cope with the torsional forces and heavy duty cutting imposed on these machines.

➢ Recirculating ball lead screws and anti friction slide ways

CONVENTIONAL

- The slide ways on a conventional machine operate under the conditions of sliding friction.

- The lead screws are usually of the Acme thread form, which are inefficient due to the high frictional resistance between the flanks of the screw and the nut. There is also backlash, because of the clearance between the screw and the nut.

- Rolling friction can be used instead of sliding friction, where re-circulating roller bearings are positioned under the slide ways.

- A recirculating ball lead screw, where both the lead screw and the nut have a precision ground radiused shaped thread. The space or track between the lead screw and nut is filled with an endless stream or ball bearings.

The advantages are longer life, less frictional resistance, lower torque required, more precise positioning of slides, where backlash is almost completely eliminated.

➢ Use of Stepping Motors in Slide Movement

The slides and spindle of the CNC machine are driven by stepper motors.

STEPPER MOTOR – A digital signal is sent from the controller to the motor in the form of pulses, which will cause the motor to rotate through a specified angle, which causes the slide to move by the required distance.

Example:

If five digital pulses are sent to the stepper motor then it will rotate by five steps, which is converted to linear movement by the lead screw. The speed by which the pulses are sent to the stepper motor will determine the velocity of the slide movement. As the distance moved by the slide and the feed can be accurately controlled by the CNC control system, there is no need for positional or velocity feedback

MAJOR COMPONENTS RELATED TO CNC MACHINE TOOLS

Any CNC machine tool essentially consists of the following parts:

❑ Part program:

- A series of coded instructions required to produce a part.
- Controls the movement of the machine tool and on/off control of auxiliary functions such as spindle rotation and coolant.
- The coded instructions are composed of letters, numbers and symbols.

❑ Program input device

- The program input device is the means for part program to be entered into the CNC control.

- Three commonly used program input devices are punch tape reader, magnetic tape reader, and computer via RS-232-C communication.

❑ Machine Control Unit

The machine control unit (MCU) is the heart of a CNC system. It is used to perform the following functions:

- To read the coded instructions.
- To decode the coded instructions.
- To implement interpolations (linear, circular, and helical) to generate axis motion commands.
- To feed the axis motion commands to the amplifier circuits for driving the axis mechanisms.
- To receive the feedback signals of position and speed for each drive axis.
- To implement auxiliary control functions such as coolant or spindle on/off and tool change.

❑Machine Tool

- CNC controls are used to control various types of machine tools.

- Regardless of which type of machine tool is controlled, it always has a slide table and a spindle to control position and speed.

- The machine table is controlled in the X and Y axes, while the spindle runs along the Z axis.

❑Feed Back System

- The feedback system is also referred to as the measuring system.
- It uses position and speed transducers to continuously monitor the position at which the cutting tool is located at any particular instant.
- The MCU uses the difference between reference signals and feedback signals to generate the control signals for correcting position and speed errors.

❑Drive System

- Drives are used to provide controlled motion to CNC elements
- A drive system consists of amplifier circuits, drive motors, and ball lead-screws.
- The MCU feeds the control signals (position and speed) of each axis to the amplifier circuits.
- The control signals are augmented to actuate drive motors which in turn rotate the ball lead-screws to position the machine table.

➢ POWER DRIVES

- In machine tools, power is generally required for driving the main spindle, saddles and carriages and to some auxiliary units.

- The motors used for CNC system are of two kinds
  - ✓ Electrical - AC , DC or Stepper motors
  - ✓ Fluid - Hydraulic or Pneumatic

- In CNC, usually stepper and servo electrical drives are used

- They exhibit favourable torque-speed characteristics and are relatively inexpensive.

✓ STEPPER MOTOR

A stepper motor is a pulse-driven motor that changes the angular position of the rotor in steps.

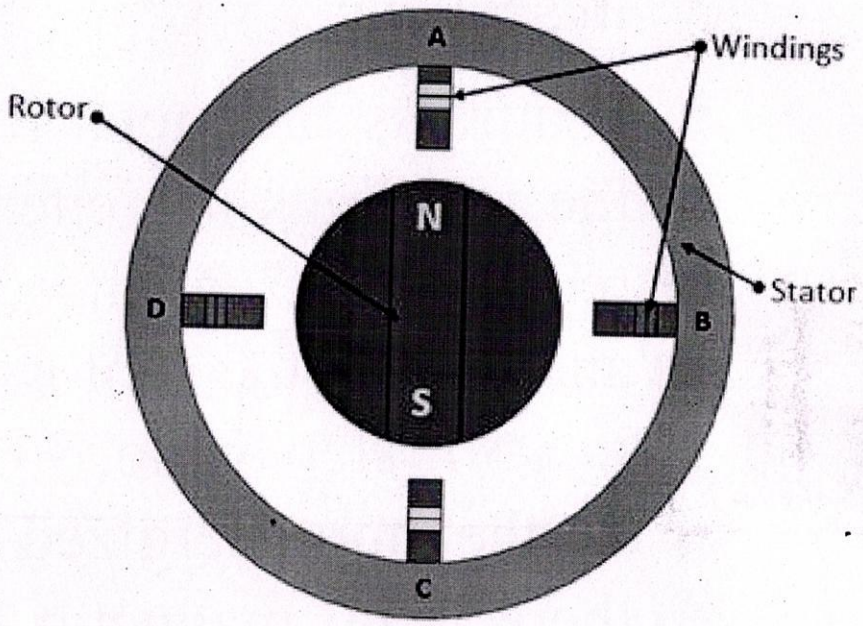
Due to this nature of a stepper motor, it is widely used in low cost, open loop position control systems.

Types of stepper motors:

- Permanent Magnet
  - Employ permanent magnet
  - Low speed, relatively high torque
- Variable Reluctance
  - Does not have permanent magnet
  - Low torque

Permanent magnet (PM) stepper motor

- Rotor is a permanent magnet.
- PM motor rotor has no teeth and is designed to be magnetized at a right angle to its axis.
- Figure shows a simple, 90^0 PM motor with four phases (A-D).
- Applying current to each phase in sequence will cause the rotor to rotate by adjusting to the changing magnetic fields.
- Although it operates at fairly low speed, the PM motor has a relatively high torque characteristic.



Permanent magnet stepper

- These are low cost motors with typical step angle ranging between 7.5^0 to 15^0

Variable Reluctance Motor

- The cylindrical rotor is made of soft steel and has four poles
- It has four rotor teeth, 90^0 apart and six stator poles, 60^0 apart.
- Electromagnetic field is produced by activating the stator coils in sequence.
- It attracts the metal rotor. When the windings are energized in a reoccurring sequence of 2, 3, 1, and so on, the motor will rotate in a 30^0 step angle.
- In the non-energized condition, there is no magnetic flux in the air gap, as the stator is an electromagnet and the rotor is a piece of soft iron; hence, there is no detent torque.

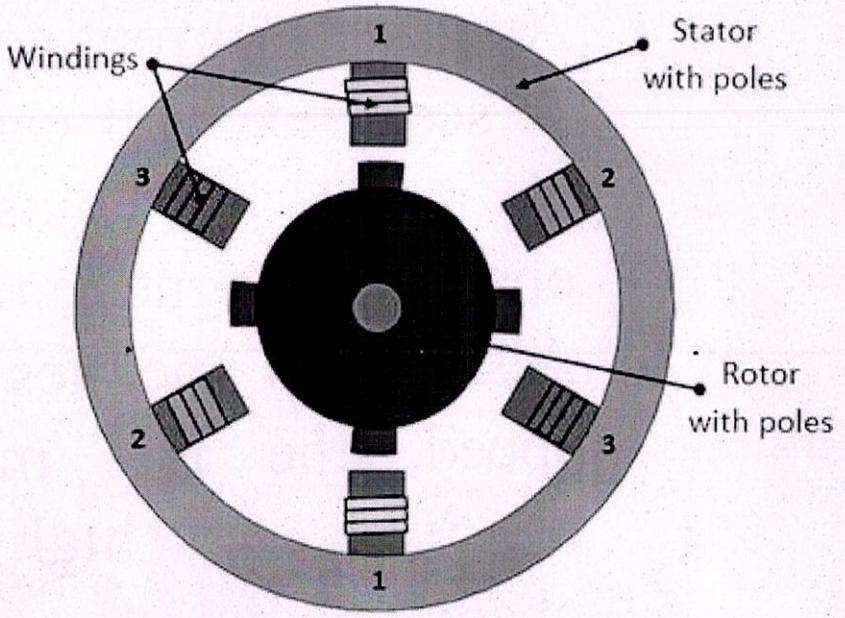


Fig. Variable reluctance stepper motor

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From 23/11/20 *to* 15/12/20 *, Organized by Department of*

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Coordinator

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Department of Mechanical Engineering
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S.No	Name of the Student	Roll List	Is the Course content meet your expectation	Is the lecture sequence well planned	Is the level of course high	Is the course exposed you to the new knowledge and practices	Rate the Knowledge of the Speaker	Rate the value of Course in increasing your skills	Any Issues
1	CHEEMALA ARAVIND REDDY	189Y1A0311	yes	Agree	Strongly Ag	Yes	4	5	Nil
2	CHILAKALA ASHOK	189Y1A0312	yes	Agree	Agree	Yes	5	5	Need extra Explanation
3	DASARI BHARATH KUMAR REDDY	189Y1A0313	yes	Agree	Agree	Yes	4	5	Nil
4	DUDDELA SANDEEP KUMAR	189Y1A0314	yes	Agree	Agree	Yes	5	5	Nil
5	DUDYALA RAVI KUMAR	189Y1A0315	yes	Agree	Agree	Yes	5	5	Provide PPT
6	GADWAL SHAIK MOHAMMED NASEERUDDIN	189Y1A0316	yes	Agree	Agree	Yes	5	4	Nil
7	GOVINDU VIKAS	189Y1A0317	yes	Agree	Agree	Yes	5	4	Nil
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40	SOORABOINA VENKATESH	189Y1A0367	yes	Agree	Agree	Yes	5	5	Nil
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55	KAMISETTY BHARGAV	199Y5A0314	yes	Agree	Agree	Yes	5	5	Nil
56	KETHAVATH SIVARAM NAIK	199Y5A0315	yes	Agree	Agree	Yes	5	5	Nil
57	KONDURU VENKATESH	199Y5A0316	yes	Agree	Agree	Yes	5	5	Nil

Coordinator

HOD

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K.S.R.M. College of Engineering
KADAPA - 516 003.