REPORT ON IN – PLANT TRAINING AT

CENTRAL INSTITUTE OF PLASTICS ENGINEERING & TECHNOLOGY,
HYDERABAD.

By

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About CIPET:

CIPET is an ISO 9001:2008 QMS, NABL, ISO/IEC 17020 accredited premier national Institution devoted to Academic, Technology Support & Research (ATR) activities for the growth of Polymer & allied industries in the country. All over India CIPET centres have state of
art infrastructural facilities in the areas of Design, CAD/CAM/CAE, Tooling & Mould Manufacturing, Plastics processing, Testing and Quality control to cater to the needs of Polymer & allied industries in the country. CIPET renders Technology Support Services in Design, Tooling, Plastics Processing, and Testing & Quality Assurance in India and abroad. The Plastics Testing Centre (PTC) at CIPET is equipped with state of the art equipments and is recognized as one of the best plastics testing facilities in Asia. The biodegradable testing centre of CIPET is first of its kind in the country works jointly with European Bio plastics& International Biodegradable products Institute. CIPET has been recognised by Department of Scientific and Industrial Research (DSIR) as a scientific and research organisation in the field of Plastics Engineering & Technology.

CIPET publishes serial publications like CIPET Times with coverage on latest technological developments, news and views about CIPET and industry trends. CIPET’s International Journal of Plastics Technology (IJPT) has international recognition as the Scientific Journal in the field of plastics technology with elite and eminent international Editorial board. CIPET has established very good interaction with Regional & National Plastics Associations in India & it is a founder member of PIF. CIPET’s place in the international arena is apparent from the prestigious assignments of Academic and Consultancy Services pouring in from all over the world.

Design and CAD/ CAM/ CAE Departments in CIPET:

Technology Support Services (TSS) is an integral part of the activities of CIPET and offers with high quality services to its customers in Tooling, Precision, Machining on CNC machines, Design and Manufacturing of Moulds, Tools & Dies for manufacturing plastics products, CAD/CAM/CAE services, plastics product manufacturing through state-of-the-art Injection molding machines, Blow molding, PET, Stretch blow molding, Pipe and Film extrusion etc, Standardization, Testing and quality control for Plastics Materials and products, Pre delivery inspection (PDI) of plastics products like PVC and PE pipes, Woven sacks, Water storage tanks, Micro-irrigation equipments, Engineered bamboo boards, Polymer based composite doors etc.
CIPET provides a world class Technology & engineering services in the areas of CAD/ CAM/ CAE by complementing our customer’s efforts to fulfill their design and Engineering requirements and to deliver them optimum solutions across the globe with high quality. The design and CAD/ CAM/ CAE Departments in all CIPET centers are facilitated with latest infrastructure. Based on the combination of engineering knowledge and software skills & industrial experience, CIPET offers spectrum of engineering services in CAD, CAM, and CAE. The departments provide services to the plastic and allied industries in the following areas.

- 3D solid Modeling
- Plastics Product Design and Mould Design
- Plastics Flow analysis
- Failure analysis
- Finite Element Analysis (FEA)
- Reverse Engineering
- Rapid tooling
- Product/ mould design validation
- Optimization of process parameters
- Manufacturing Automation
- Rapid prototyping and Rapid tooling
- CAD/ CAM/ CAE software training

**Major Software Resources Used in CIPET:**

- MASTERCAM x2
- Solid Edge
- IDEAS
- CIMATRON
- UG MOLD WIZARD
- LS DYNA
- Pro - Engineer
- Unigraphics
- CATIA
- AutoCAD
Introduction to Conventional Machines:

Lathe Machine:

The lathe is a machine tool used principally for shaping articles of metal (and sometimes wood or other materials) by causing the work piece to be held and rotated by the lathe while a tool bit is advanced into the work causing the cutting action. The basic lathe that was designed to cut cylindrical metal stock has been developed further to produce screw threads, tapered work, drilled holes, knurled surfaces, and crankshafts. The typical lathe provides a variety of rotating speeds and a means to manually and automatically move the cutting tool into the work piece. Machinists and maintenance shop personnel must be thoroughly familiar with the lathe and its operations to accomplish the repair and fabrication of needed parts.

Milling Machine:

A milling machine is a machine tool that removes metal as the work is fed against a rotating multipoint cutter. The cutter rotates at a high speed and because of multiple cutting edges it removes metal at a very fast rate. The machine can hold one or more number of cutters at a time. This is why a milling machine finds wide applications in production work. This is superior to other machines as regards accuracy and better surface finish, and is designed for machining a variety of tool room work. The first milling machine came into existence in about 1700 and was of French origin. The milling cutter was first developed by Jacques de Vaucanson in the year 1782. The machines mechanism is composed of spindle drive mechanism and table feed mechanism. Types of milling are shown in below figure.

![Milling Types](image)

Testing Equipment at CIPET:

ROCKWELL HARDNESS TEST: The Rockwell hardness test is an empirical indentation hardness test. Its worldwide adoption has likely resulted from the many advantages provided by the test method. The test is fast, inexpensive, and relatively non-destructive, leaving only a small indentation in the material. The simplicity in the operation of a Rockwell hardness machine has provided the added advantage that Rockwell hardness testing usually does not require a highly
skilled operator. By way of correlation with other material properties, the Rockwell hardness test can provide important information about metallic materials, such as the tensile strength, wear resistance, and ductility. The test is generally useful for material selection, for process and quality control, and for acceptance testing of commercial products.

OPACITY TESTER: The exhaust smoke is checked using a snap acceleration test procedure, which simulates on-the-road acceleration. After a vehicle is selected for testing, the wheels are chocked for safety. Brakes are disengaged for the testing. The inspector records the necessary vehicle information such as engine make and model, vehicle weight rating, VIN number, age, stack size, etc. The inspector places the probe from a smoke sensing meter in the vehicle’s exhaust pipe. With the vehicle in neutral, the driver is instructed to rapidly depress the accelerator and hold at the maximum governed speed for a few seconds, then return to idle. The meter measures the opacity of the smoke emitted while the driver repeats the snap acceleration test a number of times. This should all take no more than 10 minutes.
Much other testing equipment like
Thin film plastic tester, thickness tester, falling weight impact tester, universal testing machine, colorant adding tester, viscosity and temperature identifier, plastic testing chemicals laboratory placed in different forms of laboratory namely Physi- Mech Laboratory, Thermal & Product Testing Laboratory, Rheo- Mech Laboratory, etc.,

**Introduction to CNC machines:**

All CIPET centres are well equipped with ultramodern, state-of-the-art Tool Room machines and it is an ideal Tool Room for any Tool Maker. CNC machinery and extended its facilities for taking up commercial job assignments for mould fabrication, high precision machining and manufacturing of standard mould bases. Besides manufacturing of moulds, the tool rooms also undertake job orders of varying magnitude such as repair of moulds and dies, CNC machining, CNC spark erosion, grinding, drilling, designing, development of jigs and fixtures, tool parts etc.

**Different CNC machines used at CIPET:**

- Universal milling and boring Machine
- Die sinking - EDM
- Universal lathe with hydrobar feeder
- High precision surface and profile grinder
- Wire cut EDM
- HAAS USA Make turning Centre
- HAAS USA High Speed 5 Axis machining centre
- HAA USA High Speed 3 Axis Machining Centre
- CNC EDM Spark erosion Machine

**Special purpose Machines:**

- Jig boring machine
- Co-ordinate drilling and boring machine
- Rigid die sinking machine Center lathe with hydro copying attachment
- Rotary surface grinding Cylindrical grinder
- Optical profile grinding machine

**Advantages of CNC machines:**

- Easier to program;
- Easy storage of existing programs;
- Easy to change a program
- Avoids human errors
- NC machines are safer to operate
- Complex geometry is produced as cheaply as simple ones
- Usually generates closer tolerances than manual machines
Components of servo motor based CNC machines:

Part program: A computer program to specify

- Which tool should be loaded on the machine spindle;
- What are the cutting conditions (speed, feed, coolant ON/OFF etc)
- The start point and end point of a motion segment
- How to move the tool with respect to the machine.

History of CNC:
The RS274-D is a **word address format**

Each line of program = 1 block

Each block is composed of several instructions, or (words)

For e.g.

Sequence and format of words:

N3   G2   X+1.4   Y+1.4   Z+1.4   I1.4   J1.4   K1.4   F3.2   S4   T4   M2

Where,

N3- sequence no.
G2- preparatory function   X+1.4 Y+1.4 Z+1.4- destination coordinate
I1.4 J1.4 K1.4- distance to centre of circle   F3.2- Feed rate
S4 – Spindle speed   T4- Tool   M2- Miscellaneous function

Software programs can even automatically provide generation of CNC data –
CNC machines allow precise and repeatable control in machining. CNC lathes, Milling machines, etc. are all controlled by NC programs. These programs can be generated manually, automatically. NC and CNC machining provide several advantages over conventional manual machining. With CNC machining, parts can be reproduced with improved accuracy. NC and CNC technology automates the machining processes, therefore requiring fewer machine operators and avoiding operator error. This automation, combined with the improved repeatability, yield improved quality control over the machining process. Furthermore, when linked to computer aided design software, NC and CNC technology provide the foundation for agile manufacturing.

**Process Planning to Tool Room:**

All CIPET centers in the country have adequate expertise and facilities in tool rooms to develop molds for plastics products of any profile, shape or complexities. With the state-of-the-art processing machineries like double color Injection moulding machines, Micro processor control machines, all electric Machines, CIPET is undertaking precision job orders to render technical support services to plastics processing and allied industries.

**Job work to plastic industries:**

In order to exploit the resources to the fullest extent possible and also to train the students in commercial moulding and processing of different plastic materials using various parameters, job orders are being encouraged. With the result the students are provided hands on practical experience in the areas of:

- Inspection, proving and evaluation of molds and dies and moulding of components.
- Testing of mouldability and optimization of processing conditions/parameters.

Further CIPET also renders dedicated moulding/processing seminars to the plastic processing and recycling industries.
**Major Processing Industries benefited & Prestigious Assignments:**

- Development of Blown Film, Defence Research and Development Establishment (DRDE), Gwalior.
- Process recommendations and set up of PP trays manufacturing units to M/s. Srisuma Industries, Mandya.

**CNC EDM Machine:** The process is characterized by the fact that removal of material is obtained by a succession of non-stationary electrical discharges, separated from each other in time, i.e. only one spark at a time is created. The phenomenon is therefore unitary and periodic. The discharges are produced by a voltage source (off-load voltage) of more than 20Volts, and always take place in a dielectric machining fluid. The spark erosion machining process is also known as **Electro-Discharge** erosion or **Electro-Discharge Machining Process.**

![CNC EDM Machine Image]

**The electrical Discharge:**

To generate a spark between two electrodes a voltage higher than the gap (electrode-part space) breakdown voltage must be applied. The, breakdown voltage Depends:
- On the distance between the electrode and the part,
- On the insulating capability of the Dielectric,
- On the condition of pollution of the gap (erosion waste).

A discharge builds up at the point of the strongest electrical field. This is in fact the result of a complicated process. Due to the action of this field, free positive ions and electrons are accelerated, reach very high speeds and rapidly form an ionized and therefore conductive channel. At this stage, the current and flow and the spark builds up between the electrodes resulting in infinity of collisions between particles. A plasma zone is formed. This zone rapidly reaches very high temperatures, in the order of 8000 to 12000°C and develops due to the increasing number of shocks causes local and instantaneous melting a certain quantity of material at the surface of both conductors. Simultaneously due to vaporization of the electrodes and the die electric, develops gas bubble and its pressure increases regularly until it becomes very high. When the current is interrupted, the sudden drop in temperature causes the bubble to implode, causing dynamic forces which have the effect of projecting this melted material out of the crater. The eroded material then resolidifies in the dielectric in the form of small spheres, and is evacuated by the dielectric. Erosion on the electro-part assembly is asymmetrical and depends,
in particular, on the polarity, thermal conductivity and melting temperature of the materials and the duration and intensity of the discharges. This is known as wear when it takes place on the electrode, and removal of material when it takes place on the part.

The machine has 4 axes, represented by the letters X, Y, Z and C. The X axis represents length wise movements and the Y Axis crosswise movement, The Z axis represents the vertical movements of the electrode. The C axis represents rotation of the electrode in one direction of the other.

X, Y, Z axes
The movements of the electrodes are considered with respect to the part.
The movement is positive when the electrode moves to the right of the part (with the observer facing the axis in movement in the other case movement is negative.

C axes
Movement is positive when the electrode rotates counter clockwise. In this way and CNC based EDM machine works.

CNC Lathe Machine:

The below are some of the M-codes which are used in the operation of a CNC lathe machine.
The below figure shows the exact operation where the cutting tool comes in contact automatically towards the job held in the chuck.
It is a FANUC operating system. The figure below is a program being generated by FANUC language in for step turning process in Lathe CNC machine.

CNC Milling Machine:

Milling machines are very versatile. They are usually used to machine flat surfaces on square or rectangular parts, but can also produce many unique and irregular surfaces. They can also be used to drill, bore, and produce slots, pockets and many other shapes. The type of milling machine in the UCR Mechanical Engineering Machine Shop is a variable speed vertical spindle,
knee-mill with a swiveling head (also known as a “Bridgeport”). Although there are several other types of milling machines, this document will focus only on the vertical milling machine. A milling machine removes metal by rotating a multi-toothed cutter that is fed into the moving work piece. The spindle can be fed up and down with a quill handle on the head.

To create a new part file program in CNC milling machine:

A CNC milling machine looks like below
A program is fed into the machine and executed as shown below. Even in using MASTERCAM software any part model is drawn and generates itself a program which is fed through a cable given names like R23007 etc. So the program gets executed now bringing a complete easily formed part through milling.

**CNC Wire cut EDM:**

The below shown is a carbide or a graphite wire used in wire cut EDM. The same process repeats as in EDM but the main difference is where a wire is used to cut the required complex shapes. One important thing to remember in this procedure is that only any profiles which need to be cut through complete profiles are used in this method. An electrical tension is applied between the piece and the wire. When the voltage becomes high enough, the breakdown of the dielectric occurs and an ionized channel is created. The dielectric becomes locally conductive and the discharge can start.

![Image of wire cut EDM](image)

**Wire Electrode Specifications:**

The wire electrode is required to have a sufficient tensile strength and should be of uniform diameter and free from kink or twist.

The electrode wire material should be –

- Brass / Super alloy (Coated)
- Diameter variation within ±0.002 mm
- Tensile strength more than 50 Kgf/mm²
- Even winding, free from breaks/kinks.

Flushing is important to achieve a stable machining condition. It plays very important role as far as cutting speed is concerned. Both the Nozzles (upper and lower) should be just about 0.2 mm away from the work piece, otherwise cutting performance drops considerably. Also both the nozzles should be checked periodically for damages. Scratches or slight damage on the contact edge affect cutting speed. Purity of the water should be maintained by timely replacement of filters. Only Distilled water is used as a di-electric fluid here. This process cut only conductive materials.

Generally we think upto what complexity these EDM’s can be used? The answer lies in this below figures.
In CNC wire EDM as the material removal or machining proceeds, the electrode traverse along a predetermined path which is stored in the controller. The path specifications (path program) can be supplied to the controller through RS 232C port or floppy diskette from the part programming system or directly through the controller key board. When the X-Y table is moving along the predetermined path while the U-V table is kept stationary, a straight cut with a predetermined pattern is formed. In order to produce taper machining, the wire electrode has to be tilted. This is achieved by displacing the upper wire guide (along U-V axes) with respect to the lower wire guide. The desired taper angle is achieved by simultaneous control of the movement of X-Y table and U-V table along their respective predetermined paths stored in the controller. The path information of X-Y table and U-V table is given to the controller in terms of linear and circular elements via NC program.
Conclusion:

We have learnt the four operation procedures of most important machines in both conventional type and CNC programming and machining type even. The demonstration classes which were taught on the first day of our visit were even more interesting and useful. We are really thankful to our Principal Sir and our Mechanical Department and mainly to our Management for providing us a most enjoyable and knowledgeable tour to CIPET, Hyderabad.