SHRI SWAMI ATMANAND SARASWATI INSTITUTE OF TECHNOLOGY, SURAT

MECHANICAL ENGINEERING DEPARTMENT

YEAR/SEM: 4th /7th

SUBJECT: COMPUTER INTEGRATED MANUFACTURING (2171903)

LIST OF EXPERIMENTS

Sr. No.	Practical	Date	Grade	Sign
1	Study of Computer Integrated System			
2	NC/CNC technology			
3	CNC part Programming: Lathe and Milling jobs			
4	Exercise on PLC for Simple problems.			
5	Problems on GT and Industrial case problems on coding			
6	Problems on CAPP and Industrial case problems			
7	Study of Flexible Manufacturing system			
8	Study of Robotics Technology			
9	Problems on MRP-I, MRP-II			
10	Study of Expert System in Manufacturing and MIS			

Practical 1

Aim: Study of Computer Integrated System: Basics, Types of Manufacturing, role of management and CIM wheel

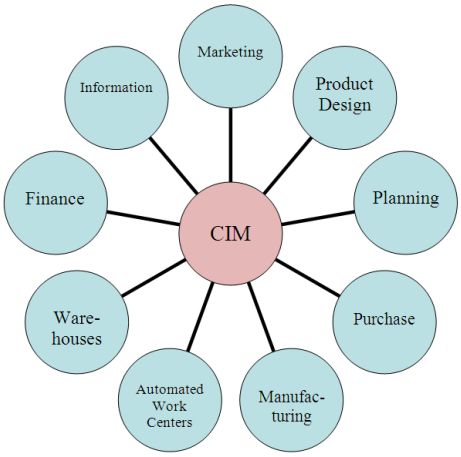
Students should be able to:

- Name the major elements of CIM
- Explain various advantage & disadvantage of CIM
- List application of CIM

Theory:

Computer Integrated Manufacturing (CIM) is considered a natural evolution of the technology of CAD/CAM which by itself evolved by the integration of CAD and CAM.

Computer Integrated Manufacturing (CIM) encompasses the entire range of product development and manufacturing activities with all the functions being carried out with the help of dedicated software packages.



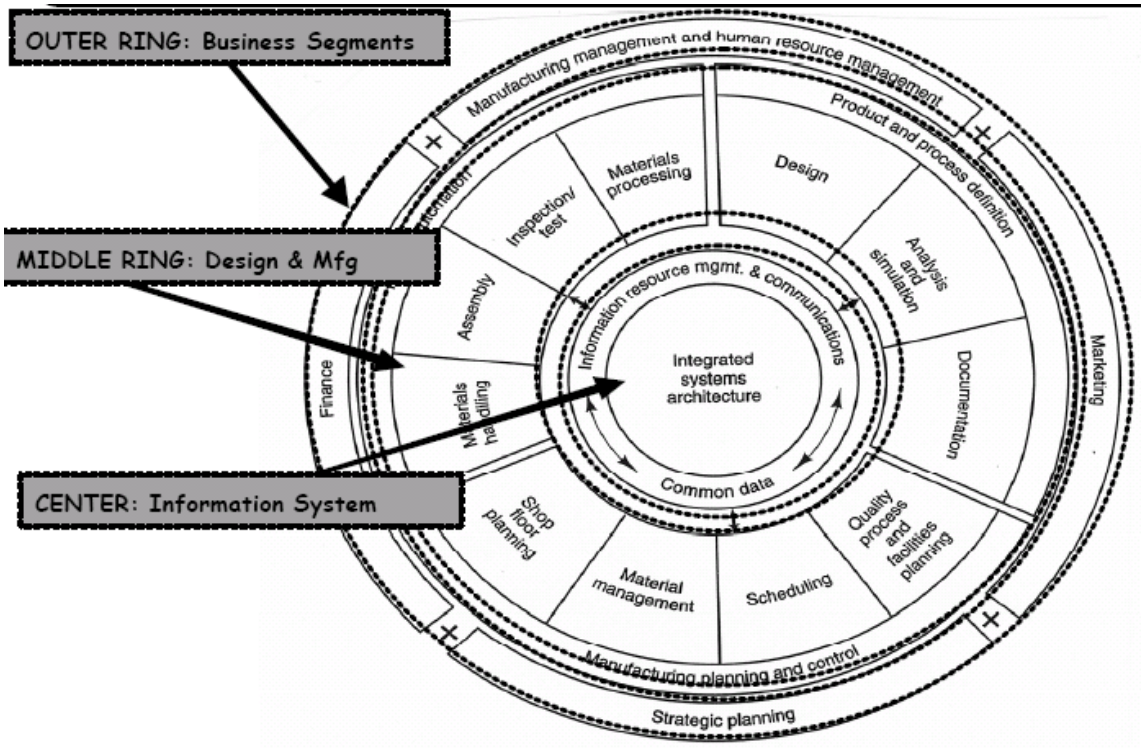
Major Elements of CIM

Objectives of CIM:

- Reduction in inventory
- Lower the cost of the product
- Reduce waste
- Improve quality

Major Applications of CIM:

- Computer Numerical Control
- Industrial Robots
- Automated Handling of Materials
- Automated and Robotic Assembly Systems
- Computer-Aided Process Planning
- Just-in-time Production
- Group Technology
- Artificial Intelligence



CIM WHEEL

Questions:

1) What is CIM? Discuss component of CIM wheel.
2) Application of computer skill, design & manufacturing
3) Advantages and limitation of CAM.
4) Types of manufacturing system
5) Role of management in CIM

Reference Books:

1) CAD/CAM/CIM by P. Radhakrishnan, S. Subramanian, V. Raju PUBLISHERS: NEW AGE INTERNATIONAL (P) LIMITED

2) Automation, Production System and computer Aided Manufacturing by M.P. Grover.

Practical 2

Aim: NC/CNC Technology: Definition, Classification, Specification, Construction details, Sensors and Actuators, and different controllers.

Students should be able to:

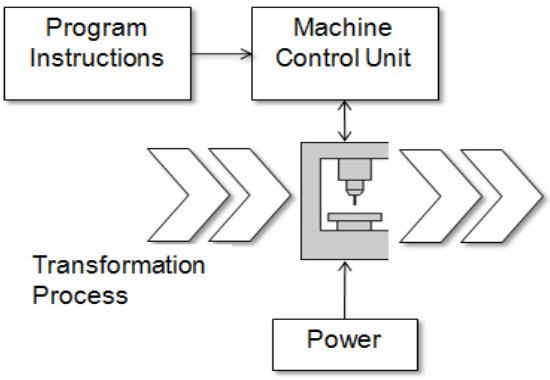
- Difference between conventional Process & NC/CNC.
- Basics difference between NC & CNC.
- Types of NC.
- Structure of NC & CNC.

Theory:

Numerical Control (NC) refers to the method of controlling the manufacturing operation by means of directly inserted coded numerical instructions into the machine tool. It is important to realize that NC is not a machining method; rather, it is a concept of machine control.

Basic components of NC:

- Software
- Machine Control Unit (MCU)
- Machine Tool



Block dia. For NC

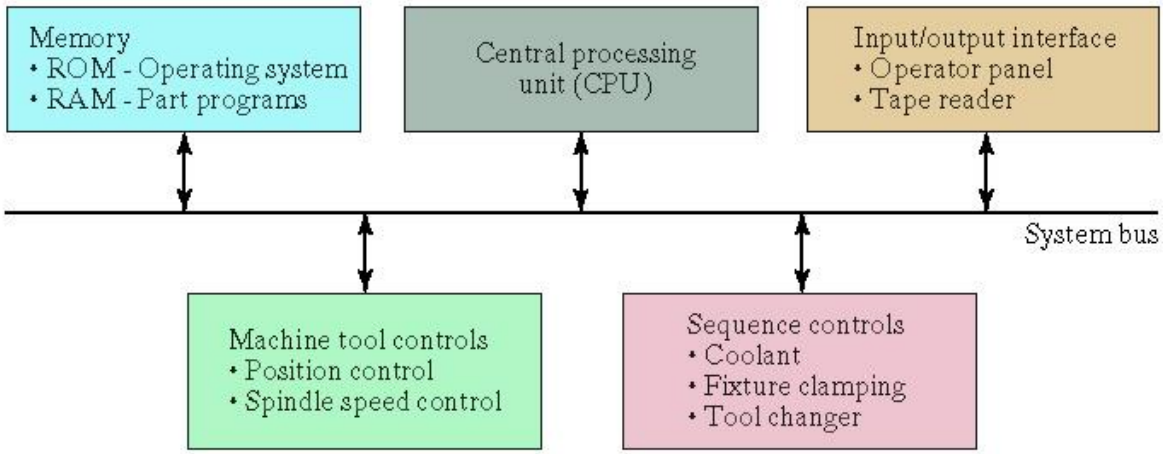
Input type of NC:

- Punched Tape
- Tape Reader

Motion Control Systems:

- Point-to-Point systems
- Continuous path systems

Computer Numerical Control (CNC): The main difference between NC & CNC is that, CNC has a storage memory for storing more than one program at a time & we can use those when we need. Also editing in the program when there is required.



MCU for CNC

Questions:

1) what is NC technology? Explain its types.
2) what is CNC machine? Explain its classification.
3) construction detail of NC & CNC machine tool
4) what are the Actuators and controllers in NC\CNC machine system?

Reference Books:

1. CNC Programming by Rd. S.K. Sinha
2. Computer Numerical Control by P. Radhakrishnan

Practical 3

Aim: CNC part Programming: Lathe and Milling jobs

Students should be able to:

- Use of G code & M code.
- Difference between codes of turning & milling.
- Particular code structure.

Theory:

CNC instructions are called part program commands. When running, a part program is interpreted one command line at a time until all lines are completed. Commands, which are also referred to as blocks, are made up of words which each begin with a letter address and end with a numerical value. Each letter address relates to a specific machine function. "G" and "M" letter addresses are two of the most common. A "G" letter specifies certain machine preparations such as inch or metric modes, or absolutes versus incremental modes. A "M" letter specifies miscellaneous machine functions and work like on/off switches for coolant flow, tool changing, or spindle rotation. Other letter addresses are used to direct a wide variety of other machine commands.

Important things to know:

- Coordinate System
- Units, incremental or absolute positioning
- Coordinates: X, Y, Z, RX, RY, RZ
- Feed rate and spindle speed
- Coolant Control: On/Off, Flood, Mist
- Tool Control: Tool and tool parameters

Programming consists of a series of instructions in form of letter codes

- Preparatory Codes: G codes - Initial machining setup and establishing operating conditions
- N codes: specify program line number to executed by the MCU
- Axis Codes: X, Y, Z - Used to specify motion of the slide along X, Y, Z direction
- Feed and Speed Codes: F and S- Specify feed and spindle speed
- Tool codes: T – specify tool number
- Miscellaneous codes: M codes - for coolant control and other activities

O - Program number (Used for program identification)
N - Sequence number (Used for line identification)
G - Preparatory function
X - X axis designation
Y - Y axis designation
Z - Z axis designation
R - Radius designation
F – Feed rate designation
S - Spindle speed designation
H - Tool length offset designation
D - Tool radius offset designation
T - Tool Designation
M - Miscellaneous function

Basic Concept of Part Programming:

Part programming contains geometric data about the part and motion information to move the cutting tool with respect to the work piece. Basically, the machine receives instructions as a sequence of blocks containing commands to set machine parameters; speed, feed and other relevant information.

A block is equivalent to a line of codes in a part program.

N135 G01 X1.0 Y1.0 Z0.125 T01 F5.0

N135 Block Number
G01 G code
X, Y, Z Coordinates
T tool Number
F Feed (Special Function)

Questions:

1) Part programming of turning.
2) Part programming of milling.

Reference Books:

1. CNC Programming by Rd. S.K. Sinha
2. Computer Numerical Control by P. Radhakrishnan

Practical 4

Aim: Exercise on PLC for Simple problems.

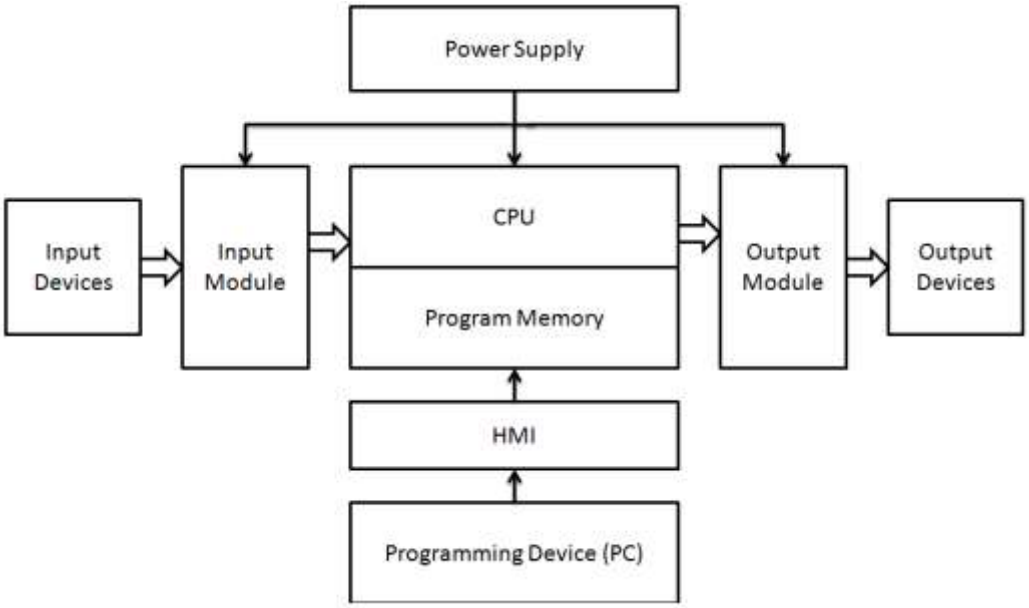
Students should be able to:

- Code & their structure.
- Structure of Program.
- Benefits of Simulation.

INTRODUCTION

A programmable logic controller, commonly known as PLC is a specialized computer mainly used for automation in various industries. It is used in place of automation of a car manufacturing company where robotic arms are used, places where motors need to be driven on reception of a command signal, in electrical power system for the operation of circuit breaker, etc. PLCs are programmable hence a single unit can be used for different kind of operations based on where it is used making it a versatile device. The major advantage of a PLC over the conventional controllers its robust nature. It has high fidelity in most dynamic environments. PLC is reluctant to noise from the peripherals and hence is a reliable device for automation where accuracy and correctness is prominent. Another major advantage of a PLC is its ability to handle multiple input and output ports which processes analog as well as digital signals.

BUILDING BLOCKS OF PLC



APPLICATIONS OF PLC

- Robotic arm in car manufacturing
- Air compressors
- Airport runway lighting control
- Traffic signal control
- Smoke alarm control
- Process valve control
- Textile equipment's
- Vacuum pump system

Questions:

1) Definition and introduction of PLC
2) Explain relay device component
3) Architecture of programmable logic controller
4) Explain programming of PLC
5) Explain tools for PLC logic

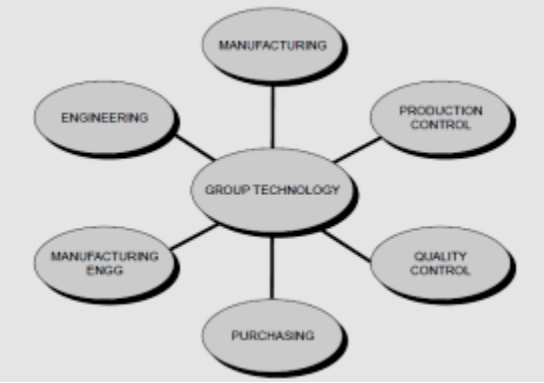
Reference Books:

1. CNC Programming by Rd. S.K. Sinha
2. Computer Numerical Control by P. Radhakrishnan

Practical 5

Aim: Problems on GT and Industrial case problems on coding

Group Technology involves grouping components having similar attributes in order to take advantage of their similarities in design or manufacturing phases of production cycle. It is implemented through the application of well structured classification and coding systems and supporting software to take advantage of the similarities of components in terms of design attributes and processing sequences.



PART FAMILY: A part family is a collection of parts which are similar either because of geometry and size or because similar processing steps are required in their manufacture. The parts within a family are different, but their similarities are close enough to merit their identification as members of the part family.

For grouping parts into part families there are three methods. They are

- Visual Inspection.
- Part Classification and coding.
- Production flow analysis.

PARTS CLASSIFICATION AND CODING SYSTEMS:

It grouped into three general types:

- Systems based on design attributes
- Systems based on part manufacturing attributes
- Systems based on both design and manufacturing attributes

Design Attributes:

Basic (External/Internal) shape, Axisymmetric/Prismatic/sheet metal, Length/diameter ratio, Material, Major dimensions, Minor dimensions, Tolerances, Surface finish

Part Manufacturing Attributes: Major process of manufacture, Surface treatments/coatings, Machine tool or processing equipment, cutting tools, Operation sequence, Batch quantity, Production time, Production rate, Fixtures needed.

CODING STRUCTURES: A part coding scheme consists of symbols that identify the part's design and/or manufacturing attributes. The symbols in the code can be all numeric, all alphabetic, or a combination of both types.

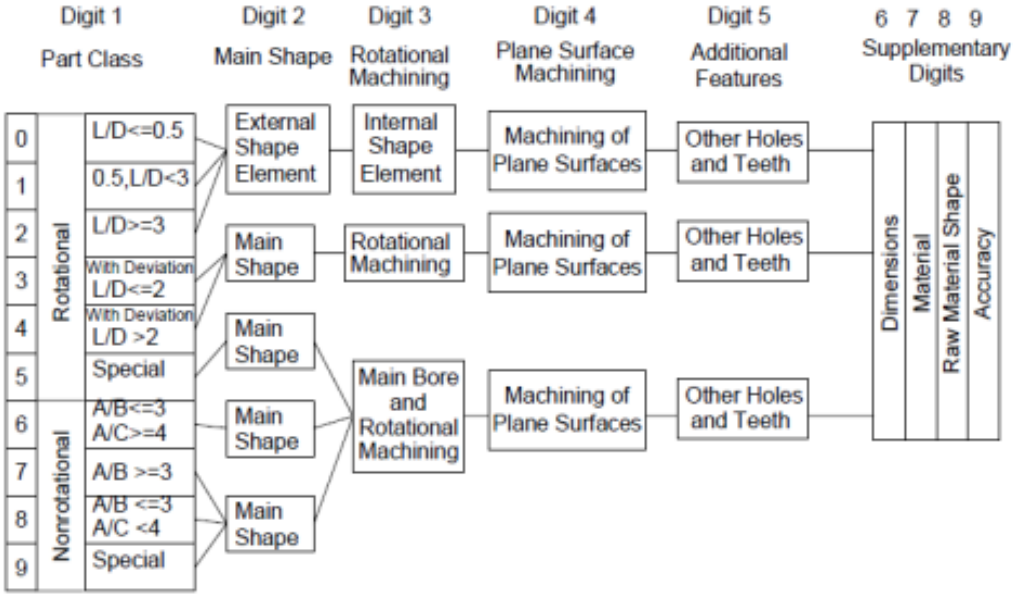
There are three basic code structures used in group technology applications:

- Hierarchical structure
- Chain type structure
- Hybrid structure

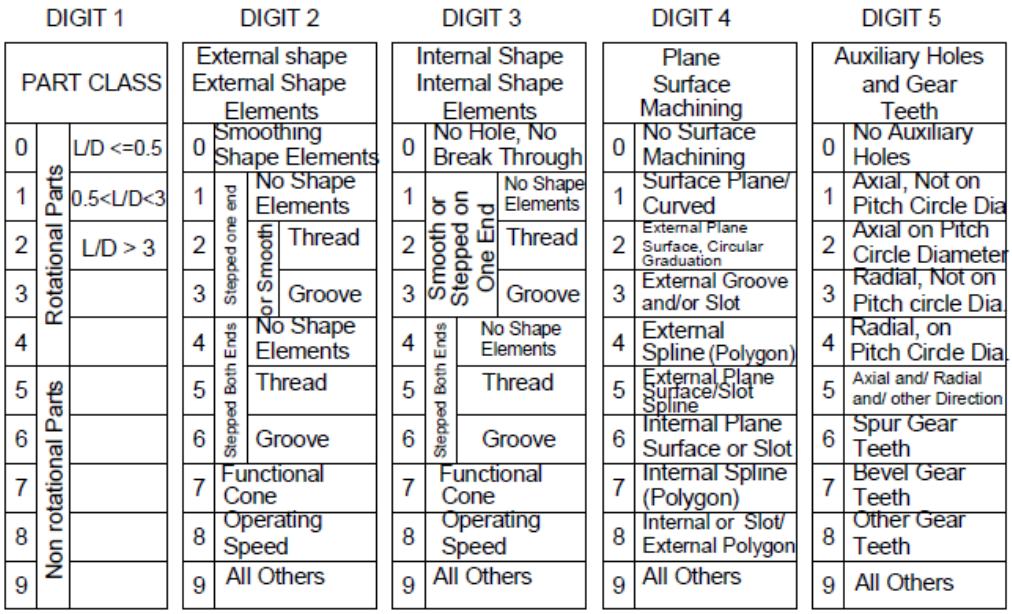
OPITZ CLASSIFICATION SYSTEM:

12345 6789 ABCD

The basic code consists of nine digits, which can be extended by adding four more digits. The first five digits, 12345, are called the "form code" and describe the primary design attributes of the part. The next four digits, 6789, constitute the "supplementary code". It indicates some of the attributes that would be of use to manufacturing (work material, raw work piece shape and accuracy). The extra four digits, "ABCD", are referred to as the "secondary code" and are intended to identify the production operation type and sequence. The secondary code can be designed by the firm to serve its own particular needs.



general shape and proportions of the part



DIGIT 1			DIGIT 2				DIGIT 3				DIGIT 4	DIGIT 5
PART CLASS			External shape External Shape Elements				Internal Shape Internal Shape Elements				Plane Surface Machining	Auxiliary Holes and Gear Teeth
0	Rotational Parts	L/D <=0.5	0	Smoothing Shape Elements			0	No Hole, No Break Through			0 No Surface Machining	0 No Auxiliary Holes
1		0.5<L/D<3	1	Stepped one end	No Shape Elements		1	Smooth or Stepped on One End	No Shape Elements		1 Surface Plane/ Curved	1 Axial, Not on Pitch Circle Dia
2		L/D > 3	2		or Smooth Thread		2		Thread		2 External Plane Surface, Circular Graduation	2 Axial on Pitch Circle Diameter
3			3		Groove		3		Groove		3 External Groove and/or Slot	3 Radial, Not on Pitch circle Dia.
4			4	Stepped Both Ends	No Shape Elements		4	Stepped Both Ends	No Shape Elements		4 External Spline (Polygon)	4 Radial, on Pitch Circle Dia.
5	Non rotational Parts		5		Thread		5		Thread		5 External Plane Surface/Slot Spline	5 Axial and/ Radial and/ other Direction
6			6		Groove		6		Groove		6 Internal Plane Surface or Slot	6 Spur Gear Teeth
7			7	Functional Cone			7	Functional Cone			7 Internal Spline (Polygon)	7 Bevel Gear Teeth
8			8	Operating Speed			8	Operating Speed			8 Internal or Slot/ External Polygon	8 Other Gear Teeth
9			9	All Others			9	All Others			9 All Others	9 All Others

For the rotational work pieces Coding the First Five Digits

BENEFITS OF GROUP TECHNOLOGY:

- Increased productivity
- Improved accuracy in estimation of costs
- Greater standardization and variety reduction
- Reduced set up times
- Reduced cost of purchasing
- Improved plant efficiency

Questions:

1) What is part classification and coding requirements in GT. Explain OPTIZ system of coding?

2) What is group technology? What are the advantages of GT in manufacturing?

3) Explain following with reference to GT: -

   a) Coding structure in GT

   b) Composite part

4) Difference between product layout and group technology layout.

Reference Books:

1) CAD/CAM/CIM by P. Radhakrishnan, S. Subramanian, V. Raju. PUBLISHERS: NEW AGE INTERNATIONAL (P) LIMITED
2) Flexible Manufacturing System by DR. H.K. SHIVANAND, M.M. BENAL, V. KOTI. PUBLISHERS: NEW AGE INTERNATIONAL (P) LIMITED
3) Automation, Production System and computer Aided Manufacturing by M.P. Groover.

Practical 6

Aim: Problems on CAPP and Industrial case problems

Theory:

Questions:

1) What is process planning? Explain its role of process planning in CAD/CAM integration
2) What are the types of CAPP? Explain variant of retrieval approaches.
3) Compare & construct CAPP & CMPP system

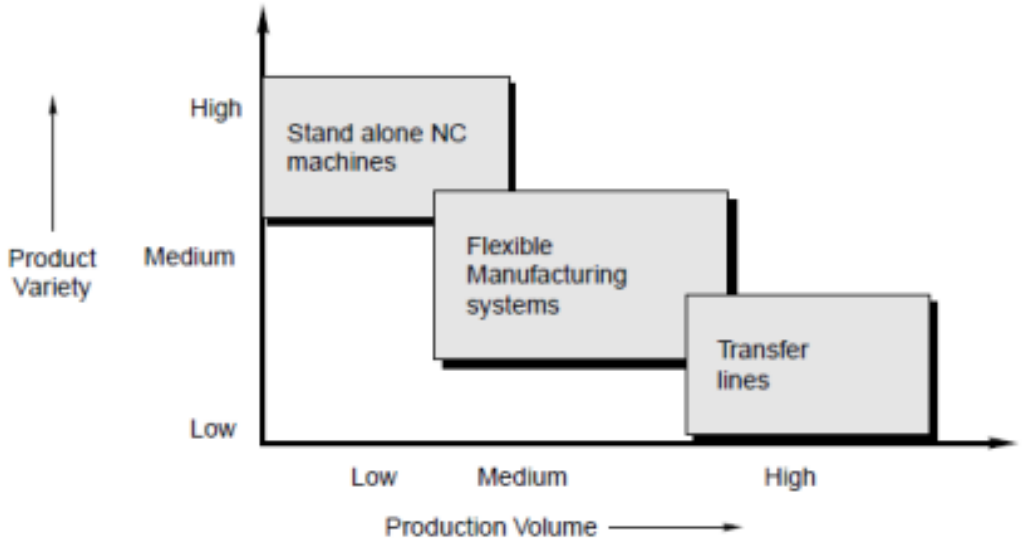
Reference Books:

1. CNC fundamentals & Programming by P.M. Agrawal & Patel
2. CNC Programming by Rd. S.K. Sinha
3. Computer Numerical Control by P. Radhakrishnan

Practical 7

Aim: Study of Flexible Manufacturing system

Theory: FMS consists of a group of processing work stations interconnected by means of an automated material handling and storage system and controlled by integrated computer control system.



Application characteristic of FMS

BASIC COMPONENTS OF FMS:

1. Workstations
2. Automated Material Handling and Storage system.
3. Computer Control System

TYPES OF FMS:

- Sequential FMS
- Random FMS
- Dedicated FMS
- Engineered FMS
- Modular FMS

TYPES OF FMS LAYOUTS:

1. Progressive or Line Type
2. Loop Type
3. Ladder Type

4. Open field type
5. Robot centered type

Questions:

1) What is FMS? List different flexibilities.
2) Write short note on AGV associated with FMS
3) Describe with sketch ASRS
4) Explain the types of flexibility in FMS and discuss the factors on which theses flexibilities depends.
5) Enlist the benefits of FMS.

Reference Books:

1) Automation, Production System and computer Aided Manufacturing by M.P. Groover.
2) Flexible Manufacturing System by DR. H.K. SHIVANAND, M.M. BENAL, V. KOTI
   PUBLISHERS: NEW AGE INTERNATIONAL (P) LIMITED

Practical 8

Aim: Study of Robotics Technology

Students should able to:

- Types of Robots.
- Use of Robots in mechanical.
- Configuration of Robot.

Theory: A robot (industrial robot) is a reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices, through variable programmed motions for the performance of a variety of tasks.

Why Use of Robots?

- Increase product quality
- Increase efficiency& Increase safety
- Reduce Cost like scrap cost, labour cost etc.
- Reduce manufacturing lead time
- Increase productivity

Laws of Robotics:

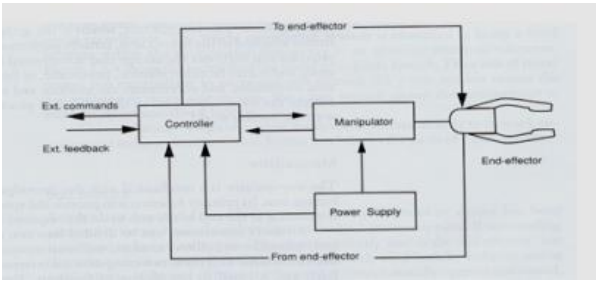
- **Law 1:** A robot may not injure a human being when it's in action.
- **Law 2:** A robot must obey orders given to it by human beings, except where such orders would conflict with a higher order law.
- **Law 3:** A robot must protect its own existence as long as such protection does not conflict with a higher order law.

Robot Configuration:

- WORK ENVELOPE
- PAYLOAD
- VELOCITY
- ACCURACY
- REPEATIBILITY
- RESOLUTION SIZE

BASIC COMPONENTS of Robot:

- Manipulator
- End effectors (WHICH IS THE PART OF THE MANIPULATOR).
- Power Supply
- Controller

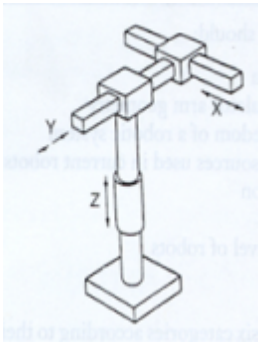


Types of Robots:

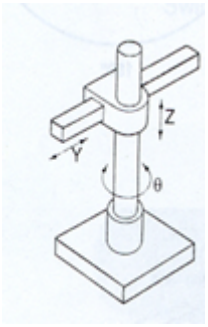
A. Cartesian (or rectangular)
B. cylindrical (or post-type)
C. spherical (or polar)
D. jointed arm (articulated or revolute)
E. SCARA (selective compliance assembly robot arm)

Robot Applications:

- Material-handling applications
- Processing Operations
- Assembly Applications
- Inspection Operations etc.



(a)



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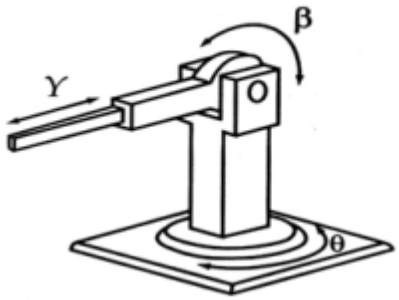

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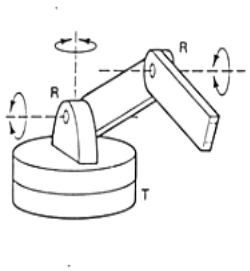

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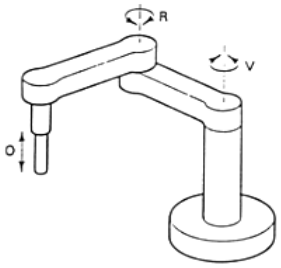


(e)

Questions:

1) What are different types drives used in robot.
2) Discuss various application of robot.
3) Draw neat sketch and explain various robot configuration.
4) Explain the commonly used robot programming languages giving examples.

Reference Books:

1) Industrial Robotics by M.P. Groover, M. Weiss, R.N. Nagle, N.G. Odrey Tata McGraw Hill Production
2) Automation, Production System and computer Aided Manufacturing by M.P. Groover.

Practical 9

Aim: Problems on MRP-I, MRP-II

THEORY

MRP-1 is the type of techniques of material management.MRP-1 means material requirement planning.

"MRP system converts the master production schedule for end items into detailed schedule for production orders."

Objectives of requirement of planning

1. To ensure right quantity of material is available for production at right time to produce right quantity of final product.
2. To ensure minimum inventory
3. To maintain the delivery schedule

FACTORS TO BE CONSIDERED IN MRP-I

- Independent and dependent
- Lumpy demand
- Ordering and manufacturing lead times
- Items of common use

Questions:

1) What are the input parameters in MRP-1? And explain it.
2) What is the difference between MRP-1 and MRP-2?
3) Short note on MRP-2

Practical 10

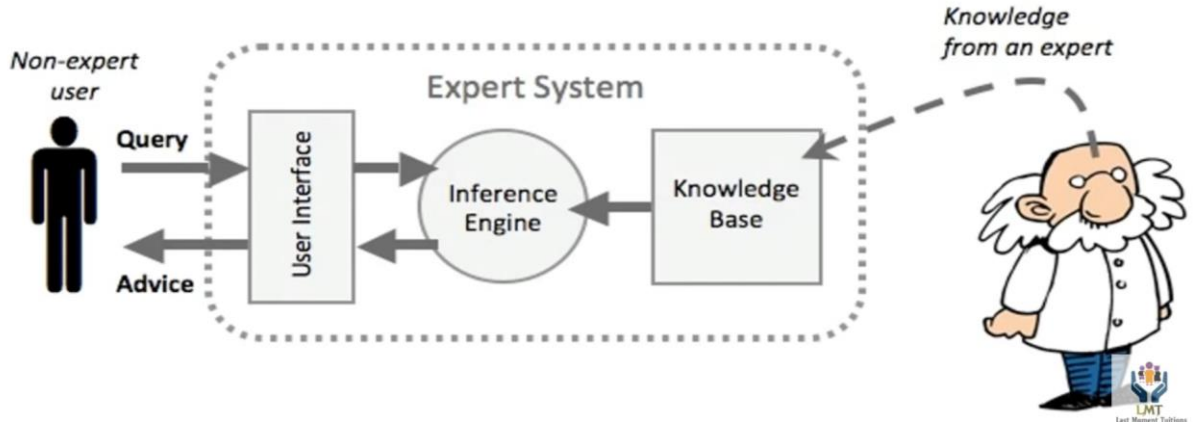
Aim: Study of Expert System in Manufacturing and MIS

Theory:

The goal of a manufacturing is to maintain an overall optimum configuration. This includes all the necessary functions from product design to final product assembly in breadth, and from business planning and control to shop floor operation in depth.

"All programs that achieve expert level competence (ability) in solving problems in particular task area by use of knowledge base about that particular task area are known as **KNOWLEDGE BASED OR EXPERT SYSTEMS."**

- Expert systems are generally software's.
- These software helps us to provide an answer to a problem.



Knowledge Base

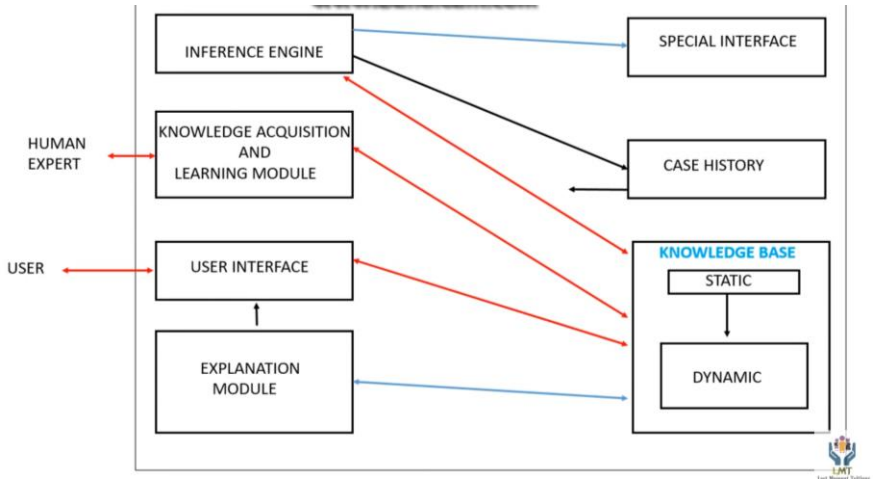
- The knowledge base contains the knowledge necessary for understanding, formulating, and solving problems
- Two Basic Knowledge Base Elements
    - Factual: Factual knowledge is that knowledge of task domain that is widely shared, typically found in textbooks or journals.

- Heuristic: Heuristic knowledge is less exhaustive, more experiential, more judgmental knowledge of performance.

– Knowledge is the primary raw material of ES

– Incorporated knowledge representation

ARCHITECTURE OF EXPERT SYSTEM



Advantages

- Consistent: It gives consistent answer for repetitive decisions, processes and tasks.
- Maintain: It holds and maintain different levels of information.
- Clarify: It clarify the logic of decision making.
- Multi User: A Multiuser expert system can serve more than one user at a time.

Disadvantages

- Sense: It lacks common sense needed in decision making as it uses given knowledge database of a system.
- Creativeness: It cannot respond creatively like a human expert would in unusual circumstances.
- Errors: In knowledge base error may occur and it leads to wrong decisions.
- Environment: If the knowledge base is changed it cannot adopt changing environments

Questions:

1) Explain expert system and its component in detail
2) Explain management information system