Unit -2 Process Planning Activities

Part A

11. What is activity based costing? (AU A/M ’18)

Activity-based costing (ABC) is a costing methodology that identifies activities in an organization and assigns the cost of each activity with resources to all products and services according to the actual consumption by each. This model assigns more indirect costs (overhead) into direct costs compared to conventional costing.

12. What are the main reasons for using jigs and fixtures? (AU N/D ’17)

The main purpose of any work holding device is to position and hold a work piece in a precise location while manufacturing operation is being performed

13. What are the most influential factors in terms of tool performance? (AU N/D ’17)

Factors affecting tool performance

- Cutting tool materials
- Cutting tool geometry
- Cutting fluids

14. What are the factors to be considered during the selection of a process? (AU N/D ’16)

- Quality of work to be completed
- Availability of equipments, tools and personnels
- Sequence in which operations will be performed on the raw material
- Standard time for each operation

15. Enumerate the documents required for process planning (AU N/D ’15) (AU N/D ’12) (AU M/J ’13)

- Product design and the engineering drawings pertaining to all the components of the product.
- Machining/Machinability Data Handbook
- Catalogues of various cutting tools and tool inserts.
- Specifications of various machine tools available in the shop/catalogues of machine tools in the shop
- Sizes of standard materials commercially available in the market.
- Machine Hr. cost of all equipment available in the shop.
- Design Data Handbook.
- Charts of Limits, Fits & Tolerances.
- Tables showing tolerances and surface finish obtainable for different machining processes.
- Tables of standard cost.
- Table of allowances (such as Personal Allowance, Fatigue Allowance etc. in % of standard time followed by the company).

16. State the parameters involved in material selection (AU N/D ’14) (AU M/J ’16)

(*i*) Functional requirements

(*ii*) Reliability

(*iii*) Service life durability
(*iv*) Aesthetics and appearance
(*v*) Environmental Factors
(*vi*) Compatibility with other materials during service
(*vii*) Producibility or manufacturability
(*viii*) Cost

17. What are the activities associated with process planning? (AU M/J '12)

- Analyse the part requirements
- Determine operation sequence
- Select the equipment
- Calculate processing times
- Select inspection methods
- Estimate manufacturing cost
- Document process plan
- Communicate to manufacturing engineer

18. State the procedure to select cost optimal process (AU N/D'11)

- Break even point
- Break even chart
- Break even analysis

19. What is the difference between routing sheet and operations list? (AU A/M'17)

A route sheet determines the sequence or order of arrangement of various departments in a facility. Thus, a route sheet is a document which has information and data inputs and a step wise listing of all the processes or transactions performed. It also contains details such as date and time, remarks, log in/out, point of contact etc.

It is a list of operations has to be performed in a process without sequence.

20. What is the relation between tolerance and surface finish? (AU A/M'17)

Components must fit together and function properly in a predicted dimension is defined as tolerance, whereas surface finish is the depth of irregularities and vertical deviations of a surface resulting from the manufacturing process used to produce it.

21. What is the purpose of a work holding device?

The main purpose of any work holding device is to position and hold a work piece in a precise location while the manufacturing operation is being performed.

22. List the types of work holding devices.

- General work holding devices
  - Vices
  - Clamps
  - Mandrels
  - Chucks
- Specialist work holding devices
  - Jigs
  - Fixtures

23. What is meant by Statistical Quality Control (SQC)?

SQC is about employing inspection methodologies derived from statistical sampling theory to ensure conformance to requirements

24. List seven statistical tools of quality that are used in quality control

(i) Flowchart
(ii) Cause and effect diagram
(iii) Check sheet
(iv) Scatter diagram
(v) Histogram
(vi) Control chart
(vii) Pareto diagram

25. What is meant by break even analysis (BEA)?

BEA also known as cost volume profit analysis is the study of inter-relationships among a firms sales, costs and operating profit at various levels of output.

Part – B

1. Describe the basic method employed for the selection of cutting tools. (AU N/D '17)

(i) ***Evaluation of process and machine selections-*** Provided the selection of processes and machines is satisfactory, the range of tools that can be used should be limited to those suitable for the processes and machines selected. Therefore, this limits the initial list of possible suitable tooling.

(ii) ***Analysis of machining operations-*** A specific machine will carry out every operation required. Each machine tool to be used will have specific tool types to carry out certain operations. Therefore, this analysis should enable the identification of specific tool types for specific operations.

(iii) ***Analysis of workpiece characteristics -*** The focus of the workpiece analysis is on the workpiece material and geometry and the capability in terms of dimensional and geometric accuracy and surface finish. The analysis of the first two characteristics enables suitable tool materials and geometry (in terms of size and shape) to be identified. The third characteristic allows the tool type and geometry to be refined further to suit the operations.

(iv) ***Tooling analysis***- Using the tooling data available, the general tooling specifications generated at the third stage can be translated into a statement of tooling requirements for the job, that is, a tooling list. This will obviously reflect whatever tooling is actually available for the operations required.

(v) ***Selection of tooling*** - There are two routes that the tool selection can take at this point. If single-piece tooling is being used, then a suitable toolholder should be selected before fully defining the tool geometry and material. However, if insert-type tooling is being used then the following steps should be followed:

i. select clamping system;
ii. select toolholder type and size;
iii. select insert shape;
iv. select insert size;
v. determine tool edge radius;
vi. select insert type;

vii. select tool material.

Once all of the above is completed, the machining parameters can be calculated. These will be the speeds, feeds and machining times for each operation. All of the above factors will have a significant influence on the determination of these parameters.

2. **Explain the process planning procedure and List out the information required for process planning. (16 marks) (AU N/D '16) (AU M/J '13) (or)**

What are the Set of documents required for process planning? (16 marks) (AU N/D '17) (10 marks) (AU N/D '13) (or)

Explain the steps involved in process planning. (16 marks) (AU N/D '17) (8 marks) (AU N/D '13)(AU M/J '12)

Set of documents required for process planning

(i) Product design and the engineering drawings pertaining to all the components of the product. (*i.e.,* components drawings, specifications and a bill of materials that defines how many of each component go into the product).
(ii) Machining/Machinability Data Handbook (Tables of cutting speeds, depth of cut, feeds for different processes and for different work materials).
(iii) Catalogues of various cutting tools and tool inserts.
(iv) Specifications of various machine tools available in the shop/catalogues of machine tools in the shop (speeds, feeds, capacity/power rating of motors, spindle size, table sizes etc.).
(v) Sizes of standard materials commercially available in the market.
(vi) Machine Hr. cost of all equipment available in the shop.
(vii) Design Data Handbook.
(viii) Charts of Limits, Fits & Tolerances.
(ix) Tables showing tolerances and surface finish obtainable for different machining processes.
(x) Tables of standard cost.
(xi) Table of allowances (such as Personal Allowance, Fatigue Allowance etc. in % of standard time followed by the company).
(xii) Process plans of certain standard components such as shafts, bushings, flanges etc.
(xiii) Handbooks (such as Tool Engineers Handbook, Design Data Handbook).

Steps in process planning

(i) Required operations must be determined by examining the design data and employing basic machining data such as :
(a) Holes can be made conveniently on drilling machines.
(b) Flat surfaces can be machined easily on milling machines.
(c) Cylindrical parts can be made using lathe. Design data can be obtained from the part-drawing or from the finished part design file from the CAD system.

(ii) The machines required for each operation must be determined. This selection depends on knowledge of machine factors, such as availability of the machine, specifications of machine tools available in the shop, accuracy grade of the m/c, table size, spindle size, speed and feed ranges available, torque, power, machining rate and other size limitations.

(iii) The required tools for each identified machine or process must be determined. For selection of specialized tools knowledge and prior experience of process planner will be useful.

(iv) The optimum cutting parameters for each selected tool must be determined. These parameters include cutting speed, feed rate, depth of cut, and type of coolant/lubricant to be used. This determination depends on design data, such as work material, tool material, surface finish specifications and behaviour of cutting tool. Again expertise knowledge and prior experience of process planner and methods engineer will be useful in this regard. Machining data handbooks can also be referred.

(v) Finally an optimum combination of these machining processes must be determined. The best process plan is the one which minimizes manufacturing time and cost. This provides a detailed plan for the economical manufacturing of the part.

(vi) The results of each of these five basic steps can be seen in the final form of the process plan

3. **What are the factors that influence process planning? Discuss (8 marks) (AU N/D ’12) (AU M/J ’12) (or)**
   Explain the steps in process selection with suitable example (16 marks) (AU N/D ’17)

Practices of Process Planning

The practices of process planning vary widely in modern industry, depending on such factors as :

- Type of product
- The equipment available, and
- The volume of production (*i.e.,* production quantity)

The individual responsible for carrying out process planning / process analysis is the Process Engineer also known as process planner, process analyst or methods engineer. To be effective on his or her job, the process analyst must be familiar with material characteristics and manufacturing processes. Knowledge of the nature, types, and properties of standard materials and new materials will assist the process analyst in selecting the most appropriate process, equipment and methods for manufacturing a particular product. The process analyst must also be familiar with engineering drawings and product design. Drawings provide the part configuration and the dimensional tolerances and specifications that need to be met by the manufacturing process selected

In addition, the process planner must be familiar with the operating characteristics and costs of the production and tooling equipment, either available in the plant or to be purchased.

Process Planning starts with a careful examination of the drawing or design of the part. The process planner must be able to analyze the engineering drawing and visualize the three dimensional part configuration. The part configuration must then be analyzed to determine its basic geometric components. Identifying these basic geometric elements assists the process planner in selecting the most appropriate process to manufacture the product.

Process Selection

Consideration should be given to the following factors in selecting a particular process

(a) Nature of part, including materials, tolerances, desired surface finish and operation required.
(b) Method of fabrication including machining or assembling of similar parts or components.
(c) Limitation of facilities including the plant and equipment available.
(d) Possibility of likely product design changes to facilitate manufacturability or cost reduction.
(e) In-plant and outside materials handling systems.
(f) Inherent process to produce specified shape, surface, finish to give desired mechanical properties.
(g) Available skill level of operators for the production. Sometimes the following additional factors affect the selection of a particular process.
(a) Proposed or anticipated production requirements, including volume requirements, production rates and short- term or long- term production runs.
(b) Total end-product costs.
(c) Time available for tooling-up.
(d) Materials receipt, storage, handling and transportation. Careful consideration of these factors will result in the selection of the most appropriate process for the manufacture of a particular product. Selection of an appropriate manufacturing process depends on many factors and requires considerable knowledge, skill and competence of the process planner or process analyst.

Machine Selection

Product manufacturing requires tools and machines that can produce economically as well as accurately. Economy depends to a large extent on the proper selection of the machine or process for the job that will give a satisfactory finished product. The selection of the machine is influenced, in turn by the quantity of items to be produced. Usually there is one machine best suited for a certain output.

In small lot or jobbing type manufacture, general purpose machines such as the lathe, drill press, and milling machine may prove to be the best type since they are adoptable, have lower initial cost, require less maintenance, and possess the flexibility to meet changing conditions in the shop. However, a special purpose machine should be considered when large quantities of a standard product are to be produced. A machine built for one type of work or operation, such as the grinding of a piston or the machining of a cylinder head, will do the job well, quickly and at a low cost requiring only the service of a semi-skilled operator.

Many of the special-purpose machines or tools differ from the usual standard type in that they have built into them some of the skill of the operator. A simple bolt may be produced on either a lathe or an automatic screw machine. The lathe operator must not only know how to make the bolt but must also be sufficiently skilled to operate the lathe. On the automatic machine the sequence of operations and movements of tools are controlled by cams and stops, and each item produced is identical with the previous one. This “transfer of skill” into the machine makes possible the use of less skillfull operators, but it does requires greater skill in supervision and maintenance. Often it is not economical to make a machine completely automatic, as the cost may become prohibitive.

The selection of the best machine or process for a given product requires knowledge of all possible production methods. Factors that must be considered are:

- Volume of production (Quantity to be produced) *i.e.*, no. of components to be produced.
- Quality of finished product, and
- Advantages and disadvantages of the various types of equipment capable of doing the work.

Too much emphasis cannot be given to the fact that production can be by several methods, but usually there is one way that is most economical.

Material selection

Material selection is done by the product designer considering the requirements of the parts designed and the hardness, strength properties and other mechanical characteristics of the material. Cost and availability of the material are also considered. Material should be strong enough and at the same time manufacturing or producibility of the part using the given material and the process are also equally important.

In the initial stages of design, the broad material groups such as ferrous or non-ferrous or other non-metallic materials can be considered. At a later stage specific material in the group can be identified.

In certain products or components specific properties of materials such as fatigue strength, thermal conductivity, electrical properties like conductivity, magnetic permeability and insulation resistance may have to be considered.

Material Selection parameters

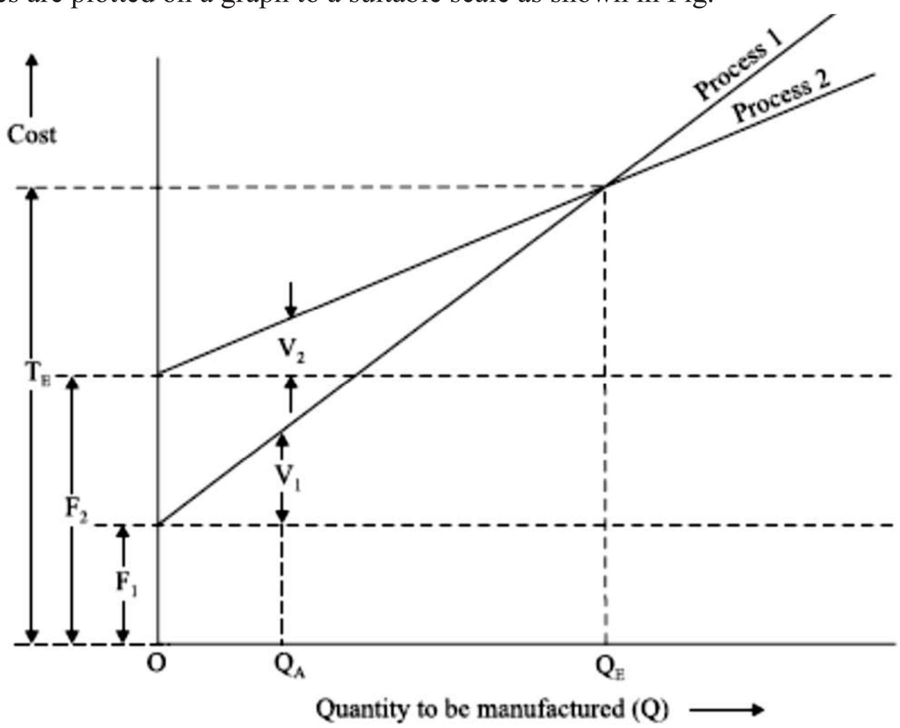
- Functional requirements
- Reliability

- Service life durability
- Aesthetics and appearance
- Environmental Factors
- Compatibility with other materials during service
- Producibility or manufacturability
- Cost

4. **Write notes on selection of cost for optimal processes. (or) write notes on economics of process planning (8 marks) (AU M/J '16) (AU A/M '18)**

Two different types of processes can be used for the same job. The processes can be compared and optimum process selected with the help of break-even charts.

Break-even charts: Break-even charts give the production engineer a powerful tool by which feasible alternative processes can be compared and the process which gives minimum cost can be selected. The fixed and variable costs for two alternative processes are plotted on a graph to a suitable scale as shown in Fig.



F_1 = Fixed costs for process (1)
F_2 = Fixed costs for process (2)
V_1 = Variable costs for process (1)
V_2 = Variable costs for process (2)
Q_E = Break-even quantity at quantity Q_A
T_E = Total costs of manufacture at quantity Q_E

For each process generally the variable cost is a linear function of the quantity manufactured. Therefore, once the fixed costs have been plotted, only one value for the variable costs is required at some value Q_A and the total cost lines can be drawn. Where these lines intersect is known as the break-even point, *i.e.*, the point where the total cost of manufacture of quantity Q_E is same for both process (1) and process (2). The break-even chart tells us to :

Use process (1) if the quantity to be manufactured $\leq Q_E$

Use process (2) if the quantity to be manufactured ≥ Q_E

The value of QE can be scaled directly from the chart with sufficient accuracy, although it can also easily be calculated.

5. A component can be produced with equal ease on either a capstan lathe or on a single spindle cam operated automatic lathe. Find the break-even quantity Q_E if the following information is known. (8 marks) (AU N/D '15)

		Capstan Lathe	*Automatic Lathe*
(*a*)	Tooling cost	Rs. 30.00	Rs. 30.00
(*b*)	Cost of cams	—	Rs. 150.00
(*c*)	Material cost/Component	Rs. 0.25	Rs. 0.25
(*d*)	Operating labour cost	Rs. 2.50/hour	Rs. 1.00/hour
(*e*)	Cycle time/Component	5 minutes	1 minute
(*f*)	Setting up labour cost	Rs. 4.00/hour	Rs. 4.00/hour
(*g*)	Setting up time	1 hour	8 hours
(*h*)	Machine overheads (setting and operating)	300 % of (d)	1000 % of (d)

Capstan lathe :

Overheads $= \frac{300}{100} \times 2.50 =$ Rs. 7.50/hour

Fixed Costs = tooling cost + setting-up cost

= 30.00 + 1(4.00 + 7.50)

= 30.00 + 11.50 = Rs. 41.50

= Rs. 42

Variable costs/Component $= \left(2.50 \times \frac{5}{60}\right) + 0.25 + \left(7.50 \times \frac{5}{60}\right)$

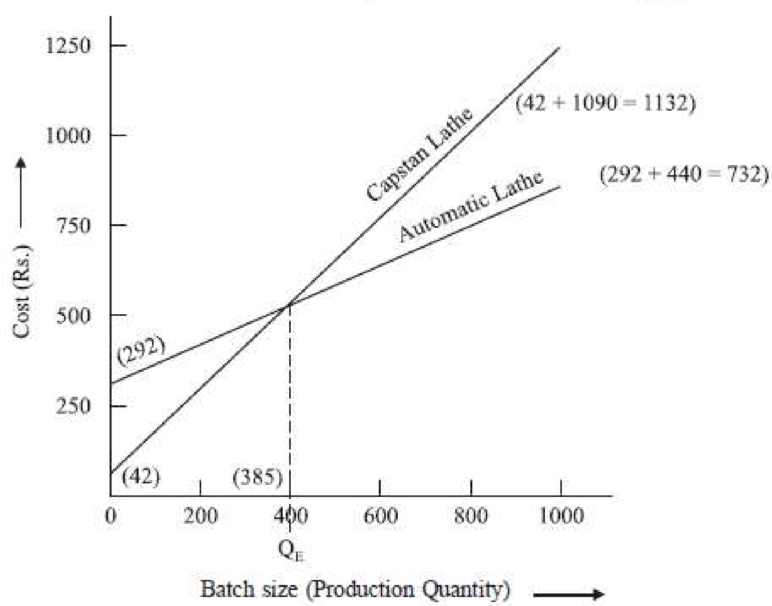
= 0.21 + 0.25 + 0.63 = Rs. 1.09

Variable costs/1000 components = Rs. 1090.00

Automatic lathe :

Overheads $= \frac{1000}{100} \times 1.00 =$ Rs. 10.00/h

Fixed costs = tooling cost + cam cost + setting-up cost



= 30.00 + 150.00 + 8 (4.00 + 10.00)
= 180.00 + 112.00
= Rs. 292.00

$$\text{Variable costs/Component} = \left(1.00 \times \frac{1}{60}\right) + 0.25 + \left(10.00 \times \frac{1}{60}\right)$$

= 0.02 + 0.25 + 0.17
= Rs. 0.44

Variable costs/1000 components = Rs. 440.00.

These costs can now be plotted on a break-even chat (Fig.) to find the value of Q_E. Q_E is scaled from the break-even chart (Fig.) and found to be 385. If the batch size to be manufactured is equal to or less than 385 use the capstan lathe.

If the batch size to be manufactured is equal to or greater than 385 use the automatic lathe. The above is the graphical method of determining Break-even Quantity.

6. **What is Inspection? Write briefly about the different methods of inspections followed in industries. (AU A/M'17)**

Inspection is the function by which the product quality is maintained

The objectives of the Inspection are
(i) To sort out confirm and non-conforming product
(ii) To initiate means to determine variations during manufacture
(iii)To provide means to discover inefficiency during manufacture

Stages of Inspection

Inspection of incoming materials

It consists of inspecting and checking all the purchased raw materials and parts that are supplied before they are taken on to stock or used in actual manufacturing.

This inspection performed either at supplier's place or at manufacturer dispatch or gate.

Inspection of production process

The inspection is done in parallel while the production is in processing. Inspection can be done at different work centers and at the critical production points.

This has the advantages of minimize the wastage of time and money on defective units and preventing delays in assembly.

Inspection of finished goods

This is the last stage when finished goods are inspected and carried out before marketing to see that quality may be either rejected or sold at reduced price.

Methods of inspection

There are two methods of inspection. They are:

i) 100% inspection, and

ii) Sampling inspection,

A. **100% inspection**

100% or cent percent inspection is quite common when the number of parts to be inspection is relatively small.

Here every part is examined as per the specification or standard established and acceptance or rejection of the part depend on the examination.

B. **Sampling inspection**

The use of sampling inspection is made when it is not practical or too costly to inspect each piece. A random sample from a batch is inspected and the batch is accepted if the sample is satisfactory. If the sample is not to the desired specification then either entire batch may be inspected piece by piece or rejected as a whole.

Statistical methods are employed to determine the portion of total quality of batch which will serve as reliable sample.

Types of inspection

Inspection can be classified according to the type of data involved as:

1. Inspection of variable, and
2. Inspection of attributes.

All qualitative characteristics are know as attributes. All characteristics that can be quantified and measurable are known as variables.

Attributes	Variables
• Number of defective pieces found in a sample. • Percentage of accurate invoices. • Weekly number of accidents in a factory. • Number of complaints. • Mistakes per week. • Monthly number of tools rejected. • Errors per thousand lines of code • Percentage of absenteeism.	• Dimension of a measured. • Temperature during heat treatment. • Tensile strength of steel bar. • Hours per week correcting documents. • Time to process travel expense accounts. • Days from order receipt to shipment. • Cost of engineering changes per month. • Time between system crashes. • Cost of rush shipment.

Measurement instruments

The selection of appropriate measurement instrument to be employed is basically depends on the type of quality characteristic of the component considered.

Measurement: The different types of quality characteristics that are to be measured are:

(i) Dimensions/size,

(ii) Physical properties,

(iii) Functionality, and

(iv) Appearance.

7. Discuss about factors to be considered in the selection of jigs and fixtures for cost reduction (8 Marks) (AU A/M '18)

Function of work holders

The main purpose of any Work holding device is to position and hold a workpiece in a precise location while the manufacturing operation is being performed. In order to perform this function adequately, all work holders consist of four basic elements:

Locating elements - that allow the work piece to be positioned correctly

Structural elements- that can withstand the forces applied during the manufacturing operation.

Clamping elements - that can withstand the forces applied during the manufacturing operation and maintain the position of the work piece.

Fixing elements - that attach the work holder to the machine; There are many devices that adhere to the above definition that can be classified as general work holding devices as opposed to specialist work holding devices, that is, jigs and fixtures. General work holding devices can be classified as:

- Vices
- Clamps and abutments
- Chucks
- Collets
- Centers
- Mandrels
- Face plates

The entire above are sometimes referred to as low-cost jigs and fixtures.

Use of jigs and fixtures

For many machining and assembly operations, general-purpose work holding devices may not be sufficient. In these instances, these special work holding requirements are generally satisfied by designing and building special-purpose work holding devices known as jigs and fixtures. The design of special jigs, fixtures and tools is considered as one of three essential activities for facilitating interchangeable manufacture, along with process planning and the design of suitable limit gauges and gauging equipment. Consequently, the main reasons for the use of jigs and fixtures are:

- Components can be produced quicker;
- Greater interchangeability is obtained due to repeatability of manufacture which subsequently reduces assembly time;
- Accuracy can be easily obtained and maintained;
- Unskilled or semi-skilled labour may be used on a machine, resulting in reduced manufacturing costs.

Jigs:

A jig is a work holding device. However, jigs have a further important function and that is determining the location dimensions of specific features. In order to fully understand this function, the distinction between location and size dimensions must be defined. Strictly speaking, not all jigs provide guidance for tools. This is because in many assembly processes, such as welding, the jig merely holds the parts together in the correct orientation with respect to each other while the tool carries out the joining process.

However, in the case of jigs being used with machining processes, they generally always provide guidance for the cutting tool. In summary, a jig is a specially designed and built work holding device, usually made of metal, and performs three basic functions

- holding the component;
- providing guidance for the cutting tools to determine the location dimension for the machining of a feature;
- Positively locating the component so that subsequent components are machined in the same manner.

Jigs can usually be generally classified as either drilling jigs or boring jigs and are used for operations such as drilling, reaming, tapping, chamfering, counterboring, countersinking and boring operations.

Fixture:

A fixture is similar to a jig and can be defined as a special-purpose workholding device used during machining or assembly. However, fixtures are generally of heavier construction than jigs and also usually fixed to the machine table. The main function of a fixture is to positively locate the workpiece. However, unlike a jig, no guidance is provided for cutting tools. Fixtures are used in a variety of processes including milling, broaching, planing, grinding and turning.

8. Explain the importance of selection of the right quality assurance method during manufacturing. (13 marks) (AU A/M '18)

All manufacturing organizations have the common goal of making a profit. The basic model of added value previously presented focuses on the main input of materials undergoing some transformation process and value being added to that material. A profit is made if the value added is greater than the cost to process the material. However, a profit will only be made if the customer is satisfied with the product. In the globally competitive market, this is where the factor of product quality is seen to be important.

The transformation processes mentioned above in this instance are obviously manufacturing processes. However, all manufacturing processes have some degree of inherent variability, even highly automated processes such as CNC milling. Therefore, steps must be taken to ensure that the product specification is adhered to in spite of this variability. The starting point for this is the establishment of the capability of the processes being used.

However, except in the case of the introduction of new processes, the capability of available processes should be known. These data should be documented and available to the process planner if required.

Based on the capability of the process being employed, the process planner will determine which are the most appropriate quality assurance (QA) tools and techniques to employ. These will range from basic measurement tools such as callipers, micrometers and gauges to the use of coordinate measuring machines (CMMs). Also covered will be the application of statistical process control (SPC) methods. Although SPC and process capability studies will most probably be designed and carried out by quality engineering, it is essential that the process planner has an understanding of these in order to enter into meaningful dialogue with regards to process capability. In fact, the process planner will have to liaise closely with the quality function on a number of issues with regards to the process plan. These include:

- identifying inspection locations;
- identifying appropriate inspection and testing methods;
- the frequency of inspection and testing;
- evaluation of inspection and test data;
- Identifying corrective action where appropriate.

All of the above will influence the processes, equipment, tools and manufacturing parameters to be used for a given job, particularly in the case where corrective action involves changing any of these. Therefore, the process planner requires a knowledge and understanding of all of these aspects of product quality.

9. Explain the factors to be considered in selection of process parameters (13 marks) (AU A/M '18)

The three Process parameters to be calculated for each operation during process planning are

- Cutting Speed
- Feed Rate
- Depth of Cut

Cutting Speed:

Cutting speed is known as surface cutting speed or surface speed, can be defined as Relative speed between the tool and the work piece

Unit: meteres per minute

Factors affecting the selection of cutting speed

- Nature of the cut
  - Continuous cut like turning, boring are done at higher cutting speed
  - Shock initiated cuts in shaping, planning, slotting machine are done at lower cutting speed.
  - Intermittent cuts as in milling, hobbing are done at quite lower speed for dynamic loading
- Work material
  - Harder and stronger materials are machined at lower cutting speed
  - Soft, non-sticky materials can be machined at higher cutting speed
- Cutting tool material
- Cutting fluid application
- Purpose of machining
  - Rough machining (lower cutting speed)
  - Finish machining (higher cutting speed)
- Kind of machining operation
- Capacity of machine tool
- Condition of machine tool

Feed and feed rate

Feed is the distance through which the tool advances into the work piece during one revolution of the workpiece or the cutter

Feed rate is the speed at which the cutting tool penetrates the work piece

Unit: millimeters per minute

Factors affecting feed rate:

- Nature of the cut
- Work material
- Cutting tool material
- Cutting fluid application
- Purpose of machining
- Kind of machining operation
- Capacity of machine tool

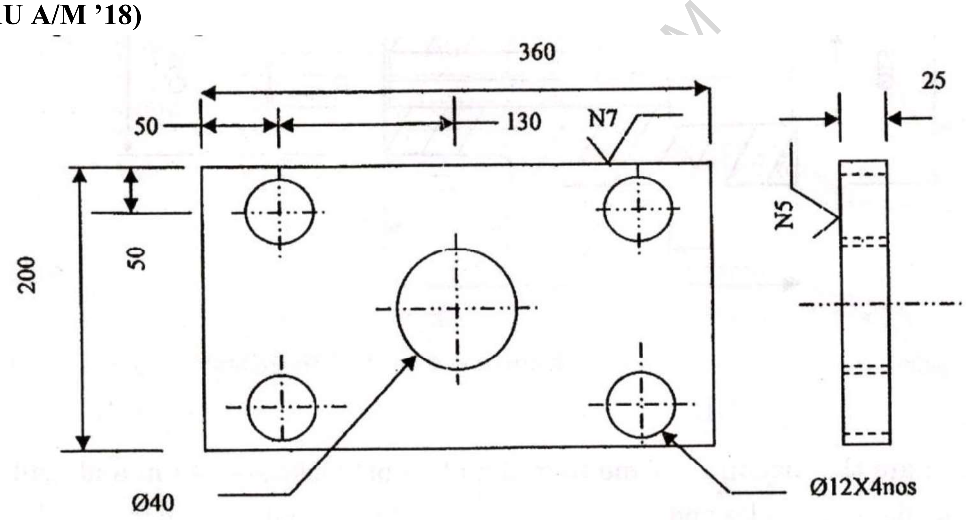
Depth of cut:

Depth of cut is the thickness of the layer of metal removed in one cut or pass, measured in a direction perpendicular to the machined surface

Unit : millimeter

The feed and depth of cut for a particular operation depend on the material to be machined, surface finish required and tool used.

10. Prepare the operation and route sheet for the component shown in fig (15 marks) (AU A/M '18)



Solution

Operation Sheet:

Comp Procedure	A.R.C	Inc: Part Name		Drill Plate	Prepared by		
		Drilling		Part No :18	Date		
Operation No.	*Operation Description*	*Machine Type*	*Tool*	*Dept*	*Set up Time (m)*	*Operation Time (min)*	*Material /Part*
01	Cutting	Cutter	Cutting Wheel	Machine Shop	30	20	Steel Plate
02	Surface Grinding	Grinder	Grinding Wheel	Machine Shop	15	30	Steel Plate
03	Drilling 4 Nos	Drilling Machine	Drill tool -12mm	Machine Shop	15	20	Steel Plate
04	Drilling	Drilling Machine	Drill tool -40 mm	Machine Shop	15	20	Steel Plate

Rout Sheet

Routing sheet		
Part name	Part no	Drg no
Quantity	Material	Planner
Date	Page 1 of 1	Order no
Operation no	Description	Machine tool
01	Cut off 200x360 mm bar to 25 mm thick	Hor. Bandsaw
02	Drill 40 mm dia.	Drill press no 1
03	Drill 12 mm dia x 4 nos	Drill press no 2
04	Surface Grind 5 micro meter	Grinding machine no 1