IMPORTANT QUESTIONS AND ANSWERS

Department of Mechanical Engineering

SUBJECT CODE : ME 6005

SUBJECT NAME : Process Planning and Cost Estimation

Regulation: 2013 **Year / Semester: IV/ VII**

2. SYLLABUS

ME6005 PROCESS PLANNING AND COST ESTIMATION L T P C

3 0 0 3

OBJECTIVES:

- To introduce the process planning concepts to make cost estimation for various products after process planning

UNIT I INTRODUCTION TO PROCESS PLANNING 10

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 10

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 8

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 8

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation-Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling,Shaping and Planning -Machining Time Calculation for Grinding

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the concepts of process planning and cost estimation for various products.

TEXT BOOKS:

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.

REFERENCES:

1. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley, 1998.
2. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
3. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002
4. Adithan.M.,”Process planning and Cost estimation”, New Age International (P) Ltd.,2007

3. TABLE OF CONTENTS

ME6005 PROCESS PLANNING AND COST ESTIMATION 3 0 0 1

1. **Aim and Objective of the Subject**

- To introduce the process planning concepts to make cost estimation for various products after Process planning
- Explain how a product is designed.
- Explain the steps involved in process design.
- Enumerate the factors affecting process design.
- List the types of production and their characteristics.
- Differentiate between costing and cost estimation.
- Understand the importance of preparing realistic cost estimates and concept of over estimating and underestimating.
- Identify the various components of a cost estimate.
- Understand the procedure for preparing the cost estimate.

Department of Mechanical Engineering
Detailed Lesson Plan

Name of the Subject& Code: ME6005 Process Planning and Cost Estimation

Text Book

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.

S.No	Unit No	Topic / Portions to be Covered	Hours Required / Planned	Cumulative Hrs	Books Referred
1	**I**	**INTRODUCTION TO PROCESS PLANNING**	**10**		
2		Introduction About Process Planning	01	01	T1
3		methods of process planning	01	02	T1
4		Drawing interpretation	01	03	T1
5		Identifying useful supplementary information	02	05	T1
6		Material evaluation	02	07	T1
7		steps in process selection	02	09	T1
8		Production equipment and tooling selection	01	10	T1
9		Revision	01	11	
	II	**PROCESS PLANNING ACTIVITIES**	**10**		
10		Process parameters	01	12	T1
11		calculation for various production processes	02	14	T1

12		Selection jigs and fixtures	02	16	T1
13		Selection of quality assurance methods	01	17	T1
14		Set of documents for process planning	01	18	T1
15		Economics of process planning	02	20	T1
16		case studies	01	21	T1
17		Revision	01	22	
	III	**INTRODUCTION TO COST ESTIMATION**	**08**		
18		Importance of costing and estimation	**01**	23	R4
19		Methods of costing	01	24	R4
20		Elements of cost estimation	01	25	R4
21		Types of estimates	01	26	R4
22		Estimating procedure	01	27	R4
23		Estimation labor cost, material cost	01	28	R4
24		Allocation of over head Charges	01	29	R4
25		Calculation of depreciation cost	01	30	R4
26		Revision	01	31	
	IV	**PRODUCTION COST ESTIMATION**	**08**		
27		Estimation of Different Types of Jobs	01	32	R4
28		Example Problem	01	33	R4
29		Estimation of Forging Shop	01	34	R4

30		Example Problem	01	35	R4
31		Estimation of Welding Shop	01	36	R4
32		Example Problem	01	37	R4
33		Estimation of Foundry Shop	**01**	38	R4
34		Example Problem	01	39	R4
35		Revision	01	40	
	V	**MACHINING TIME CALCULATION**	**08**		
36		Estimation of Machining Time, Importance of Machine Time Calculation	01	41	R4
37		Calculation of Machining Time for Different Lathe Operations	01	42	R4
38		Example Problem	01	43	R4
39		Machining Time Calculation for Milling	01	44	R4
40		Example Problem	01	45	R4
41		Machining Time Calculation for Shaping and Planning.	01	46	R4
42		Example Problem	01	47	R4
43		Machining Time Calculation for Grinding	01	48	R4
44		Example Problem	01	49	R4
45		Revision	01	50	

UNIT-I
(INTRODUCTION TO PROCESS PLANNING)
Part-A (2 Marks)

1. What is meant by process planning?

Process planning can also be defined as the systematic determination of the methods by which a product is to be manufactured economically and competitively. It consists of devising, selecting and specifying processes, machine tools and other equipment to convert raw material into finished and assembled products.

2. What are the factors affect process planning?

1. Availability of machine
2. Delivery date
3. Quantity to be produced
4. Quality standards

3. What are the reasons for process documentation?

1. To have a record on how a part is processed in order to plan future parts with similar design requirements in a consistent manner
2. To provide a record for future job quoting, cost estimating, and standard costing systems
3. To act as a vehicle for communication

4. State the general approaches to process planning?

Manual Process Planning
Computer Aided Process Planning

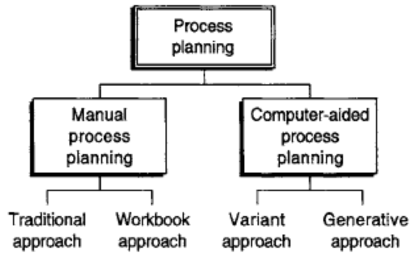
5. What is CAPP?

Computer Aided Process Planning can be categorized in two major areas; variant planning, where library retrieval procedures are applied to find standard plans for similar components, and generative process planning, where plans are generated automatically for new components without reference to existing plans. The latter system is most desirable but also the most difficult way of performing CAPP.

6. What are the advantages of CAPP?

1. It can generate consistent process plans rapidly
2. New components can be planned as easily as existing components
3. It has potential for integrating with an automated manufacturing facility to provide detailed control information.

7. What are the process planning methods?



8. What are the factors affecting tooling selection?

The three basic factors that determine tool performance are:

1. the tool material;
2. the tool geometry;
3. the use of cutting fluids.

9. State the parameters considered for material selection.

1. Functional requirements
2. Reliability
3. Service life durability
4. Aesthetics and appearance
5. Environmental Factors

10 . List the documents involved in process planning?

There are two documents involved in the preparation of the process plans. These are:

- routing sheets;
- Operations list.

Part-B (16 Marks)

1. Explain the two approaches commonly used in CAPP system bringing out their advantages and limitations. (16)

The process planning function bridges the gap between engineering design and manufacturing and is thus a critical element in integrating activities within manufacturing organizations.

Current CAPP systems range from simple editors for manual planning to fully-automated systems for planning a range of products. Some of the specific benefits of CAPP are:

1. Improved productivity

2. Lower production cost

3. Consistency

4. Time savings

5. Rapid integration of new production capabilities

There are also several problems, associated with automation of the planning process.

1. The designer's intention may not always be obvious to the process planner who must act on the designer's intentions. Differences in terminology and perspectives separate these two functions.

2. In order to fully automate process planning, the features of a part must be extracted from the product model without human intervention; however, engineering drawings sometimes do not convey all the information about a part. Information may be inaccessible or in a form incompatible with CAPP.

3. One problem source for all CAPP systems is the interface between CAD and CAPP, wherefeatures are translated into a form recognizable by CAPP. Different CAD systems have different methods of representing dimensions. Translation from CAD to CAPP is difficult and often requires a human interface.

4. The designer is often unaware of the potential manufacturing constraints and may produce a design that is either infeasible or costly to produce.

5. The generation and execution of a production plan may take a long time and involve several organizations in different geographical locations. Plan-monitoring and improvement may be complex and difficult to automate.

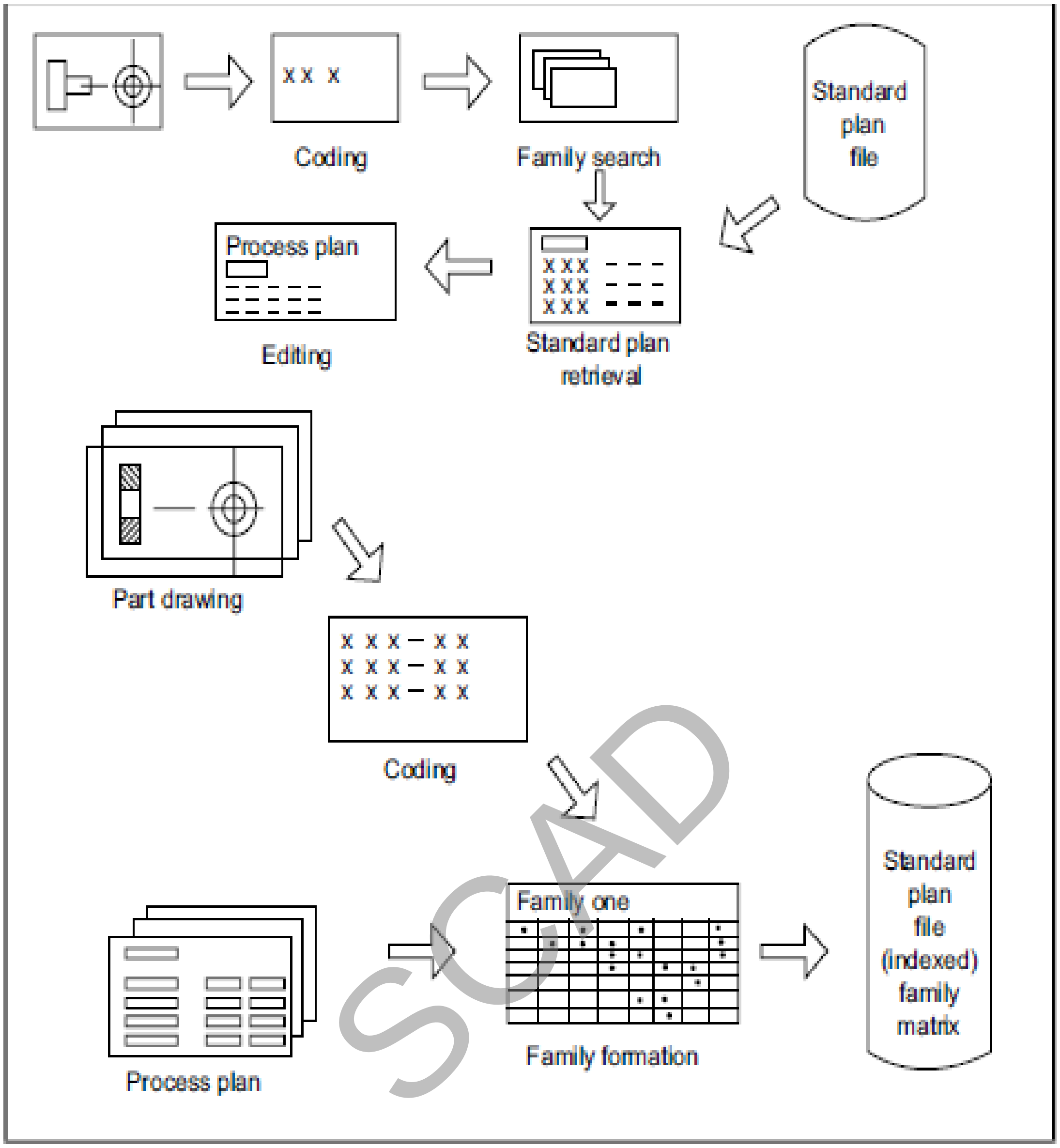


Fig. 2.2: Variant process planning procedures

RETRIEVAL TYPE APPROACH

Variant process planning explores the similarities among components and searches through a database to retrieve the standard process plan for the part family in which the component belongs.

A standard process plan is a process plan that applies to an entire part family when a standard plan is retrieved; a certain degree of modification follows in order to accommodate the details of the design.

In general, variant process planning has two operational stages, a preparatory stage and a production stage.

I. Stages in retrieval type

(a) The preparatory type stage involves coding, classifying and grouping existing components into a family matrix and deriving out of this matrix a set of standard plans that can be used and modified later to become process plans for new components.

(b) The production stage of a process planning system involves coding and classifying new components so the family that most closely matches them can be found. The standard plan for the family is retrieved and modified to produce the plan for the new component see figure.

II. Group technology

The purpose of group technology is to organize the vast amount of manufactured components which construct a product.

This method has the advantage of providing a tractable database where information about a part is easily managed, retrieved and implemented in computer algorithms.

III. Coding and classification

Coding and grouping components is done with the help of a coding system. Coding systems, which are the subject of group technology, involve the application of a matrix, where a coding system of four digits is presented.

The first digit corresponds to primary shape, the second digit corresponds to secondary shape, the third to the auxiliary shape, and the fourth to the initial form of the raw material.

The values for these four digits depend upon the particular geometric features of the component, and are systematically presented in the matrix.

GENERATIVE APPROACH

Generative process planning synthesizes manufacturing information, particularly regarding the capabilities of different manufacturing process, and creates process plans for new components.

An ideal generative process planning system receives information about the design of the part and generates the process plan, including processes to be used and their sequences, without human intervention.

Unlike the variant approach, which uses standardized process-grouped family plans, the generative approach is based on defining the process planning logic using methods like.

2. Explain the manual approach to process planning with advantages and limitations (16)

MANUAL PROCESS PLANNING

This type of planning is known as non-variant process planning. It is the commonest type of planning used for production today.

Planning the operations to be used to produce a part requires knowledge of two groups of variables.

(a) The part requirements, and

(b) The available machines and processes and the capabilities of each process.

Given these variables, the planner selects the combination of processes required to produce a finished part. In selecting this combination of processes, a number of criteria are employed.

Production cost and time are usually the dominant criteria in process selection. However, machine utilization and routing affect the plans chosen. In general, the process planner tries to select the best set of process and machines to produce a whole family of parts rather than just a single part.

There are variations in the level of detail found in route sheets among different companies and industries.

Process planning is accomplished by releasing the drawing to the production shop with the instructions 'make to drawing'.

More firms provide a more detailed list of steps describing each operation and identifying each work center.

The process planning procedure is very much dependent on the experience and judgments of the planner.

The manual approach to process planning begins when a detailed engineering drawing and data on batch size are issued to a production engineer. This information is used to determine the following:

- The manufacturing processes involved.
- The machine tools required to execute these processes.
- The tools required at each stage of processing.
- The fixtures required at each stage of processing.
- The number and depth of passes in a machining operation.
- The feeds and speeds appropriate to each operation.
- The type of finishing process necessary to achieve the specified tolerances and surface quality.

As a first step, the production engineer examines the part drawing to identify similarities with previously produced parts.

If similarities are recognized, a process plan is manually retrieved for the similar item.

The process plan is either used without modifications for identical parts or modified to meet the manufacturing requirements of the new part.

Although old process plans are used as references for similar parts, there is still significant duplication of effort due to the lack of efficient information retrieval, comparison, and editing techniques.

The manual method may also lead to inconsistency in the final plans because it is unlikely that two process planners will generate identical process plans.

As a part design changes during the product development cycle, the process plan must also change, to incorporate new features in the part. As equipment, processes and batch sizes changes, the optimum method for manufacturing the part also changes and these changes must be reflecting in current process plans. However, the lack of consistency and the labour intensity of the manual method make rapid incorporation of process changes extremely difficult.

The experience of the process planner plays a significant role in modifying or creating process plans, since the planner selects processes and process variable settings which have been successfully implemented in similar situations in the past.

Since manual process planning is largely subjective, the quality of the process plan is directly related to the skill and experience of the planner.

It is difficult or impossible to achieve consistent, optimized process plans with the conventional manual method.

As a consequence planning and manufacturing costs are increased because of the duplication of effort in the process planning function as well as specification of excessive tooling and material requirements.

Production lead times also increase due to redundancies in the planning function.

3. List the information required for process planning. (16)

A process is defined as any group of actions instrumental to the achievement of the output of an operations system in accordance with specified measure of effectiveness.

When the product designed, certain specifications are established; physical dimensions, tolerance, standards and quality are set forth.

Then it becomes a matter of deciding over the specific details of how to achieve the desired output. This decision is the essence of process planning.

The production function essentially is a transformation process that accepts the inputs and gives the outputs after adding value to the inputs.

Process selection is a major strategic decision as it involves allocation of men and material resources as well as financial commitments for a long period.

1. NEW PRODUCT MANUFACTURE

A new design may have not been produced before or, alternatively, new manufacturing operations may be introduced for the product.

Unless there is planning, the product introduction will be helter-skelter.

2. SALES

Opportunity for greater sale ability of an existing or new product can develop from different colours, materials, finish, or functional and non-functional features.

Sales and marketing departments provide advice to help manufacturing planning.

3. QUANTITY

Changes in quantity require different sequences, tools, and equipment. The OP planner differentiates for these fluctuations.

If volume increases, the chance is for lower cost. In contrast, if volume decreases, the cost should not increase out of reason.

4. EFFECTIVE USE OF FACILITIES

Operation planning often can find alternate opportunities for the plant's production facilities to take up any slack that may develop.

Seasonal products, which might be popular in the summer, need an alternative product for the winter season.

For example, companies that produce sporting equipment may use the same facilities to produce tennis rackets and skis.

5. COST REDUCTION

Various opportunities become available if the company has an ongoing cost reduction effort. Suggestion plans, value analysis, design for manufacturing (DFM), and directed and systematic effort involve operations planning.

INFORMATIONS REQUIRED TO DO PROCESS PLANNING

1. Quantity of work to be done along with product specifications.
2. Quality of work to be completed.
3. Availability of equipments, tools and personnels.
4. Sequence in which operations will be performed on the raw material.
5. Names of equipment on which the operations will be performed.
6. Standard time for each operation.
7. When the operations will be performed?

4. Explain the factors influencing in equipment selection in process planning (16)

TECHNICAL FACTORS

The focus of the technical factors is to ensure the machine tool selected is capable of producing the part to the required specification. The main factors considered are:

Physical size - the machine tool must be of a sufficient size to cope with the dimensions of the work piece and be physically able to carry out the desired processing. In addition, the structure of the machine must be able to cope with the weight of the work piece.

Machine accuracy- this refers specifically to the capability of the machines under consideration to be able to manufacture parts within the required dimensional and geometric tolerance specification. Although already used to help identify suitable processes, the parameters specified for individual processes are stated in ranges.

Surface finish- this refers specifically to the capability of the machines under consideration to be able to manufacture parts to the required surface specification. The reasoning behind considering this factor again is the same as for machine accuracy.

Cutting forces - the calculation of cutting forces should be carried out for the operations identified using the method outlined.

The cutting forces involved are functions of the manufacturing parameters such as feed, speed and depth of cut.

Although these manufacturing parameters have not been calculated for each operation, each machine will have maximum values for these parameters.

OPERATIONAL FACTORS

The focus of the operational factors is really about the available resources and how they can be used cost-effectively to fulfil the master production schedule (MPS). The MPS is a time-phased plan for all end-items, that is, it is a schedule of what is to be made and when.

From this perspective, the factors considered are more operations management issues than processing planning issues. The factors include:

Batch size -just as every process has an economic batch quantity (EBQ) that must be achieved before it can be considered economically viable, so too does specific machinery.

A common approach is to compare different machines for a given batch size using a break-even analysis to see which is most economic. when considering the economics of process planning.

Capacity- as equally important as the EBQ is the production rate of the machines under consideration. All machines are capable of achieving a particular output per unit time. Therefore, parts must be assigned to machines capable of output that can match the MPS requirements.

Availability- this can be defined on two levels. The first definition is that of whether the machine required is already being used or not, that is, is it available or unavailable. However, in terms of equipment effectiveness, availability can be defined as the proportion of time a machine is actually available to perform work out of the time it should be available.

5. Explain the steps in process planning (16)

The following are the steps involved in carrying out the process planning manually. Past experience of process planners are used in arriving at the economical manufacturing of the product.

The steps involved in process planning are :

(i) The finished product is analyzed so that its sub-assemblies and individual components are identified from manufacturing point of view.

(ii) Prepare a Bill Of Materials [BOM] for all components of the product which forms a basis for purchase of raw materials.

(iii) Decide which parts are to be manufactured in the plant and which parts are to be purchased from the market depending upon the facilities available in the plant, *i.e.,* decision with regard to "make" or "buy" to be taken.

(iv) Choose the appropriate blank size *i.e.*, raw material size and select the most economical process to be followed to manufacture components of the product. This is done by comparing the various possible methods of obtaining the final product. The basic factors of volume to be produced, *i.e.*, production quantity, required quality of the product and the capabilities of the equipment available are carefully considered in this step.

(v) Decide the sequence of operations to be performed on each component in the process selected.

(vi) Each operation is assigned to the type and size of machine or work station that will perform the job most economically.

(vii) Depending upon the accuracies called for by the drawings, determine the machine tools to do the operations

(viii) Determine the need for any special equipment like jigs, fixtures, cutting tools etc.,

(ix) Determine the inspection stages and instruments required and the need for designing any inspection devices (say gauges, etc.).

(x) Estimate the standard time for performing the job.

(xi) Determine the type of labour (skilled, semi-skilled or unskilled) required to do the job.

6. Write Down the procedure to be followed during material selection? Discuss the factors that are taken into account in process Selection and equipment selection.(16)

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

(*i*) Functional requirements: The primary function of the part for which the material is selected is the foremost consideration. A good knowledge of the product application is important. The properties of materials which have a direct bearing on the functional requirement of the part are: fatigue characteristics, strength, hardness, electrical and thermal properties.

(*ii*) Reliability: Reliability of the materials refers to the consistency with which the material will meet the entire products requirement throughout its service life. This is important for trouble-free maintenance of the product during its life time.

(*iii*) Service life durability: The length of service (years or hours of operation of the product) over which material is able to perform its function satisfactorily.

(*iv*) Aesthetics and appearance: Factors like colour, texture, lusture, smoothness and finish play an important role in the aesthetics or appearance of the final product.

(*v*) Environmental Factors: Environmental factors such as temperature, humidity, corrosive atmosphere affect the product and its performance. Hence proper materials which can with stand such environmental effects should be selected and they should be given suitable protective coatings.

(*vi*) Compatibility with other materials during service: When one type of material is used in combination with another type of material in a product or in an assembly the properties of both types of materials should be compatible and should suit each other. Otherwise deterioration in the performance of the product or assembly such as excessive wear & tear, and corrosion of parts in fitment are likely to take place.

(*vii*) Producibility or manufacturability: The extent to which the material can be processed effectively and easily using a particular machine tool or process should also be considered in the selection of the material. Machine ability of materials for machined components is an important factor.

(*viii*) Cost: The cost of material is a significant factor in many situations. The availability of the material is equally important. Appropriate material for the product or component is to be selected taking into consideration all the above factors.

Process Selection Parameters

There are several factors which govern the selection of a manufacturing process:

1. Shape requirements of the final product *i.e.,* Geometric Form : Geometric parameters such as solid shape, hollow shape, flat shape, flanged shape, concave shape, convex shape, cylindrical shape, presence of any part feartures such as groove, threaded shape, hole, chamfer, etc. are considered in the selection of a manufacturing process. Each process has its own capabilities and limitations with respect to the production of the above shapes and part features.

2. Size or Dimensional requirements : Some processes are capable of handling parts of small sizes and some processes can handle large sized parts economically and effectively.

3. Tolerance requirements : Each manufacturing process has got its own capability with regard to tolerance or accuracy of parts that can be produced using that process *e.g.* grinding process always gives close tolerances when compared with turning process. Depending upon the tolerance specified on the part drawing, suitable machining process to be selected.

4. Surface finish requirements : Each manufacturing process has got its own capability with regard to the surface finish which it can provide on the part machined, *e.g.* reaming process can provide a better surface finish in a hole when compared with drilling process. Similarly cylindrical grinding give a better surface finish, than a plain turning process.

Depending on the finish requirements specified on the component drawing, appropriate machining process need to be selected.

5. Production volume requirements : The economics of any machining process depends on the production volume, *i.e.*, no. of components required on a weekly, monthly or annual basis as the case may be. Existing order quantity as well as any anticipated future orders and their quantity need to be considered in the process selection. Some of the processes and additional cost incurred in the specialized toolings, jigs and fixtures can be justified only when there is a large volume of production.

6. Material requirements : The hardness, and strength characteristics of the material influence the tooling required. To machine hard and tough materials, carbide and ceramic tools are required. If slender or thin materials are machined, proper work holding devices and specially designed jigs and fixtures are required is order to avoid distortion and bending of work pieces during machining. Thus material requirements of the part also influence the appropriate selection of machining process.

UNIT-II
PROCESS PLANNING ACTIVITIES
Part-A (2 Marks)

1. What is Flow Chart?

Flow chart is one of the most commonly used for the collection and display of manufacturing knowledge.

2. What are the disadvantages of flow charts?

1. Flow chart focus on process rather than on the structure of decision logic
2. Flow charts provide no check against incompleteness, contradiction and redundancy.
3. Flow charts often employ abbreviations and hence they are defective for effective communication of knowledge

3. What is decision table?

Decision tables organize conditions, actions and decision rules in tabular form. Conditions and actions are placed in rows while decision rules are identified in columns. The upper part of the table includes the conditions that must be met in order for the actions (represented in the lower part of the table) to be taken. When all conditions in a decision table are met, a decision is taken.

4. State the benefits of decision table?

Decision tables have a modular structure which allows them to be easily modified and written in array format.

Decision table ensure accuracy, eliminate redundancy, and avoid contradiction

Decision table provide knowledge structure and readable documentation as a byproduct.

5. What are the tools for acquiring documentation knowledge?

- Decision trees.
- Decision tables.
- Artificial intelligence based approach.
- Axiomatic approach.

6. What are the factors affecting speed feed and depth of cut?

- the workpiece material and geometry;
- the tool material and geometry;
- the processing time available as specified by production planning.

7. What is the use of quality assurance?

These are used to identify and reduce the seven wastes of production which are overproduction, waiting, transporting, inappropriate processing, unnecessary inventory, unnecessary motion and defects. These are equally of use to the process planner not only in detailing the processes and operations, but also in establishing the QA requirements for the plan.

8. List the classification of machining process

Machining processes involve the removal of material from the workpiece and there is a variety of processes that fall into this category. These can be broken down further into three broad sub-categories:

- cutting processes;
- abrasive processes;
- non-traditional machining processes

9. What costs are associated with manufacturing?

Various costs contribute towards the selling price of a finished product. These are manufacturing costs, design/R&D costs, overheads (typically marketing, sales, customer service and administration costs) and the profit margin.

10. What are the general instruction for work holding design and construction?

- physical characteristics of the workpiece;
- cutting forces involved;
- machine selection;
- fixing method to machine;
- workholder-cutting tool relationship;
- workpiece-cutting tool relationship.

11. List out the selection of machinery.

- 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.

12. What do you understand by the term operating sequence?

It consists of devising, selecting and specifying processes, machine tools and other equipment to transform the raw material into finished product as per the specifications called for by the drawings.

13. List the information required for process planning?

1. Quantity of work to be done along with product specifications.
2. Quality of work to be completed.
3. Availability of equipments, tools and personnels.
4. Sequence in which operations will be performed on the raw material.
5. Names of equipment on which the operations will be performed.
6. Standard time for each operation.

14. What are the parameters required for calculation of various production processes?

Shape requirements of the final product

1. Size or dimensional requirements
2. Tolerance requirements
3. Surface finish requirements
4. Production volume requirements
5. Material requirements

Part-B (16 Marks)

1. Explain the Economics of process planning. (16)

Manufacturing costs play an important part in the successful design and manufacture of a product. Based on the model of added value, the manufacturing costs must be less than the value added to allow a profit to be made. Therefore, the costing of the design and manufacture of a product is vital in ensuring success. In addition, costs are very often used for making decisions for the design and manufacture of a product. The types of decisions that can be made based on costs are:

- The type of material to be used for a product.
- The type of manufacturing process to be used for a product.
- How many of a product to manufacture.
- Whether to make or buy in a product/part.
- The design of a product.

The aim is to introduce some of the economic aspects of process planning.

- Identify the main costs in manufacturing and how they are used.
- select the most cost-effective material and process combination for a particular component
- Calculate the total cost of a product.
- Compare the costs of process-material combinations using a break-even analysis.
- Use break-even analysis to help in the 'make or buy?' decision.

Financial information

Manufacturing organization use financial information and techniques, for three basic purposes:

(i)Control

Financial information is used to help control the manufacturing system efficiently, including the preparation of budgets and cost analysis. The manufacturing engineer carries out a cost analysis during the process planning phase.

(ii)Decision making

Typical decisions to be made are about the type of manufacturing process to be used, the quantity to be produced, whether to 'make or buy' a component and the type of material to be used.

(iii)Reporting and recording

Involves the compilation and upkeep of financial records and statements such as profit and loss accounts and for tax purposes and monthly management accounts

Cost elements of product selling price:

Various costs contribute towards the selling price of a finished product. These are manufacturing costs, design/R&D costs, overheads (typically marketing, sales, and customer service and administration costs) and the profit margin.

Process plan:

Throughout the analysis procedure, the planner will compile a manufacturing cost estimate for the product/component. These estimates must be made to allow management to determine the potential profitability of a product.

The main costs that the process planner is concerned with are those related to the production costs and product volumes themselves. The accuracy of the process plan will have a major influence on the organization's profit. If the planners estimate of the manufacturing costs is accurate, the organization will make a profit on the financial outlay.

In the case where the estimate of manufacturing costs is too high, the company may decide to shelve production of a potentially profitable product. On the other hand, if the estimate is too low, the company will end up producing a non-profit making product. In either case, the company is closer to economic failure.

2. Explain the various quality assurance methods. (16)

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 calipers, micrometers and gauges to the use of coordinate measuring machines (CMMs).

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.

.

Quality control:

Operations and activities focused on fulfilling quality requirements.

Quality assurance:

Planned and systematic actions focused on providing confidence that quality requirements will be fulfilled. QA focuses on the prevention of errors that can cause non-conforming products to be manufacturing.

Quality management systems and principles:

A specific definition of a quality management system is: A management system to direct and control an organization with regard to quality (ISO 9000).

The quality management system should have two objectives

- To define performance standards for all activities compatible with the products being manufactured, the customer's requirements and doing so at minimum cost;
- To operate on the basis of continuous improvement to maintain a competitive advantage.

A framework of eight quality management principles has been developed to enable this continuous improvement for an organization:

(1)Customer focus

Recognizing that organizations rely upon customers for their success. Therefore, organizations should Endeavour to understand their present needs and to anticipate their future needs.

(2)Leadership

Helping to establish common objectives and direction for the organization. Proper leadership should develop an organizational culture of involvement at different employee levels to achieve the common objectives.

(3)Involvement of people

at all levels, not only in meeting the common objectives, but to help realize the full potential of their abilities for the benefit of the organization.

(4)Process approach

Allows resources and operations to be managed more efficiently.

(5) Systems approach to management

Which identifies and understands the complexity of the sub-systems and processes that interact within the organization, thus improving the organization's ability to meet its objectives.

(6)Continuous improvement of an organization's overall performance.

This should not only be an objective of the quality management system, but also be recognized as an organizational objective.

(7)Factual approach to decision-making

This allows effective decision-making based on the analysis of data and information.

(8)Mutually beneficial supplier relationships

Recognizing the need to manage the supply chain to minimize waste and maximize added value.

ISO 9000:2000:

The standard is based on the process based model of a quality management system. This model identifies four major groups of generic processes that allow that standard to be applied in any type of organization, namely management responsibility, resource management, product realization and measurement, analysis and improvement.

The ISO 9000 family consists of three standards:

ISO 9000:2000 Quality management systems - Fundamentals & vocabulary.

This describes the fundamentals of, and defines the terminology for quality Management systems..

ISO 9001:2000 Quality management systems- Requirements.

This specifies the requirements for a quality management system. It includes models that help illustrate the structure and implementation of the standard.

ISO 9004:2000 Quality management systems- Guidelines for performance Improvements.

One of the eight principles upon which the family of standards is based is continuous improvement. This standard focuses on how an organization can assess its effectiveness and the efficiency of the quality management system.

3. What are the factors to be considered in the selection jigs and fixtures?

The special work holding requirements are generally satisfied by designing and building special-purpose work holding devices known as jigs and fixtures.

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. Jigs have a further important function and that is determining the location dimensions of specific features. 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:

Fixture is similar to a jig and can be defined as a special-purpose work holding device used during machining or assembly . 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 work piece . However, unlike a jig, no guidance is provided for cutting tools. Fixtures are used in a variety of processes including milling, broaching, planning, grinding and turning.

Selection of jigs and fixtures:

The aim is to introduce the design and/or selection of work holding devices for particular operations.

- define and differentiate between a jig and a fixture in terms of their functionality;
- select an appropriate type of' jig or fixture for a given component based on the operations and processes specified for its manufacture;
- apply the basic principles of location and clamping for a given component;
- apply the basic principles of jig and fixture design and produce a general arrangement drawing for a given component;
- Identify other types of work holders used in component manufacture.

Basic principles of jig and fixture design

The basic principles of jig and fixture design can be categorized under six Broad headings:

- Location
- Clamping
- Clearance
- Stability And Rigidity

- Handling And Fixing
- Ease of construction and design.

4. What are the basic factors influencing process selection and write down the process selection parameters?

Factors influencing process selection:

There are a number of factors common to both the material and Process selection decisions:

- the number of components to be made;
- the component size;
- the component weight;
- the precision required;
- the surface finish and appearance required

  The workability will also have a significant influence on the quality of the part, where quality is defined by three factors ,

  - freedom from defects;
  - surface finish;

Dimensional accuracy and tolerances General guidelines for process selection some general guidelines can be applied for the selection of manufacturing processes.

- Select a process capable of providing the specified dimensional/ geometric accuracy and surface finish.
- Specify the widest possible tolerances and surface finish variation for products to allow the widest possible choice of manufacturing processes.
- Use prototypes as much as possible, taking into consideration the variation in performance of methods used to manufacture a one-off compared with volume manufacturing.
- Carry out a detailed comparison of candidate processes early in the design process, paying particular attention to the variation in assembly costs for different processes.

Process selection parameters:

The process selection method was developed to help undergraduates grasp the complexity of process selection while providing them with a systematic method to follow. Two basic assumptions are made in using this method. These are:

- the material has been selected first, as opposed to manufacturing processes first, and specified at the design stage;
- all the information contained within the design documents, that is, drawings, parts lists, etc. is comprehensive and that all information required for manufactures can be derived during the drawing interpretation.

5. What are the set of documents required for process planning (16)

(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).

6. A large computer manufacturer requires 1200 printed circuit board (PCB) carriers every month for the production of the PCBs themselves. Within their tool oom, they have a variety of machining processes available and the carriers are roduced on a conventional milling machine. The following information relates to the CB carrier manufacture: However, it has been decided to investigate if there is any significant cost advantage of producing these on a CNC milling machine. Determine which machine is the most suitable for producing the PCB carriers at the current rate of 1200 per month.

Solution

Method (a): Conventional milling machine

Set-up time	1 h 20 min
Machining time	39 min
Material cost/unit	£5.62
Machinist's hourly rate	£9.85/h

Set-up cost C = 1 h 20 min @ £9.85 = £13.13

Labour cost/unit = £9.85 × 39/60 = £6.40
Material cost/unit = £5.62
Unit cost U = £12.02

Take the batch size Q = 1200

$$T = \frac{C}{Q} + U$$

$$T = \frac{£13.13}{1200} + £12.02$$

T = £12.03

Method (b): CNC milling machine

Set-up time	2 h 55 min
Machining time	28 min
Material cost/unit	£5.62
Machinist's hourly rate	£10.85/h

Set-up cost C_B = 2 h 55 min @ £10.85 = £31.65

Labour cost/unit = £12.85 × 28/60 = £6.00
Material cost/unit = £5.62
Unit cost U_B = £11.62

Take the batch size $Q = 1200$

$$T_B = \frac{C_B}{Q} + U_B$$

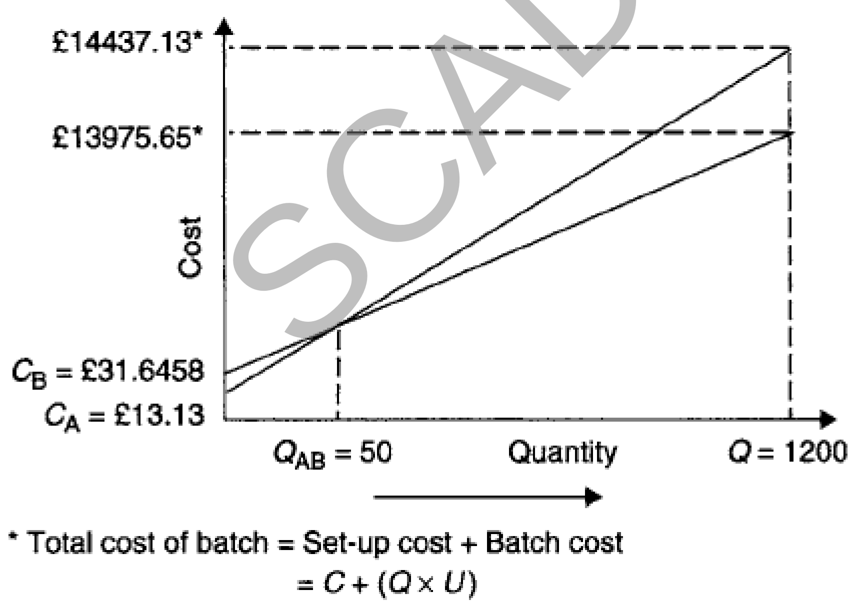
$$T_B = \frac{£31.65}{1200} + £11.62$$

$$T_B = £11.65$$

Break-even analysis

$$Q_{AB} = \frac{C_B - C_A}{U_A - U_B}$$

$$Q_{AB} = \frac{£31.65 - £13.13}{£12.02 - £11.65} = 50$$



Cost Comparison represented on a break-even chart

7. What is inspection? Write briefly about the different method of inspection followed in industries?

Based on the process sequence outlined in Section 10.6.4, there are a number of basic decisions to be made with regards to the inspection required for the manufacture of the component. These are primarily:

- The type of inspection
- The inspection locations
- The inspection methods

- The measurement instruments or methods required.

Although the process plan will specify the above, ultimately the detail design of the quality assurance regime will be the responsibility of the quality engineer.

Inspection methods

The inspection method employed will be heavily influenced by the inspection location.

Hundred per cent inspection

As the name suggests, this involves the inspection of every single unit in a batch. It is ommon in many situations, particularly for output inspection, as it is considered the only ay of guaranteeing all defects being identified. It is always used on critical parts where afety is paramount, that is, aerospace engine components, nuclear plant components, etc. However, it is time consuming and fatigue can cause loss of operator concentration and herefore errors. Errors such as these that may occur at the end of a shift can be as high as 15 per cent (Timings, 1993).

'Gate' sample inspection

This involves splitting production output into inspection lots. The basic assumption is that each inspection lot is subject only to normal variation. How the inspection lot is etermined will depend on:

- The uniformity of the process
- The ability to have truly random samples.

After each lot is finished, it is sampled. Any part of the lot can be sampled and has to wait at the 'gate' until the sampling inspection is complete. Based on the results of the sampling inspection the entire lot will proceed or be rejected, following which it will be 100 per cent inspected. This inspection method is used for output inspection or final inspection, usually in conjunction with *patrol inspection.*

Patrol inspection

In this inspection method samples are taken at a fixed times. This is particularly useful at the beginning and end of a shift and when a machine set-up has changed. Therefore, it is ideal for process inspection. The only drawback is that problems may occur between inspection sampling.

First-off inspection

This simply entails inspecting the first part produced after a new set-up to ensure that the set-up is correct. It is carded out and if the set-up is satisfactory, production commences. It is, therefore, suitable for process inspection.

Statistical process control

This has already been detailed earlier in the chapter and provides the means of controlling the process and not just the product.

Statistical sampling

This method of inspection relies on there being a specified quality level known as an acceptable quality level (AQL). This can be defined as the worst level of quality for a process considered acceptable by a customer and specified as a process mean (Messina, 1987). Using a sound statistical sampling method can be an effective means of monitoring the AQL.

UNIT-III
INTRODUCTION TO COST ESTIMATION
Part-A (2 Marks)

1. Write the importance of cost estimating?

- Cost estimates help to fix the selling price of a product.
- It helps the manufacturer to choose from the various production methods.
- It helps to establish the standard performance.
- Helps to predict before the start of production.

1. **What are the functions of cost estimation?**

   Cost estimates are required to submit accurate tenders. For getting the contracts.
- Cost estimates are required for the manufacturer to choose from various methods of production the one which is likely to be most economical.
- Cost estimates are required for fixing the selling price of a product.
- Cost estimate gives detailed information of all the operations and their costs, thus setting a standard to be achieved in actual practice.
- Cost estimate enables the management to plan for procurement of raw materials, tools, etc., and to arrange the necessary capital, as it gives detailed requirement.

3. What are aims of costing?

The main aims of costing are

1 Cost determination: To determine the actual cost of each component and cost of the final product.

2 For fixing selling price: To provide information to ascertain e selling price of the product.

3. Cost control - To analyse the expenses incurred in production, that control can be kept over them.

4. Define Cost Estimation

Cost estimating may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into consideration all expenditures involved in design and manufacturing with all the related service facilities such as pattern making tool making, as well as a portion of the general administrative and selling costs.

5. Define Job Costing or Batch Costing.

This method is concerned with finding the cost of each individual job or contract.In this method, the total cost for each order is obtained from the daily cost sheet. This method is adopted in job order industries such as ship building, machine manufacturing, fabrication, building contracts, etc.

6. What you mean by Process Costing?

1. This method is employed' when a standard product is made which involves a number of distinct processes performed in a definite sequence.

2. This method is adopted in industries such as oil refining, chemical, paper making, paint, cement manufacturing and other similar industries.
3.This method indicates the cost of a product at different stages as it passes through various operations or processes. or departments

7. Define Unit Cost Method

This method is adopted by the firms, which supply a uniform product rather than a variety of products such as mines, quarries, *etc.*

8 . Define Multiple Cost Method

This method is used in firms which manufacture variety of standardised products, having no relation to one another in cost, quality and the type of.process, *etc.*

9. Define Design Cost?

The cost of design of a. product is estimated by ascertaining the expected time for the design of that product.

Estimated design cost = Estimated design time x Salary of designer per unit time.

The design time can be estimated on the basis of similar products already designed in the past or on the basis of good judgement of designer.

If the design of the product is done by some outside agency, the total amount paid to outside agency gives the cost of design.

10. List the types of estimates.

1. Conceptual design,
2. Preliminary design, and
3. Detailed design.

11. Define Direct Expenses.

Direct expenses are those which can be charged directly to a particular job and are done for that specific job only. Direct expenses are also known as *'chargeable expenses'*.

Examples of direct expenses are

- Cost of preparing designs, drawings for the manufacture of a particular product.
- Cost of experimental work done specifically for a *particular* product.
- Cost of procuring or manufacturing special types of jigsand fixtures for the manufacture of a particular product.
- Cost of hiring special types of patterns, moulding flasks,dies, *etc.*
- Cost of consultancy charges for design and manufacture of a specific product.

12. Define Indirect Expenses.

Indirect expenses are those which cannot be charged directly to a particular product manufactured.

All expenses other than the direct material cost direct labour cost and direct expenses are indirect expenses. ‘Indirect expenses are also known as *'Overhead charges"* 'On *cost* and *'Burden'*.

13. What do you mean by depreciation?

Depreciation is defined as the reduction in the value of an asset, machinery, equipment or building with passage of time due to various reasons, such as wear and tear, and obsolescence. Whether we use the machine or not its value is decreasing with passage of time. Depreciation is computed and accounted for in calculating the hourly cost of running and maintenance of machines.

14. Define cost accounting.

Costing or cost accounting means classifying, recording and allocating the appropriate expenditure for determining the cost of production and achieved by keeping a continuous record of all the costs involved in manufacturing.

15. What is target cost?

When the cost estimate is to be used as a goal, i.e., target cost to be achieved in production, it should be set on lower side than the actual estimated cost. The factory is more likely to try to meet a low cost target than to try to get costs down very far below an overestimated target cost.

16. What is under estimate?

Estimated cost is below the actual cost of product, means a financial loss to the firm and too many losses mean failure or closure of the shop.

17. What is conceptual cost estimating?

It is estimating during the conceptual design stage. In the conceptual design stage, the geometry of parts and materials have not been specified, unless they dictate essential product functions. In the conceptual design stage, the costs associated with a change in the design are low.

18. Write any two objectives of cost estimation.

- It gives an indication to the manufacturer whether the project to be undertaken will be economical or not.
- It enables the manufacturer to choose from various methods of production.
- It enables the manufacturer to fix the selling price (sales price) of the product in advance of actual production.
- It helps in taking decisions to make or to buy.

19. Give the methods of costing.

- Job Costing method
- Batch Costing method
- Operating Cost method
- Process Costing method
- Departmental Costing method

20. What shall be the effect of over estimate?

The estimated cost is much above the actual cost of the product, the shop or firm will not be able to compete with its competitors who have estimated the price correctly and lose the order to its competitors.

21. Define Over Head Cost?

The indirect costs or fixed expenses of operating a business (that is, the costs not directly related to the manufacture of a product or delivery of a service) that range from rent to administrative costs to marketing costs. Overhead refers to all non-labor expenses required to operate your business.

Part-B (16 Marks)

1. **Name the various elements of cost. Explain each element in detail. (16)**

The total cost is made up of three main elements.

1. Material.
2. Labour.
3. Expenses.
4. Overhead.

MATERIAL COST

Material cost consists of the cost of materials which are used in the manufacture of product. It is divided into the following:

(i)Direct Material Cost

It is the cost of those materials which are directly used for the manufacture of the product and become a part of the finished product. This expenditure can be directly allocated and charged to the manufacture of a specific product or job and includes the scrap and waste that has been cut away from original bar or casting.

The procedure for calculating the direct material cost is as follows:

(ii)Indirect Material Cost

In addition to direct materials a number of other materials are necessary to help in the conversion of direct materials into final shape. Though these materials are consumed in the production, they don't become part of the finished product and their cost cannot be directly booked to the manufacture of a specific product. Such materials are called indirect materials.

The indirect materials include oils, general tools, greases, sand papers, coolants, cotton waste etc. The cost associated with indirect materials is called indirect material cost.

LABOUR COST

It is the expenditure made on the salaries, wages, overtime, bonuses, etc. of the employees of the enterprise. It can be classified as (i).Direct Labour Cost

Direct labourer is one who actually works and processes the materials to convert it into the final shape. The cost associated with direct labour is called direct labour cost.

Examples of the direct labour are the workers operating lathes, milling machines or welders, or assemblers in assembly shop. The direct labour cost may be allocated to a product or job on the basis of time spent by a worker on a job.

(ii).indirect Labour Cost

Indirect are the non productive staff who helps the productive labour in performing their dities.

Indirect labour cost cannot be charged directly to particular job, but are charged on the number of products produced in the plant during a particular period.

Examples: supervisors, inspectors, store keeper, etc

.

EXPENSES

Except for direct material and direct labour cost, all other expenditures are known as expenses. The expenses include indirect material cost and indirect cost and such other expenses.

(i)Direct Expenses

Direct expenses also known as chargeable expenses include any expenditure other than direct material or direct labour incurred on a specific cost unit. These are the expenses which can be charged directly to a particular job and are done for that specific job only.

Example special tools and equipment cost of special jigs and fixtures or some special patterns and its maintenance cost, costs of layouts, designs and drawings or experimental work on a particular job etc.

Indirect Expenses

These are known as overhead charges, burden or on cost. All the expenses over and above prime cost are indirect expenses. Overhead is the sum of indirect labour cost, indirect material cost and other expenses including service which cannot be conveniently charged to specific cost unit. These can be further classified as

1. Production expenses/Factory expenses.
2. Administrative expenses.
3. Selling expenses.
4. Distribution expenses.

2. Explain the procedure involved in cost estimation (16)

Step 1.Study the cost estimation request thoroughly and understand it completely.

Step 2.Analyse the product and decide the requirement and specification of the product.

Step 3.Prepare the list of all the parts of the product and their bill of materials.

Step 4.Take make or buy decisions and prepare separate list of parts to be manufactured within the plant and parts to be purchased outside of the plant.

Step 5.Estimate the materials cost for the parts to be manufactured in the plant.

Material cost = weight of the material × material cost per unit weight.

Step 6.Determine the cost of parts to be purchased from outside.

Step 7.Make a manufacturing process plan for the parts to be manufactured in the plant.

Step 8. Estimate the machining time for the each operation listed in the manufacturing process plan.

Step 9.Determine the direct labour cost.

Direct labour cost = total operation time × labour wege time.

Step10. Determine the prime cost by adding direct expenses, direct material cost, and direct labour cost.

Prime cost = direct labour cost+ direct material cost + direct expenses.

Step 11. Estimate the factory overheads, which include all indirect expenditure incurred during production such as indirect material cost, indirect labour cost, depreciation and expenditure on maintenance of the plant, machinery, power,etc

Step12. Estimate the administrative expenses.

Step13.Estimate the selling and distribution expenses, which include packing and delivery charges, advertisement charges,etc.

Step 14. Calculate the total cost of product.

Total cost=prime cost + factory overheads +administrative expenses + selling and distribution expenses.

Step 15. Decide the profit and add the profit to the total cost to fix the selling price of the part.

Selling price = total cost + profit

Step 16. Finally estimate the time of delivery in insulation with the production and sales department.

3. Write short notes on cost allowances in estimation. (8)

1. Miscellaneous Allowances

Allowance is the additional time allowed to perform the work over and above the basic time.to obtain the standard time a proper allowances must be added depending upon the work conditions

Standard time = basic time + allowance

2. Personal allowance

They are provide to the worker to fill his / her personal needs such as washing hands, going to the lavatory, getting water, tea, coffee, etc

They are taken usually taken as 5% for male and 7% for female worker of the total working time.

3.Fatigue allowance

They are intended to provide a workman an opportunity to recover from physiological and psychological effects of fatigue caused by carrying out a specified task under specified conditions

Fatigue may be due to the excessive work, repeated work, poor lighting, poor ventilation, machine noises, visual and mental strain, etc

Generally 5% of the total time is considered as fatigue allowance.

4.Contingency allowance

These allowances are providing for small unavailable delays as well as for occasional and minor extra work.

Some of these occurrences are : tool breakage, tool sharpening, tool replacing, filling coolant reservoirs, power failure , etc

They are usually less than 5% of the total time.

5.Interference allowance

This allowances is provided when two or more work elements occur simultaneously.

6.Process allowance

Provided for compensate for enforced idleness during a process

it includes loss of time due to i) no work ii) power failure iii) faulty material iv) faulty tools and equipments

7.Contingency allowance

Allowance of time to meet legitimate, irregular and infrequent items of work or delays

It can't be economically measured correctly

it is taken less than 5%

8.Special Allowance

These allowances are provided for activities which are not normally a part of the operation cycle, but they are essential for satisfactory performance of the work.

It includes for the following items

1) Startup 2) Cleaning 3) Shutdown 4) Setup 5) Changeover

6) Tools allowance

4. List and discuss the different methods of costing (16)

METHODS OF COSTING

Process costing.

Job costing.

Batch costing.

Departmental costing

Operating cost method

Unit cost method

Multiple cost method

(a) **Process costing**

This method is employed when a standard product is being made which involves a number of distinct processes performed in a definite sequence.

The total time spent and materials used on each process, as well as services such as power, light and heating are all charged. For this purpose cost sheet may be employed.

This method is adopted in industries such as oil refining, chemical, papermaking, paint, cement manufacturing and other similar industries.

Example : grinding the raw material, burning, cooling and grinding.

(b) **Job costing or order costing**

Job costing is concerned with finding the cost of each individual job or contract. Examples :general (job order) engineering industries, ship building, building contracts, etc.

The main features of the system is that each job has to be planned and costed separately. Overhead costs may be absorbed on jobs on the basis of actual costs incurred or on predetermined costs.

It involves consideration of the following factors for each job/order:

1. Materials requirements and prices to arrive at the direct material cost.
2. Labour hours and rates to determine labour costs.
3. Overhead costs.
4. Percentage added to total cost to cover profit.

(c) **Batch costing**

Batch costing is a form of job costing. Instead of costing each component separately, each batch of components are taken together and treated as a job.

example, if 100 units of a component, say a reflector are to be manufactured, then the costing would be as far a single job.

This methods is adopted in job order industries such as ship building, machine manufacturing, fabrication, etc

(d) **Departmental costing**

This method is adopted in determining the cost of the output of each department separately for the manufacturer of the standardized.

(e) **Operating cost method**

This method is used firms providing utility services.

Example transport service, water works, electricity board, railways etc

(f) **Unit cost method**

This method is adopted by the firms, which supply a uniform products rather than a variety of products such as mines, quarries etc

(g) **Multiple cost method**

It is used in firms which manufacture variety of standardized products, having no relation to one another in cost, quality and the type of process etc

5. Briefly explain the allocation of overheads? (16)

In industries producing single product the total overhead costs may be simply divided by the number of items produced.

Some important methods of allocation of overhead costs :

1. Allocation by cost proportion.
2. Allocation by hourly rate.
3. Allocation by unit rate.

1. Allocation by Cost Proportion

This method is sub-divided into three categories :

Proportional to prime cost :

In this method the total overhead costs of the industry are expressed as a fraction or percentage of the prime cost. This percentage multiplied by the prime cost of individual item gives the part of total overheads to be allocated to that item of manufacture. The formula for calculating the percentage of overheads is

$$\text{Percentage of overheads} = \frac{\text{TOTAL OVERHEAD COST}}{\text{TOTAL PRIME COST}} \times 100$$

Proportional to direct labour cost :

In this method the percentage of overhead costs to be allocated is given by

$$\text{Percentage of overheads} = \frac{\text{TOTAL OVERHEAD COST}}{\text{TOTAL DIRECT LABOUR COST}} \times 100$$

Allocation proportional to direct material cost :

According to this method, the percentage of overhead cost equals the total overhead cost of the factory expressed as a fraction of the total direct material costs

$$\text{Percentage of overheads} = \frac{\text{TOTAL OVERHEAD COST}}{\text{TOTAL DIRECT MATERIAL COST}} \times 100$$

2.Allocation by Hourly Rate

This method is again sub-divided into two categories :

By man-hour rate :

The rate of overhead is obtained by dividing the total overhead costs by the total production man-hours worked during that period.

$$\text{Rate of overhead} = \frac{\text{TOTAL OVERHEAD COST FOR THE ENTIRE FACTORY}}{\text{TOTAL PRODUCTION ON MAN HOURS EMPLOYED}}$$

By machine hour rate .

In this method the overhead costs are allocated on the basis of fraction of the time used on particular machine in the manufacture of an item

$$\text{Rate of overhead per machine-hour} = \frac{\text{OVERHEAD EXPENSES FOR SPECIFIC MACHINE}}{\text{NO OF MACHINE HOURS}}$$

3.***Allocation by Unit Rate***

In this method of allocation of overhead costs, it is assumed that the overhead expenses are proportional to the total output

$$\text{Overheads costs/unit produced} = \frac{\text{TOTAL OVERHEAD CHARGES FOR ENTIRE FACTORY}}{\text{NO OF UNIT PRODUCED}}$$

6. **What is cost estimating . State the objectives of cost estimating** **(08)**

OBJECTIVES OR PURPOSE OF ESTIMATING

The main purpose or objective of estimating are

- To establish the selling price of a product for a quotation or contract, so as to ensure reasonable profit to the company.
- Verify quotation submitted by vendors.
- To ascertain whether a proposed product can be manufactured and marketed profitably.
- To determine how much must be invested in equipment.
- To find whether parts or assemblies can be more cheaply fabricated or purchased from outside (make or buy decision).
- To determine the most economical process, tooling or material for making a product.
- To establish a standard of performance at the start of project.
- For feasibility studies on possible new products.
- To assist in long term financial planning.
- To prepare production budget.
- To help in responding to tender enquiries.
- To evaluate alternate designs of a product.
- To set a standard estimate of costs.
- To initiate programs of cost reduction that result in economics due to the use of new materials, which produce lower scrap losses and which create savings due to revisions in methods of tooling and processing, and
- To control actual operating costs by incorporating these estimates into the general plan of cost accounting.

7. Explain the various types of estimation. **(16)**

TYPES OF ESTIMATE

Estimates can be developed in a variety of different ways depending upon the use of the estimates and the amount of detail provided to the estimator.

Importance of understanding estimating methods. Every estimator should understand every estimating method and when to apply each, because no one estimating method will solve all estimating problems.

(1)**Guesstimates**

Guesstimates are a slang term used to describe as estimate than lacks detail. This type of estimate relies on the estimators experience and judgment. There are many reasons why some estimates are developed using his method.

(2)**Budgetary**

The budgetary estimate can also be a guesstimate but is used for a different purpose. The budgetary estimate is used for planning the cost of a piece part, assembly, or project. This type of estimate is typically on the high side because the estimator understands that a low estimate could create real problems.

(3)**Using Past History**

Using past history is a very popular way of developing estimates for new work. Some companies go to great lengths to ensure that estimates are developed in the same way actual cost is conducted. This provides a way past history in developing new estimates. New advancements in group technology now provide a way for the microcomputer to assist in this effort.

(4)**Estimating in Some Detail**

Some estimators vary the amount of detail in an estimate depending on the risk and dollar amount of the estimate. This is true in most contract shops. This level of detail might be at the operation level where operation 10 might be a turning operation and the estimator would estimate the setup time at 0.5 hours and the run time at 5.00 minutes. The material part of the estimate is usually calculated out in detail to reduce estimating error.

(5)**Estimating in Complete Detail**

When the risk of being wrong is high or the dollar amount of the estimate is high, the estimator will develop the estimate in as much detail as possible. Detailed estimates for machinery operations

Example: calculations for speeds, feeds, cutting times, load and unload times and even machine manipulations factors. These time values are calculated as standard time and adjusted with an efficiency factor to predict actual performance.

(6)**Parametric Estimating**

Parametric estimating is an estimating method developed and used by trade associations. New housing constructions can be estimated on the basis of cost per square. There would be different figures for wood construction as compared with brick and for single strong construction as compared with multilevel construction.

(7)**Project Estimating**

Project estimating is by far the most complex of all estimating tasks. This is especially true if the project is a lengthy one. A good example of project estimating is the time and cost of developing a new missile. The project might take 5 years and cost millions of dollars. The actual manufacturing cost of the missile might be a fraction of the total cost. Major projects of this nature will have a PERT network to keep track of the many complexities of the project. A team of people with a project leader is usually required to develop a project estimate.

8. From the following data for a sewing machine manufacturer, prepare a statement showing prime cost, works/factory cost, production cost and profit. (16)

	Rs
Value of stock of material as on 01-04-2003	26,000
Material purchased	2, 74,000
Wages to labour	1,20,000
Depreciation of plant and machinery	8,000
Depreciation of office equipment	2,000
Rent, taxes and insurance of factory	16,000
General administrative expenses	3400
Water, power and telephone bills factory	9,600
Water, lighting and telephone bills of office	2500
Material transportation in factory	2000
Insurance and rent of office building	2000
Direct expenses	5000
Commission and pay of salesman	10,000
Repair and maintenance of plant	1000
Works manager salary	30,000
Salary of office staff	60,000
Value of stock of material as on 31/03/2004	36,000
Sale of products	6,36,000

Solution

i. material cost = opening stock value + material purchases – closing balance

= 26,000 + 2,74,000 – 36000

= Rs 2,64,000.

Prime cost = direct material cost + direct labour cost + direct expenses

= 2,64,000 + 1,20,000 + 5,000

= Rs 3,89,000.

ii. Factory overheads are

	Rs
Rent, taxes and insurance of factory	16,000
Depreciation of plant and machinery	8,000
Water ,power and telephone bills factory	9,600
Material transportation in factory	2000
Repair and maintenance of plant	1000
Works manager salary	30,000

Factory overheads or factory cost	66,600.

Factory cost = prime cost + Factory expenses

= 3,89,000 + 59,500

= Rs 4,48,500.

iii. Administrative / office expenses are:

Depreciation of office equipment	2,000
General administrative expenses	3400
Water, lighting and telephone bills of office	2500
Insurance and rent of office building	2000
Salary of office staff	60,000

Total	69,900.

Production cost = factory cost + office expenses
= Rs 4,55,600 + Rs 69,900

= Rs 5,25,500.

iv. Selling overheads are

Commission and pay to salesman = Rs 10,500.

Total cost = production cost + selling expenses

= 5,25,500 + 10,500

= Rs 5,36,000.

v. Profit = sales – total cost

= 6.36.000 – 5,36,000

= Rs 1,00,000.

9. Explain any one method of calculating depreciation Cost with an example.

Unit of Production method

This is a two-step process, unlike straight line method. Here, equal expense rates are assigned to each unit produced. This assignment makes the method very useful in assembly for production lines. Hence, the calculation is based on output capability of the asset rather than the number of years.

The steps are:

Step 1: Calculate per unit depreciation:

Per unit Depreciation = (Asset cost – Residual value) / Useful life in units of production

Step 2: Calculate the total depreciation of actual units produced:

Total Depreciation Expense = Per Unit Depreciation * Units Produced

Example: ABC company purchases a printing press to print flyers for Rs. 40,000 with a useful life of 1,80,000 units and residual value of Rs. 4000. It prints 4000 flyers.

Step 1: Per unit Depreciation = (40,000-4000)/180,000 = Rs. 0.2

Step 2: Total Depreciation expense = Rs. 0.2 * 4000 flyers = Rs. 800

So the total Depreciation expense is Rs. 800 which is accounted. Once the per unit depreciation is found out, it can be applied to future output runs.

UNIT-IV
(PRODUCTION COST ESTIMATION)
Part-A (2 Marks)

1. Define Machine or Upset Forging

In upset forging, the cross section of the metal is increased with a corresponding reduction in its length. This method is used for making gear blanks, shafts, axles and similar parts.

2. Write the forging operations.

1. Upsetting
2. Drawing Down (Fullering)
3. Setting Down
4. Bending
5. punching
6. Drifting
7. Swaging

3. Define Shear Loss

The blank required for forging a component is cut from billets or long bars, by means of, a sawing machine. During sawing, the material equal to the product of thickness of sawing blade and cross-section of bar is lost for each cut. This material loss is known as shear loss..

4. Define Tonghold Loss

While performing some forging operations, some length of the stock (at one end) is required for holding the stock in tong. This small extra length will be removed after completion of the workpiece. These losses known as *tonghold loss* Therefore this tonghold loss should be added while calculating the required stock material. Length of tonghold is generally taken as 2 to 2.5 cm of the stock length.

5. Define Scale Loss

At high temperature during the forging processes, the oxidation of the outer surface of the workpiece will take place. That is, the heated workpiece reacts, with oxygen from air forms a thin film of iron oxide on the outer surface of the wokpiece. This thin film of iron oxide is called scale. When hammering is done, the scale is broken and falls down as a waste. This material waste is known as scale loss. Generally scale loss is taken as 6% of the net weight

6.Define Flash Loss

When dies are used for forging, certain quantity of material comes out of the die at the parting line of the top and bottom halves of the die. This surplus wastage material is called flash. Flash is generally taken as 20 mm wide and 3 mm thick.

7. Define Sprue Loss

The portion of metal between the length held in the tong (i.e., tonghold) and the material in the die is called sprue or runner. This is cut off when workpiece is completed. The material loss due to this portion of the material used as a contact is called sprue loss. The sprue must be heavy enough to permit lifting the workpiece out of the impression die without bending. The sprue loss is generally taken as 7% of the net weight.

8. What is unit rate?

This is also known as production unit basis method. In this, on-cost is allocated on the basis of unit of production. Unit of production is generally piece, kilogram, tonne, litres, metre, etc. This method is mostly used where only one type of production is carried out. This method cannot be used in factories, where different kinds of products are manufactured. Unit rate is the overheads for one unit.

9. What is shrinkage allowance?

Almost all metals contract during cooling at different rates. The shrinkage is volumetric which affects the dimensions all around the casting.

10. Define man hour and machine hour rate.

$$\text{Man-hour rate} = \frac{\text{Total overheads}}{\text{Total direct man hour spent}}$$

$$\text{Machine-hour rate} = \frac{\text{Total overhead}}{\text{Total productive machine hour}}$$

11.List out the material losses in forging.

- Shear Loss
- Tonghold Loss
- Scale Loss
- Flash Loss
- Sprue Loss

12.Define Inadequacy.

Sometimes the existing machine is functioning well, but it is not capable to cope-up with the increased demand. Because of the increased demand, that particular machine becomes inadequate. For example, an existing pit furnace replaced by a cupola fumace to meet the increased demand. Therefore additional money, should be spent either to replace the machine or to install more similar size machines. This type of depreciation where a machine is to be replaced while it is functioning is known as depreciation by inadequacy

13.Brief about the procedure for calculating material cost.

Cost of material required for casting is calculated as follows :

(i) From the component drawing, calculate the volume of material required for casting. This volume multiplied by density of material gives the net weight of the casting.

(ii) Add the weight of process scrap *i.e.* weight of runners, gates and risers and other material consumed as a part of process in getting the casting.

(iii) Add the allowance for metal loss in oxidation in furnace, in cutting the gates and runners and over runs etc.

14. Define Production Cost.

Production cost refers to the cost incurred by a business when manufacturing a good or providing a service. Production costs include a variety of expenses including, but not limited to, labor, raw materials, consumable manufacturing supplies and general overhead.

15. Differentiate Rightward and leftward welding.

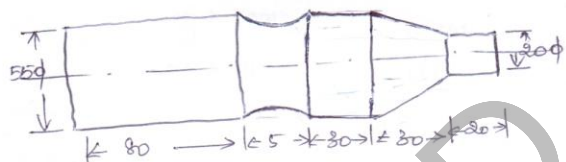
The leftward method of welding is also known as forward welding. It is the oldest and most widely established method for the butt-welding of steel plates. Welding is commenced at the right hand edge of the plate and proceeds across the plane in a leftward direction, the blowpipe following the welding rod.

The rightward method of welding consists of commencing at the left-hand side of the plate and proceeding towards the right, the filler rod following the blowpipe.

Part-B (16 Marks)

PROBLEMS ON MACHINING TIME CALCULATION.

1. A 60 mm rod of aluminium to be machined on a lathe, the finished size is shown in Fig. The length of the rod is 175 mm. Determine the total machining time & material cost, if the material is purchased at the rate of Rs. 12 per kg. Assuming cutting speed 30 m/min & feed 0.2 mm/rev. Take density of aluminium as 2.7 gm/cc. Depth of cut not to exceed 2.5 mm. (APRIL/MAY 2015)



Given:

$S = 30$ m/min ; $f = 0.2$ mm/rev ; $\rho = 2.7$ gm/cc

To find:

(i) Total Machining time (ii) Material Cost.

Solution: (i) Total Machining time:

First operation: Facing both ends of φ 60 mm.

Facing reduces the rod length from 175 mm to 165 mm.

Length of Cut $= \frac{60}{2} = 30$ mm.

$$N = \frac{1000\,S}{\pi D} = \frac{1000 \times 30}{\pi \times 60} = 159.15 \text{ rpm}.$$

$$\therefore \text{Time for facing on one side} = \frac{L}{f \cdot N} = \frac{30}{0.2 \times 159.15}$$

$$= 0.942 \text{ min}.$$

$\therefore$ Time to face on both ends, $T_1 = 0.942 \times 2$

$T_1 = 1.884$ min.

Second operation:

Step: 1 Turning from 60 mm ϕ to 55 mm ϕ and 165 mm long.

$$N = \frac{1000 S}{\pi D} = \frac{1000 \times 30}{\pi \times 60} = 159.15 \text{ rpm}.$$

$$\text{Number of cuts} = \frac{D - d}{2 \times \text{Depth of cut}} = \frac{60 - 55}{2 \times 2.5} = 1$$

$$\therefore \text{Time for turning}, \ T_2 = \frac{L}{f \times N} = \frac{165}{0.2 \times 159.15} = 5.184 \text{ min}$$

Step: 2

Turning from 55 mm ϕ to 20 mm ϕ and 20 mm long.

$$N = \frac{1000 S}{\pi D} = \frac{1000 \times 30}{\pi \times 55} = 173.62 \text{ rpm}.$$

$$\text{Number of cuts} = \frac{D - d}{2 \times \text{Depth of cut}} = \frac{55 - 20}{2 \times 2.5} = 7$$

$$\therefore \text{Time for Turning}, \ T_3 = \frac{L}{f \times N} = \frac{20}{0.2 \times 173.62} \times 7$$

$$T_3 = 4.032 \text{ min}.$$

Third operation: Grooving for 5 mm length.

$$\text{Time for grooving}, \ T_4 = \frac{L}{f \times N} = \frac{5}{0.2 \times 159.15}$$

$$T_4 = 0.157 \text{ min}.$$

Fourth operation:

Taper turning from 55 mm ϕ to 20 mm ϕ and 30 mm long.

$$N = \frac{1000 S}{\pi D} = \frac{1000 \times 30}{\pi \times 55} = 173.62 \text{ rpm}.$$

$$\text{Number of cuts} = \frac{55 - 20}{2 \times 2.5} = 7$$

$$\therefore \text{Time for taper turning}, \ T_4 = \frac{L}{f \times N} \times \text{no. of cuts}$$

$\therefore \quad T_5 = 6.047$ min

$\therefore$ Time for Machining:

$\therefore$ Total machining time, $T = T_1 + T_2 + T_3 + T_4 + T_5$

$= 1.884 + 5.184 + 4.032 + 0.157 + 6.047$

$$\boxed{T = 17.304 \text{ min}} \text{ Ans.}$$

Material Cost:

$\therefore$ Total Volume = Vol. of Cylinders + Vol. of frustum of Cone

$$= \left[\frac{\pi}{4}(55)^2\, 115\right] + \left[\frac{\pi \times 30}{3}\left(20^2 + 55^2 - 20 \times 55\right)\right] + \left[\frac{\pi}{4}\left(20^2\right)20\right]$$

Total volume = 281828.57 mm^3

$\therefore$ Total weight = Total volume $\times$ Density

$= 281828.57 \times 2.7 \times 10^{-6}$

$W = 0.761$ kg.

Then,

Material Cost = Total weight $\times$ Cost of material per kg.

$= 0.761 \times 12$

$$\boxed{\text{Material Cost} = \text{Rs. } 9.13} \text{ Ans.}$$

2. Estimate the size of the stock to forge a M.S. Hexagonal headed bolt blank. The diameter of the bolt is 20 mm and length of the stem is 100 mm. Assume necessary dimensions for the head.

Given: Bolt diameter = 20 mm ; length of the stem = 100 mm.

To find: size. i.e., diameter & length of the stock to forge a M.S. Hexagonal headed bolt blank.

Solution:

The dimensions of the bolt head are assumed.

(i) To find the diameter of the bar stock:

In general, the bar stock diameter and the bolt shank diameter are same. Therefore, the diameter of the bar - stock = 20 mm.

(ii) To find the length of the bar stock:

Now, we have to forge only the hexagonal head.

Net volume of head = Area of the Hexagon x thickness of head.

$$= \left[\frac{3\sqrt{3}}{2} \times a^2\right] \times t$$

$$= \left[\frac{3\sqrt{3}}{2} \times 25^2\right] \times 22$$

Here, Assume a = length of each side of hexagon is equal to radius of bolt = 25 mm & thickness = 22 mm.

$\therefore$ Net volume = 35723.55 mm^3

Considering 5% of net volume as scale loss and neglecting all other losses, we get

$\therefore$ Scale loss $= \frac{5}{100} \times 35723.55 = 1786.18$ mm^3

$\therefore$ Gross volume of head = Net volume + Scale loss

= 35723.55 + 1786.18

= 37509.73 mm^3

∴ Length of 20 mm φ bar stock required for making head,

$$= \frac{\text{Net volume of head}}{\text{Area of cross-section of bar}}$$

$$= \frac{37509.73}{\pi/4 \times 20^2}$$

$$l = 119.397 \text{ mm.}$$

Then, length required for making one bolt,

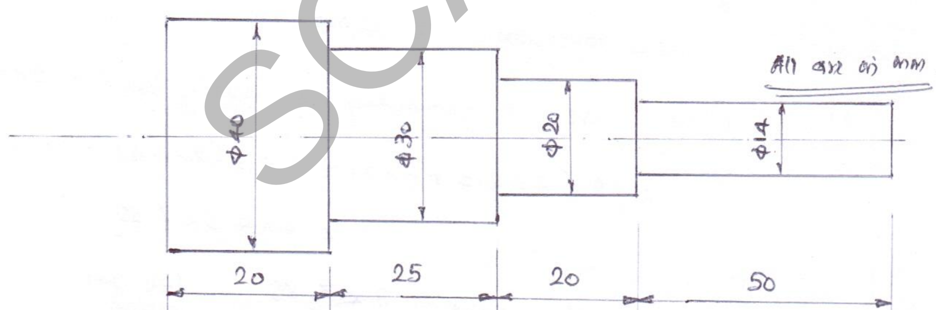
$$= 119.397 + 100$$

$$L = 219.397 \text{ mm.}$$ Ans.

---

3. Calculate the net weight and gross weight for the component shown in Fig. Density of material used is 7.86 gm/cc. Also calculate:

(i) Length of 14 mm dia. bar required to forge one component.



(ii) Cost of forging / piece if:

Material cost = Rs. 8 per kg.

Labour cost = Rs. 5 per piece.

Overheads = 150% of labour cost.

Solution:

Net volume of forged component $\Big\}$ $v = \frac{\pi}{4}\left[(d_1^2 \times l_1) + (d_2^2 \times l_2) + (d_3^2 \times l_3) + (d_4^2 l_4)\right]$

$$V = \frac{\pi}{4}\left[(4^2 \times 2) + (3^2 \times 2.5) + (2^2 \times 2) + (1.4^2 \times 5)\right]$$

$$= \frac{\pi}{4} \times 72.3 = \underline{\underline{56.76 \ cm^3}}.$$

$\therefore$ Net weight = Vol $\times$ density

$= 56.76 \times 7.86$

$$\boxed{W = 446 \ gms.}$$

Losses:

i) Shear loss = 5% of net wt.

$= \frac{5}{100} \times 446 = \underline{\underline{22.30 \ gms}}.$

ii) Scale loss = 6% of net wt.

$= \frac{6}{100} \times 446 = \underline{\underline{26.76 \ gms}}.$

Taking flash width = 20 mm.

flash thickness = 3 mm.

iii) $\therefore$ Flash loss = (periphery of Parting line) $\times 2 \times 0.3 \times 7.86$

$= [2(2 + 2.5 + 2 + 5) + 1.4 + (2 - 1.4) + (3 - 2) + (4 - 3) + 4]$

$\times 2 \times 0.3 \times 7.86$

$= 31.0 \times 2 \times 0.3 \times 7.86 = \underline{\underline{146 \ gms}}.$

(iv) Tonghold loss = 2 $\times$ Area of cross section of bar $\times$ density

$= 2 \times \frac{\pi}{4}(1.4)^2 \times 7.86 = \underline{\underline{24.22 \ gms}}$

(v) Sprue loss = 7% of net wt.

$= \frac{7}{100} \times 446 = \underline{\underline{31.22 \ gms}}.$

∴ Total Material loss = 22.3 + 26.8 + 146 + 24.22 + 31.22

= 250 gms.

∴ Gross wt. = Net wt. + losses

= 446 + 250

Gross wt. = 696 gm Ans.

(i) Near length of 14 mm φ bar required per piece:

$$= \frac{\text{Volume of forging}}{\text{Area of the section of bar}}$$

$$= \frac{56.76}{\frac{\pi}{4} \times 1.4^2} = 36.86 \text{ cm.}$$

i) Direct Material Cost $= \frac{696}{1000} \times 8$

= Rs. 5.57

(ii) Direct Labour Cost = Rs. 5/- per piece.

(iii) Over heads = 150 % of Labour Cost.

= 1.5 × 5 = Rs. 7.5

∴ Cost per piece = 5.57 + 5 + 7.5

Cost / piece = Rs. 18 Ans.

4. Calculate the cost of welding two pieces of mild steel sheets 1m long & 7mm thick. A 60° V is prepared by means of gas cutting before welding is to the commenced. The cost of oxygen is Rs. 7/m³ and of acetylene is Rs. 4/m³. The filler material costs Rs. 20/kg. The following data is also available:

For gas cutting (For 10 mm thick plate)

Cutting speed = 20 m/hr.

Consumption of oxygen = 2 m³/hr.

Consumption of acetylene = 0.2 m³/hr.

Data for Rightward welding (For 7mm thick plate)

Consumption of oxygen = 0.8 m³/hr.

Consumption of acetylene = 0.8 m³/hr.

Dia. of filler rod used = 3.5 mm.

Filler rod used per meter of weld = 3.4 m.

Rate of welding = 3 m/hr.

Density of filler metal = 8 gm/cc.

Solution:

Cost of V preparation.

i) Time taken to cut two plates of one meter length each for edge preparation $= \frac{2 \times 1}{20} = 0.1$ hr.

ii) Consumption of oxygen for cutting $= 2 \times 0.1$
$= 0.2\ m^3$

Cost of oxygen for cutting $= 0.2 \times 7$
$=$ Rs. 1.4

iii) Consumption for acetylene for cutting = 0.2 × 0.1

= 0.02 m^3

Cost of acetylene for cutting = 4 × 0.02

= Rs. 0.08

∴ Total cost of gases for cutting = 1.40 + 0.08

= Rs. 1.48

Cost of welding:

i) Cost of filler rod:

Length of weld = 1 m.

Length of filler rod used = 3.4 × 1

= 3.4 m. = 340 cm.

Wt. of filler rod used = $\frac{\pi}{4}\left(\frac{3.5}{10}\right)^2 \times 340 \times 8$

= 261.8 gms (or) 0.262 kgs.

∴ Cost of filler rod used = 0.262 × 20

= Rs. 5.24

ii) Cost of gases:

Time taken for welding = $\frac{1}{3} \times 1$ = $\frac{1}{3}$ hr.

Volume of oxygen consumed for welding = $\frac{1}{3} \times 0.8$ = 0.26 m^3

Cost of oxygen consumed for welding = 0.26 × 7

= Rs. 1.82

Volume of acetylene consumed for welding = $\frac{1}{3} \times 0.8$ = 0.26 m^3

Cost of acetylene consumed for welding = 4 × 0.26

= Rs. 1.04

∴ Cost of gases for welding = 1.82 + 1.04

= Rs. 2.86

∴ Total cost of making the weld:

= 1.48 + 5.24 + 2.86

= Rs. 9.58 Ans.

---

5. Estimate the total cost of 20 C.I. Flanged pipe casting shown in Fig. Assuming the following data:

Cost of C.I = Rs. 5/kg.

Cost of process scrap = Rs. 2/kg.

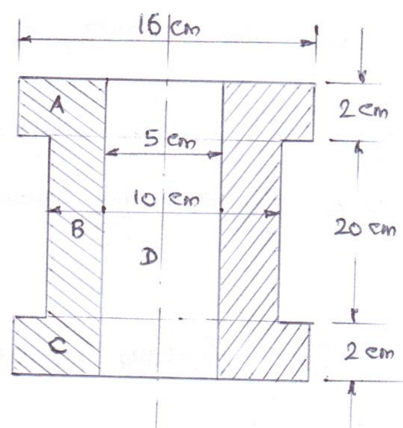
Process scrap = 2% of net weight of casting.

Moulding & Pouring charges = Rs. 2/piece.

Casting removal & cleaning = Rs. 0.50/piece.

Administrative overheads = 5% factory cost.

Selling overheads = 70% of administrative overheads.



Solution: First let us find the net weight of a C.I. flanged pipe shown in fig.

Break up the flanged pipe into simple parts A, B, C & D.

Net volume of Cast Component } = volume of (A+B+C−D)

$= \left[\frac{\pi}{4} \times 160^2 \times 20\right] + \left[\frac{\pi}{4} \times 100^2 \times 200\right] + \left[\frac{\pi}{4} \times 160^2 \times 20\right] - \left[\frac{\pi}{4} \times 50^2 \times 240\right]$

Net volume = 1903805.15 mm³

Assume, density of cast iron as 7.2 gm/cc.

∴ Net weight of cast component $= 1903805.15 \times 7.2 \times 10^{-6}$

$= 13.71$ kg.

(i) To find material cost:

Process scrap = 2% of net wt. of casting

$= \frac{2}{100} \times 13.71 = 0.274$ kg.

∴ Gross material required = Net wt. + Process scrap

= 13.71 + 0.274

= 13.984 kg.

Cost of Cast Iron = Rs. 5/kg. (Given)

∴ Cost of total Cast Iron = 13.984 × 5

= Rs. 69.92

Cost of Process scrap = Rs. 2/kg

Then Cost of 0.274 kg scrap = 2 × 0.274 = Rs. 0.548

∵ Material Cost / piece = Cost of C.I − Cost of Process scrap

= Rs. 69.92 − Rs. 0.548

= Rs. 69.37

ii) To find the Labour Cost:

Moulding & Pouring charges = Rs. 2/ piece.

Casting removal & Cleaning = Rs. 0.50/ piece.

∴ Total labour Cost / piece = Rs 2 + 0.50

= Rs. 2.50

iii) To find Overheads:

Factory Cost = Material Cost + Labour Cost + Direct Expenses (if any)

= Rs. 69.37 + Rs. 2.50 + 0

∴ Factory Cost / piece = Rs. 71.87

Administrative overheads = 5% of factory cost (given)

$= \frac{5}{100} \times 71.87$

= Rs. 3.59

Selling overheads = 70% of administrative overheads

$= \frac{70}{100} \times 3.59$

= Rs. 2.52

(iv) To find total cost of 20 C.I. flanged pipes:

$$\left.\begin{array}{l}\text{Total casting}\\ \text{cost per piece}\end{array}\right\} = \left\{\begin{array}{c}\text{Factory}\\ \text{cost}\end{array}\right\} + \left\{\begin{array}{c}\text{Administrative}\\ \text{overheads}\end{array}\right\} + \left\{\begin{array}{c}\text{Selling}\\ \text{overheads}\end{array}\right\}$$

$= Rs.\ 71.87 + Rs.\ 3.59 + Rs.\ 2.52$

$= Rs.\ 77.98$

$\therefore$ Total casting cost for 20 pipes $= 20 \times 77.98$

$= Rs.\ 1559.60$ Ans.

6. Losses in Forging.(8)

Certain amount of material is lost during different forging operations. The exact estimation of losses is very difficult, but by practical experience, the losses can be calculated during forging as accurate as possible. Various losses in forging are:

(i) Tong Loss: While performing forging operations, some length of stock is required for holding the job in tong. This length is an extra length, which is removed after completion of the job. For estimation purposes, the weight of the extra length is also considered and is known as Tong loss. 2 to 3 cm of the stock length.

(ii) Scale Loss: The outer surface of the hot metal is generally oxidized, and when hammering is done oxidized film is broken and falls down in the form of scale. It reduces the dimensions of the job, and therefore, this loss must be considered for estimation purposes. Generally, it is taken as 6% of the net weight.

(iii) Flash Loss: It is the surplus metal, which comes out between the two meeting surfaces of the dies. For getting finished product, this surplus metal is required to be trimmed off.

This loss may be calculated by assuming it to be 20mm wide and 3mm thick all around the periphery of the dies.

Thus, volume of flash loss = periphery x 20x 3 cu mm nearly.

(iv) Shear Loss: The required sizes of workpiece for forging operations are obtained from long bars by sawing or shearing. In sawing operation, some material is always lost. If last piece of bar is not to be required length, it is rejected. This loss of material is taken as 5% of the net weight.

(v) Sprue Loss: The portion of metal between the length held in the tong and the material in the die is called sprue. This is also a metal loss and can be taken as 7% of the weight.

UNIT-V
(MACHINING TIME CALCULATION)
Part-A (2 Marks)

1. What are the elements of machining time?

- Set-up time,
- Handling time,
- Machining time,
- Tear down time,
- Down time, and
- Allowances.

2. List the allowances in machining time.

- Personal allowance
- Fatigue
- Inspection or Checking allowance
- Tool sharpening/Tool change allowance
- Other allowances

3. What is setup time?

This is the time taken to prepare the machine for operation. The set-up time includes the time taken to :

(i) Study the component drawing.
(ii) Draw tools from tool crib, and
(iii) Install and adjust the tools, jigs and fixtures on the machine.

4. What is machining time?

It is the time for which the machine works on the component, *i.e.* from the time when the tool touches the work piece to when the tool leaves the component after completion of operation. The machining time depends on the type and extent of machining required, material being machined, speed, feed, depth of cut and number of cuts required.

5. What is unit operation time?

The sum of handling time and machining time for a job is called operation time. It is the duration of time that elapses between output of two consecutive units of production. It is also called cycle time.

6. What is tear down time?

It is the time taken to remove the tools, jigs and fixtures from the machine and to clean the machine and tools after the operation has been done on the last component of batch. The tear down time is usually small. The tear down time occurs only once for a complete lot or batch taken for machining. Standard data are available for tear down time for various machines.

7. What is down time?

It is the time wasted by the operator due to breakdowns, non-availability or delay in supply of tools and materials etc.

8. Enumerate the estimation in milling and list the operations done on a milling machine.

Milling machine is a very versatile machine. The milling machine employs a multipoint tool, called milling cutter, for machining. The various operations done on a milling machine include facing, forming or profile machining, slotting, key way cutting, etc.

In milling machine, the formula to calculate machining time is :

$$\text{Time} = \frac{\text{Length of cut}}{(\text{Feed per rev.}) \times (\text{r.p.m.})}$$

9. List the process parameters for lathe.

- Length of cut
- Feed
- Depth of cut
- Cutting speed

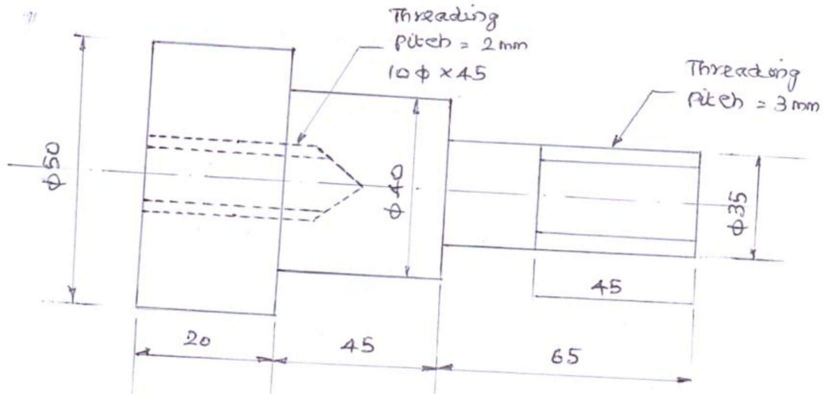
10. Define Cutting Speed.

Cutting speed is the speed at which the cutting edge of tool passes over the job and it is usually expressed in meters per minute. The cutting speed depends on the cutting tool material, the work piece material and the operation.

Part-B (16 Marks)

UNIT : 5

1. Find the machining time to complete the job as shown fig. from the basic material of 60 mm diameter and 130 mm length.



Assume:

Cutting speed for turning = 28 m/min

Feed = 1 mm/revtn

Depth of cut = 3 mm

Cutting speed for thread cutting = 10 m/min.

Cutting speed for drilling = 30 m/min.

Feed for drilling = 0.25 mm/revtn

To find:

Machining time to complete the job.

Solution:

First operation: Turning from ϕ 60mm to ϕ 35 mm.

Step : 1 Turning from ϕ 60mm to ϕ 50 mm

$S = 28$ m/min ; $L = 130$ mm ; $f = 1$ mm/revtn.

Depth of cut = 3 mm.

$$N = \frac{1000 S}{\pi D} = \frac{1000 \times 28}{\pi \times 60} = 148.54 \text{ rpm}$$

$$\text{Number of Cuts} = \frac{D - d}{2 \times \text{Depth of Cut}}$$

$$= \frac{60 - 50}{2 \times 3} = \underline{1.66 \simeq 2}$$

$$\text{Time for Turning, } T_1 = \frac{L}{f \times N} \times \text{Number of Cuts}$$

$$= \frac{130}{1 \times 148.54} \times 2$$

$$\boxed{T_1 = 1.75 \text{ min.}}$$

<u>Step : II</u> <u>Turning from φ 50 mm to φ 40 mm</u>

$L = 45 + 65 = 110$ mm ; $D = 50$ mm.

$$N = \frac{1000 \times 28}{\pi \times 50} = \underline{178.25 \text{ rpm}}$$

$$\text{Number of Cuts} = \frac{D - d}{2 \times \text{depth of cut}}$$

$$= \frac{50 - 40}{2 \times 3} = \underline{1.66 \simeq 2}$$

$$\text{Time for Turning, } T_2 = \frac{110}{1 \times 178.25} \times 2$$

$$\boxed{T_2 = 1.234 \text{ min}}$$

<u>Step : III</u> <u>Turning from φ 40 mm to φ 35 mm</u>

$L = 65$ mm ; $D = 40$; No. of Cut $= 1$.

$$N = \frac{1000 \times 28}{\pi \times 40} = \underline{222.82 \text{ rpm}}$$

$$\text{Time for Turning, } T_3 = \frac{65}{1 \times 222.82} \times 1$$

$$\boxed{T_3 = 0.292 \text{ min.}}$$

Second operation:

Drilling a ϕ 10 mm hole for a 45 mm length.

$S = 30$ m/min ; $f = 0.25$ mm/revoln ; $L = 45$ mm

$D = 10$ mm.

$$N = \frac{1000 \times 30}{\pi \times 10} = 954.93 \text{ rpm}.$$

Time for drilling, $T_4 = \dfrac{45}{0.25 \times 954.93}$

$$\boxed{T_4 = 0.188 \text{ min}}$$

Third operation:- Internal threading

$L = 45$ mm ; $D = 10$ mm ; $S = 10$ m/min.

$f = \text{pitch} = 2$ mm.

$$N = \frac{1000 \times 10}{\pi \times 10} = 318.31 \text{ rpm}$$

Threads per cm $= \dfrac{1}{\text{pitch}} = \dfrac{1}{0.2} = 5$

Number of cuts $= \dfrac{32}{\text{Threads per cm}}$, for internal threading

$= \dfrac{32}{5} = 6.4$, say 7

Time for threading, $T_5 = \dfrac{45}{2 \times 318.31} \times 7$

$$\boxed{T_5 = 0.495 \text{ min}}$$

Fourth operation: External threading

$L = 45$ mm ; $f = \text{pitch} = 3$ mm ; $D = 35$ mm

$S = 10$ m/min.

$$N = \frac{1000 \times 10}{\pi \times 35} = 90.95 \text{ rpm}$$

$$\text{Threads per cm} = \frac{1}{\text{pitch}} = \frac{1}{0.3} = 3.333$$

$$\text{No. of cuts} = \frac{25}{\text{Threads / cm}}, \text{ for external threading}$$

$$= \frac{25}{3.333} = 7.5 \text{ say } 8.$$

$$\therefore \text{Time for threading, } T_6 = \frac{45}{3 \times 90.95} \times 8$$

$$\boxed{T_6 = 1.32 \text{ min.}}$$

$\therefore$ Total Time for machining $\}$ $T = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$

$$T = 1.75 + 1.234 + 0.292 + 0.188 + 0.495 + 1.32$$

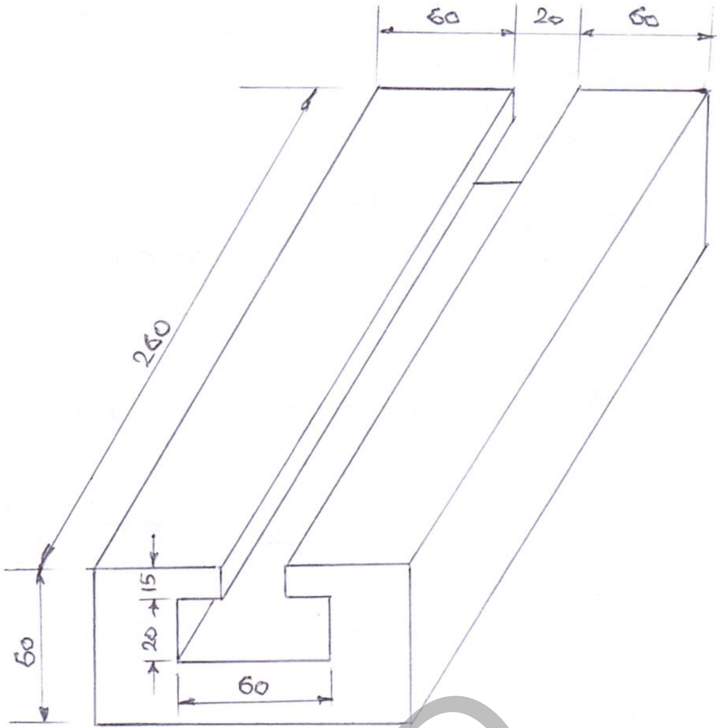
$$\boxed{T = 5.279 \text{ min}} \quad \text{Ans.}$$

---

2. A T-slot is to be cut in a C.I slab as shown in fig. Estimate the machining time. Take cutting speed 25 m/min, feed is 0.25 mm/revoln., Dia. of cutter for channel milling is 80 mm.

Solution: The T-slot will be cut in 2 steps:-

Step: 1 Cut a 20 mm wide & 35 mm deep channel along the length.



Dia. of the Cutter = 80 mm

Cutting speed = 25 m/min.

Length of job = 260 mm.

RPM of the Cutter = $\frac{25 \times 1000}{\pi \times 80}$ = 100 rpm.

Over Travel = $\sqrt{Dd - d^2}$

= $\sqrt{(80 \times 35) - 35^2}$ = 40 mm

Total tool travel = 260 + 40 = 300 mm

Time for cutting slot = $\frac{\text{length of Cut}}{\text{Feed / min}}$

= $\frac{300}{0.25 \times 100}$

= 12 min.

Step: II Cut T-slot of dimensions 60 x 20 with a T-slot Cutter.

Here, dia. of the cutter = 60 mm.

$$\text{Rpm. of the Cutter} = \frac{25 \times 1000}{\pi \times 60} = 133 \text{ rpm}$$

In this case, the over travel of the tool = $\frac{1}{2}$ Dia. of the Cutter

since, Dia. of the cutter = width of the slot

$$\therefore \text{over travel} = \frac{60}{2} = 30 \text{ mm}$$

$$\text{Total tool / Table travel} = 260 + 30 = 290 \text{ mm}$$

$$\therefore \text{Time taken} = \frac{290}{0.25 \times 133} = 8.7 \text{ min.}$$

$$\therefore \text{Total time to cut T-slot} = 12 + 8.7$$

$$= 20.7 \text{ Min. Ans.}$$

3. Find the time required on a shaper to machine a plate 1100 x 500 mm, if the cutting speed is 16 m/min. The ratio of return stroke time to cutting time is 2:3. The clearance at each end is 20 mm along the length and 15 mm on width. Two cuts are required, one roughing cut with cross feed of 2 mm per stroke and one finishing cut with feed of 1.25 mm per stroke.

(P.T.O)

Given:

Plate size = 1100 x 500 mm.

Cutting speed, $S = 16$ m/min.

$K = \frac{2}{3} = 0.666$

Feed for rough cut, $f_{rough} = 2$ mm/stroke

Feed for finish cut, $f_{finish} = 1.25$ mm/stroke.

To find: Time required to shape a plate.

Solution:

Length of stroke, $L = \left\{\text{Length of Plate}\right\} + \left\{\text{Clearance on both sides}\right\}$

$= 1100 + (2 \times 20)$

$\boxed{L = 1140 \text{ mm}}$

Cross travel of table, $W = \text{width of job} + \left\{\text{Clearance on both sides}\right\}$

$= 500 + (2 \times 15)$

$\boxed{W = 530 \text{ mm}}$

Time for one complete stroke $= \frac{L(1+K)}{1000 \times S} = \frac{1140(1+0.666)}{1000 \times 16}$

$= 0.1187$ min.

Number of strokes for roughing cut $= \frac{\text{Cross travel of table}}{\text{Feed / stroke (roughing)}}$

$= \frac{530}{2} = 265$ strokes.

Number of strokes for finishing cut = $\frac{\text{Cross travel of table}}{\text{Feed / stroke (finishing)}}$

$= \frac{530}{1.25} = \underline{\underline{424 \text{ strokes}}}$

∴ Total number of complete strokes required = 265 + 424

$= \underline{\underline{689 \text{ strokes}}}$

∴ Total machining time = 689 × 0.1187

$= \underline{\underline{81.78 \text{ min}}}$ Ans.

---

4. Estimate the planning time for a casting 1.25 m long and 0.5 m wide which is machined on a planer having cutting speed of 12 m/min and a return speed of 30 m/min. Two cuts are required : one roughing with a depth of 3.125 mm & a feed of 0.1 mm/revn. and other finishing a depth of 0.125 mm and using a feed of 0.125 mm.

Given: L = 1.25 m ; W = 0.5 m ; Cutting speed = 12 m/min ;

Return speed = 30 m/min ; f_{rough} = 0.1 mm/revn.

f_{finish} = 0.125 mm/revn.

To find:

Planning time.

Solution:

$$\text{Length of stroke, } L = \begin{Bmatrix}\text{Length of} \\ \text{casting}\end{Bmatrix} + \text{Approach} + \text{Over-run}$$

$$= 1250 + 25 + 25$$

$$\boxed{L = 1300 \text{ mm}}$$

$$\text{Cross feed, } W = \begin{Bmatrix}\text{Width of} \\ \text{Casting}\end{Bmatrix} + \text{Approach} + \text{over-run}$$

$$= 500 + 15 + 15$$

$$\boxed{W = 530 \text{ mm}}$$

$$K = \frac{\text{Return stroke time}}{\text{Cutting stroke time}} = \frac{\text{Cutting stroke speed}}{\text{Return stroke speed}}.$$

$$= \frac{12}{30}$$

$$\boxed{K = 0.4}$$

$$\therefore \text{Time for one Complete stroke} = \frac{L(1+K)}{1000 \times S}$$

$$= \frac{1300(1+0.4)}{1000 \times 12}$$

$$= \underline{\underline{0.152 \text{ min}}}.$$

$$\text{No. of strokes for roughing} = \frac{\text{Cross feed}}{\text{Feed/Stroke (roughing)}}$$

$$= \frac{530}{0.1} = \underline{\underline{5300 \text{ strokes}}}.$$

No. of strokes for finishing = $\frac{\text{Cross feed}}{\text{Feed/stroke (finishing)}}$

$= \frac{530}{0.125} = 4240$ strokes.

∴ Total number of Complete strokes required $= 5300 + 4240$

$= 9540$ strokes.

∴ The total planning time $= 0.152 \times 9540$

$= 1450$ min. (or) 24.17 hrs. Ans.

---

5. Estimate the grinding time to finish a shaft from 38.5 mm to 30 mm diameter. Length of shaft as 300 mm. Assume the following data:

Width of grinding wheel = 50 mm.

Depth of Cut in roughening operation = 0.785 mm.

Depth of Cut in finishing operation = 0.05 mm.

Cutting speed = 12 m/min.

Assume 1 mm on diameter to be finished ground & remaining rough ground.

To find:

Grinding time to Complete the shaft.

Solution:

Step: 1 Grinding time required for roughening operation (from 38.5 mm ϕ to 31 mm ϕ)

Length of Cut, $L = \begin{Bmatrix} \text{Length of} \\ \text{Shaft } (L_0) \end{Bmatrix} - \begin{Bmatrix} \text{Width of} \\ \text{grinding} \\ \text{wheel } (W) \end{Bmatrix} + \text{Approach}.$

$$= 300 - 50 + 5$$

$$\boxed{L = 255 \text{ mm}}$$

For rough Grinding, feed $= \frac{W}{2} = \frac{50}{2} = 25 \text{ mm/revln.}$

$$N = \frac{1000 S}{\pi D} = \frac{1000 \times 12}{\pi \times 38.5}$$

$$\boxed{N = 99.21 \text{ rpm}}$$

Number of Passes required $= \frac{\text{Depth of stock to be removed}}{\text{Depth of Cut}}$

$\therefore$ Depth of stock to be removed $= \frac{38.5 - 31}{2} = \underline{3.75 \text{ mm}}$

Depth of Cut in roughening operation $= 0.785$ mm (given)

$\therefore$ Number of Passes required $= \frac{3.75}{0.785} = \underline{4.77 \text{ say } 5}$

$\therefore$ Rough Grinding time, $T_1 = \frac{L}{\text{feed / rev} \times \text{rpm}} \times \begin{Bmatrix} \text{No: of} \\ \text{Passes} \end{Bmatrix}$

$$= \frac{255}{25 \times 99.21} \times 5$$

$$\boxed{T_1 = 0.514 \text{ min.}}$$

<u>Step : II</u>

Grinding time required for finishing operation (from 31 mm ϕ to 30 mm ϕ)

For finish Grinding,

$$\text{feed} = \frac{W}{4} = \frac{50}{4} = 12.5 \text{ mm/revolution}$$

$$N = \frac{1000\,S}{\pi D} = \frac{1000 \times 12}{\pi \times 31}$$

$$\boxed{N = 123.22 \text{ rpm}}$$

∵ Depth of stock to be removed $= \frac{31-30}{2} = \underline{\underline{0.5 \text{ mm}}}$

Depth of cut in finishing operation $= 0.05$ mm (given)

∴ No. of passes required $= \frac{0.5}{0.05} = \underline{\underline{10}}$

∴ Finishing Grinding Time, $T_2 = \frac{255}{12.5 \times 123.22} \times 10$

$$\boxed{T_2 = 1.655 \text{ min.}}$$

∴ Total Grinding Time, $T = T_1 + T_2$

$$= 0.514 + 1.655$$

$$\boxed{T = 2.169 \text{ min.}} \quad \text{Ans}$$

B.E/B.TECH. DEGREE EXAMINATION, MODEL QUESTION PAPER

SEVENTH SEMESTER

MECHANICAL ENGINEERING

ME 6005 PROCESS PLANNING AND COST ESTIMATION

(COMMON TO PRODUCTION ENGINEERING)

(REGULATION 2013)

Time:Three hours Maximum :100 marks

Answer ALL questions.

PART A- (10 X 2=20 marks)

1. What are the types of process planning?
2. State the parameters involved in material selection.
3. List the information required for process planning.
4. What are the parameters required for calculation of various production processes?
5. What do you mean by depreciation?
6. Define Under Estimate.
7. Define Flash Loss.
8. What is electric arc welding?
9. Define Cutting Speed.
10. List the various operations done on a milling machine.

PART B- (5 X 16 = 80 marks)

11. (a) (i) Write the process planning procedure.

(ii) Descibe various approaches to process planning.

Or

(b) What are the factors inflencing selection of production equipment and tools.

12. (a) (i) What are the factors to be considered in the selection of jigs and fixtures.

(ii) Explain various quality assurance methods.

Or

(b)What are the set of documents required for process planning.

13. (a) (i) Discuss in detail the various methods of costing with examples.

(ii) Explain the various methods used in an industry for allocation of overheads.

Or

(b) (i) Write down the step by step procedure in estimating the cost of an industrial product.

(ii) Name the various elements of cost . Explain each element in detail giving suitable examples.

14. (a) Calculate the net weight and gross weight for the component shown in the figure. Density of the material used is 7.86gm/cc. also calculate:

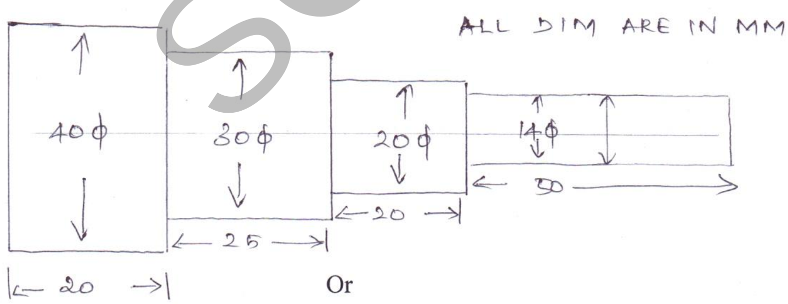
(i)Length of 14mm dia bar required to forge one component.

(ii)Cost of forging/ piece if:

Material cost = Rs 8/Kg

Labour cost = Rs 5/ piece

Overheads =150% of labour cost.



Or

(b) Calculate the cost of welding two pieces of mild steel sheets 1mm length and 7mm thick. A 60^0 v is prepared by means of gas cutting before welding is to be commenced. The cost of oxygen is Rs7/m^3 and of acetyleneis Rs 4/m^3. The filler material cost Rs20/Kg. the following data is also available:

For gas cutting (for 10mm thick plate)

Cutting speed =20mm/hr

Consumption of oxygen =2m^3/hr

Consumption of acetylene =0.2m^3/hr

Data for rightward welding (for 7mm thick plate)

Consumption of oxygen =0.8m^3/hr

Consumption of acetylene =0.8m^3/hr

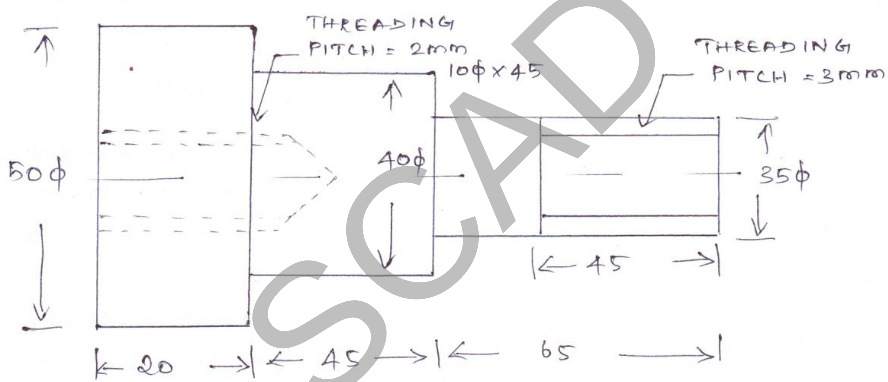
Dia. Of filler rod used =3.5,,

Filler rod used per meter of weld =3.4m

Rate of welding =3m/hr

Density of filler metal =8gm/cc.

15. (a) Find the machining time to complete the job as shown in figure from basic material of 60mm diameter and 130mm length. Given the following data: Cutting speed for turning =28 m/min; Feed = 1mm/rev; Depth of cut = 3mm; Cutting speed for thread cutting =10 m/min; Cutting speed for drilling =30 m/min; Feed for drilling = 0.25mm/rev.



Or

(b)Estimate the grinding time to finish a shaft from 38.5mm to 30mm diameter. Length of shaft as 300mm

Assume the following data:

Width of grinding wheel =50mm

Depth of cut in roughening operation =0.785mm

Depth of cut in finishing operation =0.05mm

Cutting speed =12m/min

Assume 1mm on diameter to be finished ground and remaining rough ground.

Reg. No. :

Question Paper Code : 80641

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Seventh Semester

Mechanical Engineering

ME 6005 — PROCESS PLANNING AND COST ESTIMATION

(Common to Mechanical and Automation and Sixth Semester – Robotics and Automation Engineering)

(Regulations 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define process planning.
2. What are the factors to be considered during the selection of a process?
3. List the factors to be considered while selecting process parameters.
4. Classify the three basic functions of Jigs and fixtures.
5. What do you mean by cost accounting?
6. Define over head cost.
7. Name the various losses in forging process.
8. Differentiate leftward and rightward welding.
9. Define cutting speed. List various factors affecting cutting speed.
10. What is machining time?

PART B — (5 × 16 = 80 marks)

11. (a) Explain with neat sketch various methods of process planning. (16)

Or

(b) (i) What are the constraints in tool selection. (6)

(ii) Write down the procedure to be followed during material selection? Discuss the factors that are taken into account in process selection and equipment selection. (10)

12. (a) (i) Explain the process planning procedure. (8)

(ii) List the information required for process planning. (8)

Or

(b) (i) What are the procedures to be followed for selecting Jigs and fixtures? Discuss in detail. (8)

(ii) What are the different types of inspection methods? Write briefly about them. (8)

13. (a) (i) Discuss various methods of costing in detail. (8)

(ii) Explain the procedure followed for estimating the cost of an individual product. (8)

Or

(b) (i) Explain any one method of calculating depreciation cost with an example. (8)

(ii) Discuss the various methods used for allocation of overheads. (8)

14. (a) (i) Generalize the meaning of tonghold loss in forging. (6)

(ii) 200 pieces of a component as shown in Figure. 1 are to be drop forged from a bar stock of diameter 4 cm. Calculate the cost of manufacturing if (1) Material cost is Rs. 1000/metre, (2) Forging charges are Rs. 10 per cm^2 of surface area to be forged, (3) On-cost is 10% of material cost. Consider all possible losses. (10)

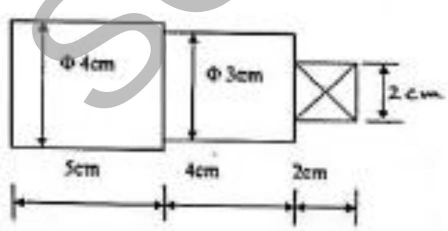


Figure 1

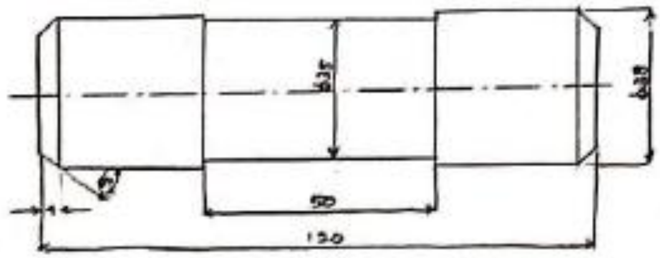
Or

(b) (i) State and explain various losses which are to be considered in a foundry shop. (8)

(ii) List the various elements which are to be considered while calculating the cost of a welded joint. (8)

80641

15. (a) A mild steel bar 120 mm long and 40 mm in diameter is turned to 38 mm diameter and was again turned to a diameter of 35 mm over a length of 50 mm as shown in the figure 2. The bar was chamfered at both the ends to give a chamfer of 45° × 4 mm after facing. Calculate the machining time. Assume cutting speed of 50 m/min and feed 0.3 mm/rev. The depth of cut is not to exceed 3 mm in any operation. (16)



ALL DIMENSIONS ARE IN MM

Figure 2

Or

(b) (i) Find the time required to drill 4 holes in a CI flange each of 2 cm depth, if the hole diameter is 2 cm. Assume cutting speed as 21.9 m/min and feed as 0.02 cm/rev. (8)

(ii) A keyway has to be cut in a spindle whose dimensions are 46 cm length, 5 cm diameter and 1 cm width. The cutter diameter is 13.25 cm. If the cutter revolves at 120 rpm, what is the time required to cut a 1 cm deep key way at a feed of 0.05 cm/rev of cutter? (8)

Reg. No.

Question Paper Code : 72109

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Sixth/Seventh/Eighth Semester

Mechanical Engineering

ME 6005 — PROCESS PLANNING AND COST ESTIMATION

(Common to Manufacturing Engineering, Mechanical and Automation Engineering, Production Engineering, Robotics and Automation Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Use of PSG Design Data Book is Permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define process planning.

2. Write any four cutting tool materials (specify in the increasing order of hardness).

3. What is the difference between routing sheet and operations list?

4. What is the relation between tolerance and surface finish?

5. Differentiate costing from estimation.

6. What are overhead costs?

7. Define production cost.

8. What are the various material losses which can occur in a forging shop?

9. Define 'tool approach' and 'tool overtravel'.

10. Define cutting speed.

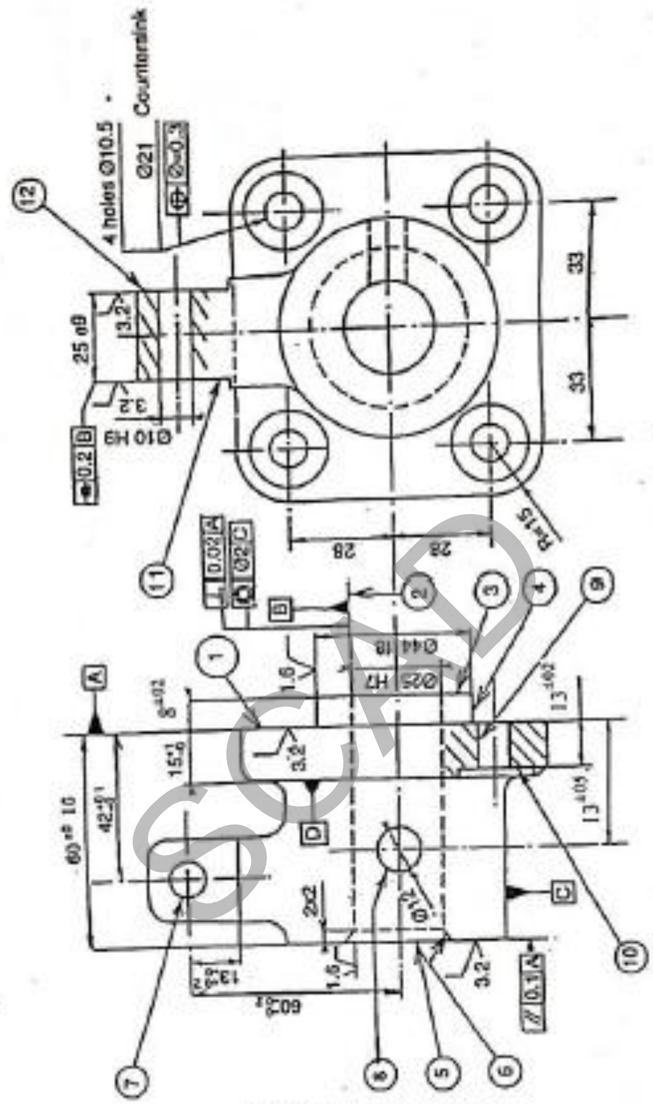
PART B — (5 × 16 = 80 marks)

11. (a) In the figure 11(a), interpret the meaning of any two

(i) Dimensional tolerance symbols (4)

(ii) Form tolerance feature control frames (8)

(iii) Surface finish symbols. (4)



All dimensions are in mm

Figure 11 (a)

Or

(b) Explain the procedure followed in selecting the appropriate manufacturing process for a given product design.

12. (a) A large manufacturer requires 1200 turned components every month for a regular order. Within their tooling machine shop area there are a wide variety of machines. It is decided to investigate if there is any significant advantage of producing the components on a CNC machine as opposed to a conventional machine. The following data is available:

Conventional milling machine	
Set-up time	55 min
Machining time	29 min
Material cost per unit	Rs. 200
Batch size	1200
Machinist's hourly rate	Rs. 100
CNC milling machine	
Set-up time	2 h 15 min
Machining time	18 min
Material cost per unit	Rs. 200
Batch size	1200
Machinist's hourly rate	Rs. 150.

Determine:

(i) the total component cost T for both machines;

(ii) the break-even quantity and which machine should be used.

Or

(b) What is inspection? Write briefly about the different methods of inspection followed in industries.

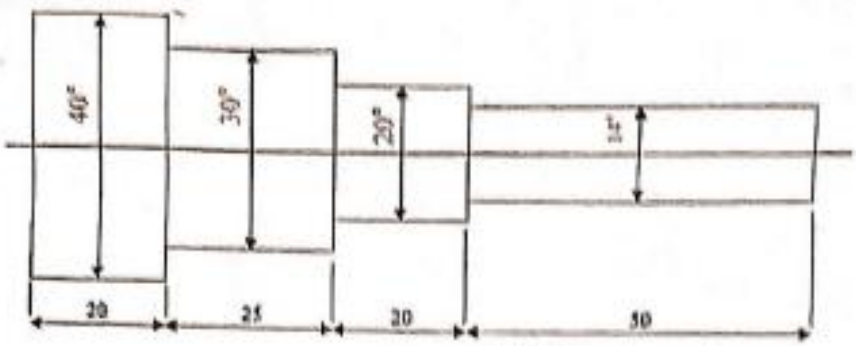
13. (a) Explain the different methods of cost estimation.

Or

(b) Calculate the selling price per unit from the following data:

Direct material cost	= Rs. 8,000
Direct labour cost	= 60 percent of direct material cost
Direct expenses	= 5 percent of direct labour cost
Factory expenses	= 120 percent of direct labour cost
Administrative expenses	= 80 percent direct labour cost
Sales and distribution expenses	= 10 percent of direct labour cost
Profit	= 8 percent of total cost
No. of pieces produced	= 200.

14. (a) (i) Calculate the net weight and gross weight for the component shown in Fig. 14 (a). Density of material used is 7.86 gm/cc and losses = 25% of net weight. (6)



All dimensions are in mm

Figure 14 (a)

Also calculate

(ii) Length of 14 mm dia bar required to forge one component. (4)

(iii) Cost of forging/piece if:

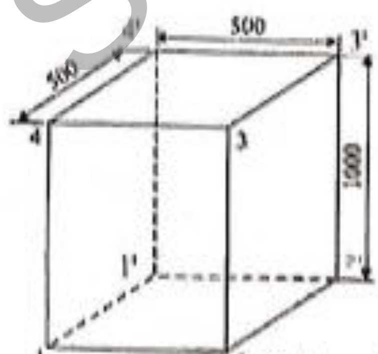
Material cost = Rs. 80 per kg

Labour cost = Rs. 5 per piece

Overheads = 150 percent of labour cost. (6)

Or

(b) A container open on one side of size 0.5 m × 0.5 m × 1 m is to be fabricated from 6 mm thick plates Fig. 14 (b). The plate metal weighs 8 gm/cc. If the joints are to be welded, make calculations for the cost of container.



All dimensions are in mm

Figure 14 (b)

The relevant data is:

Cost of plate	= Rs. 16 per kg
Sheet metal scarp (wastage)	= 5 percent of material
Cost of labour	= 10 percent of sheet metal cost
Cost of welding material	= Rs. 20 per meter of weld.

15. (a) Using the data in Table and the drawing in Fig. 15(a), determine suitable speeds (rev/min) and feeds (mm/rev) and the total machining time for all operations listed. The raw material billet is $\phi 85 \times 250$ mm and the machining allowance to be used is 5 mm. The surface cutting speeds and feed rate when machining brass using HSS can be selected within the range 50—110 m/min and 0.15–8 mm/rev.

Note: Select the maximum and minimum values within the range for roughing and finishing operations respectively.

Operation description	Tooling description	Cutting condition
Face end	HSS turning tool	Finish in one pass
Turn $\phi 80\,mm \times 160\,mm$	HSS turning tool	One roughing cut, one finishing cut of 0.4 mm
Turn $\phi 70\,mm \times 100\,mm$	HSS turning tool	One roughing cut, one finishing cut of 0.4 mm
Turn $\phi 60\,mm \times 60\,mm$	HSS turning tool	One roughing cut, one finishing cut of 0.4 mm
Parting off	HSS parting off tool	Finish in one pass

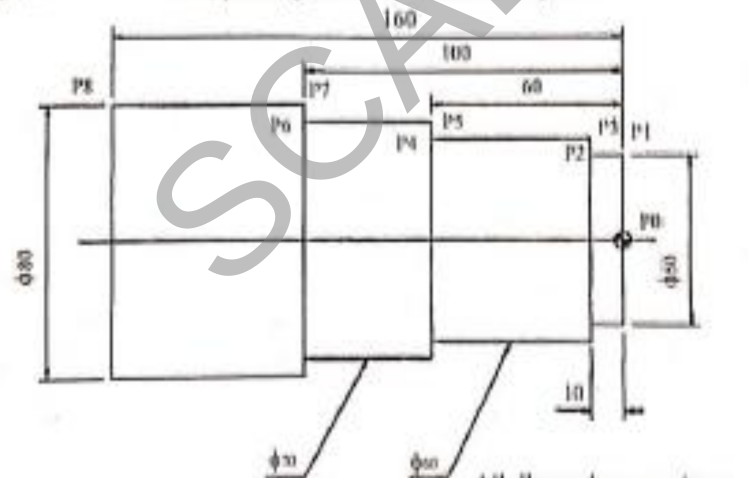
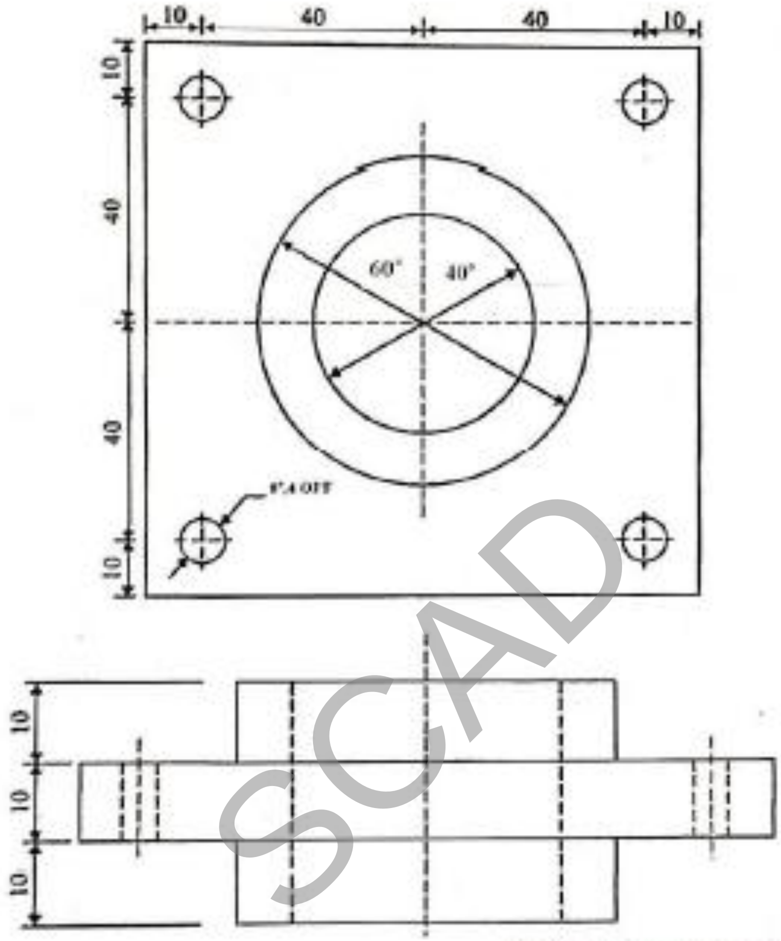


Figure 15 (a)

Or

(b) Calculate the machining time to drill four 8 mm dia holes and one 40 mm dia central hole in the flange shown in Fig. 15 (b) 20 mm dia hole is drilled first and then enlarged to 40mm hole. Take cutting speed 10 m/min, feed for 8mm drill 0.1 mm/rev, for 20mm drill feed is 0.2 mm/rev and for 40 mm drill feed is 0.4 mm/rev.



All dimensions are in mm

Figure 15 (b)