- WEIGHTED POINT METHOD
- In recent years, systematic methods have been developed for selection of materials. One such method is the weighted point method. It consists of the following four steps:
- (i) The fi rst step consists of the study of the given application and preparing a list of the desirable properties of the material for the application.
- (ii) The desirable properties are then assigned values. The approximate range of these properties, such as yield strength, endurance strength, hardness, etc., is specifi ed.
- (iii) The desirable properties are divided into two groups—Go-no-go parameters and discriminating parameters. The Go-nogo parameters are the constraints. As an example, if a material is not available, or if it cannot be fabricated into a given shape, it is totally rejected. This is a screening stepand only those materials, which meet the essential requirement, are allowed further consideration.
- (iv) The discriminating parameters are the properties of the material which can be given quantitative values. The weightage depends upon the importance of that particular property in the given application. As an example, in case of a connecting rod, the endurance strength may be given a weighting factor of 5, compared with the cost having a weighting factor of 1. In general, the weighting factor varies from 1 to 5, with 1 for the poorest and 5 for the best. Then each property of the candidate material is assigned a rating, ranging from 1 to 5, depending upon how closely it meets the requirements. These ratings are multiplied by the weighting factors for each property. These numbers are fi nally added and materials are arranged in descending order of their total points. The main drawback of this method is the skill and judgement required for assigning the weightage. The results may not be numerically correct; however, one can get a priority list of materials for a given application.

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- The manufacturing processes can be broadly classifi ed into the following three categories:
- (i) Casting Processes In these processes, molten metals such as cast iron, copper, aluminium or nonmetals like plastic are poured into the mould and solidifi ed into the desired shape, e.g., housing of gear box, fl ywheel with rim and spokes, machine tool beds and guides.
- (ii) Deformation Processes In these processes, a metal, either hot or cold, is plastically deformed into the desired shape. Forging, rolling, extrusion, press working are the examples of deformation processes. The products include connecting rods, crankshafts, I-section beams, car bodies and springs.
- (iii) Material Removal or Cutting Processes In these processes, the material is removed by means of sharp cutting tools. Turning, milling, drilling, shaping, planing, grinding, shaving and lapping are the examples of material removal processes.

- The products include transmission shafts, keys, bolts and nuts. In addition, there are joining processes like bolting, welding and riveting. They are essential for the assembly of the product.
- Many times, a number of manufacturing methods are available to make the component. In such cases, the optimum manufacturing method is selected by considering the following factors:
- (i) Material of the component
- (ii) Cost of manufacture
- (iii) Geometric shape of the component
- (iv) Surface fi nish and tolerances required
- (v) Volume of production

- One of the easiest methods to convert the raw material into the fi nished component is casting. There are several casting processes such as sand casting, shell-mould casting, permanent mould casting, die casting, centrifugal casting or investment casting. Sand casting is the most popular casting process. The advantages of sand casting process as a manufacturing method are as follows:
- (i) The tooling required for casting process is relatively simple and inexpensive. Thisreduces the cost. Sand casting is one of the cheapest methods of manufacturing.
- (ii) Almost any metal such as cast iron, aluminium, brass or bronze can be cast by this method.
- (iii) Any component, even with a complex shape, can be cast. There is no limit on the size of the component. Even large components can be cast.
- The disadvantages of the sand casting process are as follows:
- (i) It is not possible to achieve close tolerances for cast components. Therefore, cast components require additional machining and fi nishing, which increases cost.
- (ii) Cast components have a rough surface fi nish.
- (iii) Long and thin sections or projections are not possible for cast components. One of the important deformation processes is forging. In forging, the metal in the plastic stage, rather than in the molten stage, is forced to fl ow into the desired shape. There are a number of forging processes such as hand forging, drop forging, press forging or upset forging.
- The dropforging method accounts for more than 80% of the forged components. The advantages of forging as a manufacturing method are as follows:
- (i) The fi brelines of a forged component can be arranged in a predetermined way to suit the direction of external forces that will act on the component when in service. Therefore, forged components have inherent strength and toughness. They are ideally suitable for applications like connecting rods and crankshafts.
- (ii) In forging, there is relatively good utilisation of material compared with machining.
- (iii) Forged components can be provided with thin sections, without reducing the strength. This results in lightweight construction.
- (iv) The tolerances of forged parts can be held between close limits, which reduce the volume of material removal during the fi nal fi nishing stages.
- (v) The forging process has a rapid production rate and good reproducibility. The disadvantages of the forging process are as follows: (i) Forging is a costly manufacturing method. The equipment and tooling required for forging is costly. (ii) Forging becomes economical only when the parts are manufactured on a large scale.

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- Material removal or cutting processes are the most versatile and most common manufacturing methods. Almost every component is subjected to some kind of machining operation in its fi nal fi nishing stage.
- Metal removal processes are broadly divided into three categories—metal cutting processes, grinding processes and unconventional machining processes.
- Depending upon the shape of machined surfaces, the metal removal processes are selected in the following way:
- (i) For machining fl at surfaces, shaping, planing and milling processes are usually used. A fl at surface can also be machined on a lathe by the facing operation. Broaching and surface grinding are fi nishing methods for fl at surfaces.
- (ii) For machining external cylindrical surface, turning on lathe is a popular method. Such surfaces are fi nished by the cylindrical grinding method.
- (iii) For machining internal cylindrical surfaces, drilling and boring are popular processes.
- Reaming and cylindrical grinding are fi nishing processes.
- The advantages of metal cutting processes as a manufacturing method are as follows:
- (i) Almost any metal can be machined.
- (ii) It is possible to achieve close tolerances for machined components.
- (iii) Machined components have a good surface fi nish. The disadvantages of machining processes are as follows:
- (i) Machining processes are costly and the rate of production is low compared with casting or forging.
- (ii) It is not possible to machine thin sections or projections.
- (iii) There is wastage of material during material removal process.
- In drilling operation, the cost of the hole increases linearly with the depth of the hole. However, when the depth is more than three times the diameter, the cost increases more rapidly.

- DESIGN CONSIDERATIONS OF CASTINGS
- Always Keep the Stressed Areas of the Part in Compression
- Round All External Corners
- Wherever Possible, the Section Thickness throughout should be Held as Uniform as Compatible with Overall Design Considerations
- Avoid Concentration of Metal at the Junctions
- Avoid Very Thin Sections
- Shot Blast the Parts wherever Possible