UNIT 5
PRODUCTION COST ESTIMATION

5.1 ESTIMATION OF MATERIAL COST 5.1.1 Determination of Material Cost

To calculate the material cost of the product the first step is to study drawing of the product and split it into simple standard geometrical shapes and to find the volume of the material in the product and then to find the weight. The volume is multiplied by density of the metal used in the product. The exact procedure to find the material cost is like this:

1. Study the drawing carefully and break up the component into simple geometrical shapes. (Cubes, prisms, cylinders, etc.)
2. Add the necessary machining allowances on all sides which are to be machined.
3. Determine the volume of each part by applying the formulae of mensuration.
4. Add the volumes of all the simple components to get total volume of the product.
5. Multiply the total volume of the product by the density of the material to get the weight of the material.
6. Find out the cost of the material by multiplying the cost per unit weight to the total weight of the material.

5.1.2 Mensuration in Estimating Introduction

Mensuration is the science which deals with the calculation of length of lines, areas of surfaces and volumes of solids by means of mathematical rules and formulae. An estimator is often required to calculate the length, area of volume of a job he is going to perform.

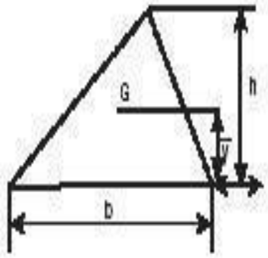
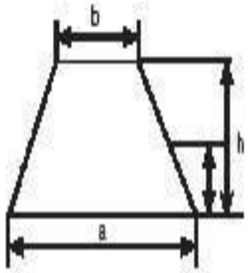
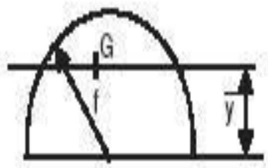
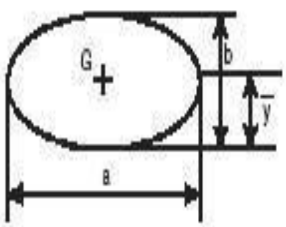
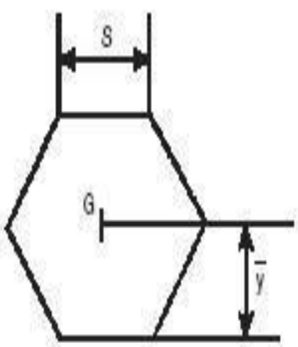
Hence, he must be thoroughly acquainted with the rules and formulae of mensuration. The general formulae for calculating the volume of a simple solid having a uniform cross sectional area throughout in the direction normal to the section considered, is to find the product of the cross-sectional area and the length of the solid in the direction normal to the section considered.

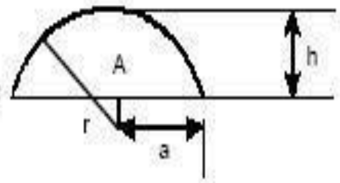
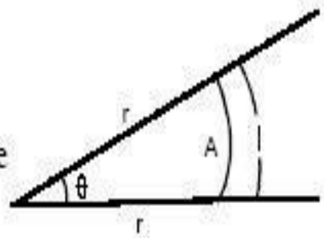
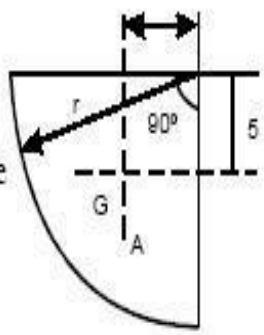
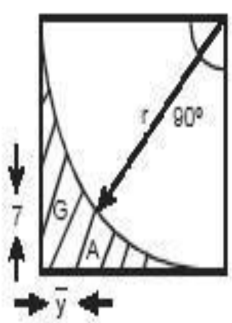
To calculate the volume of a complex solid, it should be divided into a number of sample geometric solids. The volume of all these parts are calculated separately and then added together to get the total volume.

The volume of a solid of revolution, as generated by the rotation of a plane area about a given axis in its plane, is equal to the product of the area of the revolving section and the length of the path covered by its centroid in describing a circle about the axis.

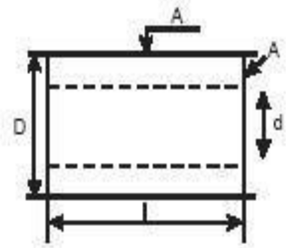
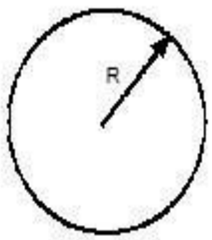
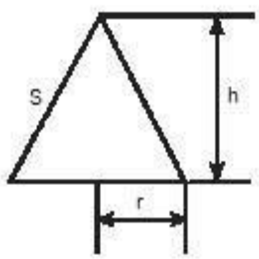
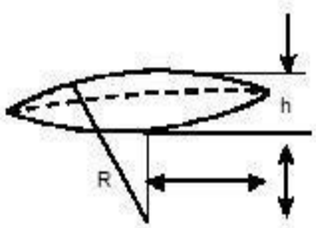
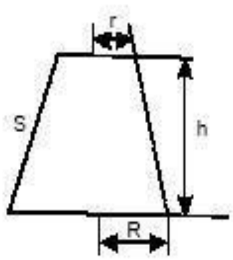
This theorem was given by Guldinus. Volume of a circular ring, a half-round rib surrounding the boss of a fly wheel, and V groove of a V-belt pulley may be calculated by Guildinus theorem.

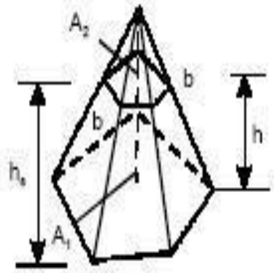
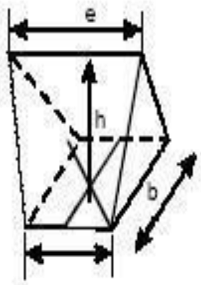
Centroids and area of plane figures

Name	*Figure*	*Centroid*	*Surface area*
Triangle		$\bar{y} = \frac{h}{3}$	$A = \frac{1}{2} bh$
Trapezium		$\bar{y} = \frac{h\ 2a + b}{3\ a + b}$	$A = \frac{1}{2}\left(a + b\right) h$
Semi circle		$\bar{y} = \frac{4r}{3\pi}$	$A = \frac{\pi r^2}{4}$
Ellipse		$\bar{y} = \frac{b}{2}$	$A = \frac{\pi ab}{4}$
Regular hexagon		$\bar{y} = \frac{\sqrt{3}}{2} S$	$A = \frac{3\sqrt{3}}{2} S^2$

Name	*Figure*	*Centroid*	*Surface area (A)*
Segment of a circle		-	$A = \frac{4}{3} h \sqrt{a^2 + \frac{2}{5} h^2}$
Sector of a circle		-	$A = \frac{1}{2} l t$ $= \frac{\theta}{360°} \pi r (\theta \text{ in degree})$
Quadrant of a circle		$\bar{x} = \bar{y} = \frac{4r}{3\pi}$	$A = \frac{\pi r^2}{4}$
Circular fillet		$\bar{x} = \bar{y} = 0.223\ r$	$A = r^2 - \frac{\pi r^2}{4}$ $= \frac{1}{5} r^2$

Volumes and surface areas of solids

Name	*Figure*	*Surface area (A)*	*Volume (V)*
Hollow cylinder		Outer curved surface area $A = \pi Dt$ Flat surface area on each end $A^1 = \frac{\pi}{4}\left(D^2 - d^2\right)$	$V = \frac{\pi}{4}\left(D^2 - d^2\right) t$
Right sphere		$A = 4\pi R^2$	$V = \frac{\pi}{3} \pi R^3$
Right circular cone		Curve surface area $A = \pi r S$ $= \pi r\sqrt{r^2 + h^2}$ $\left[S = \sqrt{r^2 + h^2}\right]$	$V = \frac{1}{3} \pi r^2 h$
Segment of a sphere		Curved surface area $A = 2\pi Rh$	$V = \frac{\pi h}{6}\left[3r^2 + h^2\right]$ $= \frac{\pi h^2}{3}\left[3R - h\right]$
Right truncated cone		Curved surface $A = \pi\,(R + r)3$ [When S = Slant height] $= \sqrt{\left\{l(R - r)^2 + h^2\right\}}$	$V = \frac{\pi h}{3}$ $\left[R^2 + r^2 + Rr\right]$

Regular truncated pyramid		Slant surface area $A = \frac{nhs}{2}(a + b)$ n = Number of sides h_s = Perp. distance between parallel lines ab along the slant surface of truncated pyramid.	$V = \frac{h}{3}$ $\left[A_1 + A_2 + \sqrt{A_1 A_2}\right]$ A_1 = Base area A_2 = Top flat area h = Vertical height
Wedge			$V = \frac{bh}{b}(2l + e)$