POSTAL BOOK PACKAGE 2025

MECHANICAL ENGINEERING

CONVENTIONAL Practice Sets

CONTENTS

INDUSTRIAL ENGINEERING

1 CHAPTER
Break Even Analysis

Practice Questions : Level-I

Q.1 A company manufactures pocket transistors. The details of its monthly expenditure are as follow:

Direct material - ₹10000

Direct labour - 200 hours at the rate of ₹5 per hour

125 hours at the rate of ₹4 per hour

Applied overheads (factory overheads) = 10% of prime cost

Other overheads = 10% of works cost

Profit = 20% of total cost

Number of units manufactured per month = 200

Estimate the selling price unit.

Solution:

$$\text{Prime cost} = \text{Cost of direct material} + \text{Cost of direct labour} + \text{Direct expenses}$$
$$= 10000 + 200 \times 5 + 125 \times 4 = ₹11500$$

$$\text{Factory overheads} = \frac{10}{100} \times 11500 = ₹1150$$

$$\text{Works cost (Factory cost)} = \text{Prime cost} + \text{Factory overheads}$$
$$= 11500 + 1150 = ₹12650$$

$$\text{Other overheads} = \frac{10}{100} \times 12650 = ₹1265$$

$$\text{Total cost} = ₹12650 + ₹1265 = ₹13915$$

$$\text{Profit} = \frac{20}{100} \times 13915 = ₹2783$$

$$\text{Selling price for 200 units} = 13915 + 2783 = ₹16698$$

$$\text{Selling price per unit} = \frac{16698}{200} = ₹83.49$$

Q.2 A standard machine tool and an automatic machine tool are being compared for the production of a component. Following data refers to the two machines.

	Standard Machine tool	Automatic Machine tool
Setup time	30 min.	2 hours
Machining time per piece	22 min.	5 min
Machine rate	Rs. 200 per hour	Rs. 800 per hours

What is the breakeven production batch size above which the automatic machine tool will be economical to use?

Practice Questions : Level-II

Q.8 The P/V ratio of Alpha Pvt. Ltd. is 50% and Margin of Safety is 40%. The company sold 500 units for ₹500000. Calculate:

(i) Break even point (in units)

(ii) Fixed cost

(iii) Profit earned at present level of sales.

(iv) Sales in units to earn a profit of 10% on sales.

(v) Units to be sold to earn a target net profit of ₹ 500000 for the next year.

(vi) Selling price per unit if BEP is to be brought down by 50 units.

Solution:

Selling price per unit, $s = \frac{500000}{500} = ₹1000$ per unit

$$\left(\frac{P}{V}\right)_{ratio} = \frac{s-v}{s}\times 100$$

$$50 = \frac{1000-v}{1000}\times 100$$

Variable cost per unit, $v = ₹\ 500$

(i) Given: Total sale, $x = x_{BEP} + 0.4x$,

$$x_{BEP} = 0.6x = 0.6 \times 500$$

$$x_{BEP} = 300 \text{ units}$$

(ii) $$x_{BEP} = \frac{F}{s-v}$$

$$300 = \frac{F}{1000-500}$$

Fixed cost, $F = ₹150000$

(iii) Sale in units, $$x = \frac{P+F}{s-v}$$

$$500 = \frac{P+150000}{1000-500}$$

Profit at present level of sales, $P = ₹100000$

(iv) $$x' = \frac{P'+F}{s-v} = \frac{0.1sx'+150000}{1000-500} = \frac{0.1\times 1000x'+150000}{500}$$

$$500x' = 100x' + 150000$$

$$x' = 375 \text{ units}$$

(v) $$x'' = \frac{P''+F}{s-v} = \frac{500000+150000}{1000-500} = 1300 \text{ units}$$

(vi) $$(x_{BEP})_{new} = (x_{BEP})_{old} - 50 = 300 - 50 = 250 \text{ units}$$

$$(x_{BEP})_{new} = \frac{F}{s_{new}-v}$$

$$\Rightarrow \quad 250 = \frac{150000}{s_{new}-500}$$

$$s_{new} = ₹1100 \text{ per unit}$$

9 CHAPTER

Maintenance Engineering

Practice Questions : Level-I

Q.1 A module of an automatic machine has 10 components in series. Each component has an exponential time to failure distribution with a constant failure rate of 0.05 per 4000 hours. What is the reliability of each component and the module after 2000 hours of operation? What is the mean time to failure of the module?

Solution:

The failure rate of each component (λ) is given by

$$\lambda = \frac{0.05}{4000} = 1.25 \times 10^{-5} \text{ per hour.}$$

The reliability (r) of each component after 2000 hours of operation:

$$r = e^{-\lambda t} = e^{-0.0000125(2000)} = 0.975$$

The reliability (R) of the module is given by

$$R = r^{10} = (0.975)^{10} = 0.779$$

The mean time to failure of the module $= \frac{1}{n\lambda} = \frac{1}{10} \times \frac{1}{(1.25 \times 10^{-5})} = 8000$ Hrs.

Q.2 A electronic circuit consists of 15 valves, 20 resistors and 10 capacitors all connected in a series. The components in each category are identical and their failure times are found to follow exponential distribution with the following mean failure times:

	Valves	Resistors	Capacitors
Mean failure time (hrs.)	10000	20000	20000

What is the mean time between failure of the system? What is its reliability for 100 hours?

Solution:

Let the failure rates of valves, resistors and capacitors be denoted by λ_1, λ_2 and λ_3 respectively, which are the parameters of exponential distribution. So, we have

$$\lambda_1 = \frac{1}{10000},\ \lambda_2 = \frac{1}{20000} \text{ and } \lambda_3 = \frac{1}{20000}$$

$$\text{MTBF} = \frac{1}{[15\lambda_1 + 20\lambda_2 + 10\lambda_3]} = \left[\frac{15}{10000} + \frac{20}{20000} + \frac{10}{20000}\right]^{-1}$$

$$= \frac{20000}{(30 + 20 + 10)} = 333.33 \text{ hours}$$

the reliability R(t) of the system for 100 hours is

$$R(t) = e^{-100/333.33} = e^{-0.33} = 0.74082$$