

V.S.B ENGINEERING COLLEGE, KARUR
DEPARTMENT OF MECHANICAL ENGINEERING

Two Mark Questions with answers

Academic Year : 2017-2018 (Even Semesters)

Year of Study : IV Year

ADVANCED IC ENGINES
UNIT – 1 SPARK IGNITION ENGINES

1. What are the stages of combustion in a SI engines?

The stages of combustion in a SI engines are: FIRST STAGE: Ignition lag (or) preparation phase SECOND STAGE: propagation of flame
THIRD STAGE: After burning

2. What are the various factors that affect the flame speed?

a) Turbulence b) F/A ratio c) T, P d) Compression ratio e) Engine speed, size & output

3. Define normal combustion?

In normal combustion, the flame initiated by the spark travels across the combustion chamber in a fairly uniform manner.

4. Define abnormal combustion and its consequences?

Under certain operating conditions the combustion deviates from its normal Course leading to loss of performance and possible damage to the engine are termed as abnormal combustion (or) knocking combustion. Consequences are (1). Loss of power (2).Recurring preignition (3). Mechanical damage to the engine

5. What is equivalence ratio?

The ratio of the actual fuel-air ratio to the stoichiometric fuel air ratio.

6. Short note on SI engine equivalence ratio requirements?

In a homogeneous mixture with equivalence ratio close to 1.0 the flame speed is normally of the order of 40cm/s .However in a SI engine the maximum flame speed is obtained when is between 1.1 and 1.2 (i.e.) when the mixture is slightly richer than stoichiometric.

7. Write the desirable qualities for SI engine fuel?

In order to avoid or inhibit detonation, a high auto ignition temperature and a long ignition lag are the desirable qualities for SI engine fuel.

8. Explain the type of vibration produced when auto ignition occurs.

Two different vibrations are produced.

1. In one case, a large amount of mixture may auto ignite giving use to a very rapid increase in pressure throughout the chamber and there will be a direct blow on free vibration of the engine parts

2. In another case, larger pressure differences may exist in the combustion chamber and the resulting gas vibration can force the walls of the chamber to vibrate at the same frequency as the gas.

9. What is the method to detect the phenomenon of knocking?

The scientific method to detect the phenomenon of knocking is to use a pressure transfer transducer. This transducer is connected, usually to a cathode ray oscilloscope. Thus pressure-time traces can be obtained from the pressure transducer.

10. List out some of the knock limited parameters?

The knock limited parameters are:

1. Knock limited compression ratio
2. Knock limited into pressure
3. Knock limited Indicated mean effective pressure. (Klimep)

11. Define performance number?

Performance number is defined as the ratio. Of Knock limited Indicated mean effective pressure with the sample fuel to knock limited Indicated mean effective pressure with ISO-OCTANE .when the inlet pressure is kept constant.

12. List the factors that are involved in either producing (or) preventing knock.

The factors that are involved in either producing (or) preventing knock are temperature, pressure, density of the unburned charge and the time factor.

13. List the parameters which are affecting knock in SI engine?

The parameters which are directly (or) indirectly connected with knocking are inlet temperature of mixture compression ratio, mass of inducted charge, power output of the engine.

14. List the parameters in time factors that reduce the knocking?

Parameters are turbulence, engine speed, flame travel distance, combustion chamber shape and location of spark plug.

15. List the composition factors in the knocking?

Air –fuel ratio and octane value of the fuel are the composition factors.

16. What are the objectives to be kept in mind during design of combustion chamber?

General objectives are (a) Smooth engine operation (b) Moderate rate of pressure rise (c) Reducing the possibility of knocking (d) High power out put and thermal efficiency

17. What are the factors to be considered to obtain high thermal efficiency?

Following are the factors:

1. A high volumetric efficiency.
2. Anti knock characteristic must be improved.
3. Compact combustion chamber reduces heat loss during combustion increases the thermal efficiency.

18. Write the different types of combustion chambering SI engine?

T-Head type, L- Head type, I- Head type, F- Head type.

19. What are the components required in the fuel injection system?

Components are –pumping element, metering element, mixing element, distributing element, Timing control, and ambient control.

20. What are the advantages of fuel –injection in an SI engine?

Advantages are:

1. Increased volumetric efficiency. 2. Better thermal efficiency 3. Lower exhaust emissions
4. High quality fuel distribution.

21. List the drawbacks of the carburetion?

1. Non uniform distribution of mixture in multi cylinder engines. 2. Loss of volumetric efficiency due to retraction for mixture flow and possibility of back firing.

22. What are the functional requirements of an injection system?

1. Accurate mixing of the fuel injected per cycle. 2. Timing the injection of the fuel. 3. Proper atomization of fuel into fine droplets 4. Proper spray pattern. 5. No lag during beginning and end of injection.

23. List some of the important requirements of an automobile carburetor?

1. Ease of starting the engine, particularly under low ambient conditions. 2. Good and quick acceleration of the engine. 3. Good fuel economy. 4. Ensuring full torque at low speeds.

24. What are the general types of carburetors?

Types are UPDRAUGHT, DOWN DRAUGHT, and CROSS DRAUGHT.

25. What are the essential parts, compensating device and additional system (modern) carburetors?

Parts – fuel strainer, float chamber, main metering and idling system, the choke & the throttle.

Compensating device- Air –bleed jet, compensating jet, Emulsion tube, auxiliary valve and port, back suction control mechanism.

Additional system–Ant dieseling, richer coasting, acceleration pump and economic (or) power enrichment system.

26. Define carburetion?

The process of formation of a combustible fuel –air mixture by mixing the proper amount of fuel with air before admission to engine cylinder is called carburetion.

27. What are the factors effecting carburetion?

1. The engine speed 2. The vaporization characteristic of fuel 3. The temperature of the incoming air 4. The design of the carburetor

28. What are the different types air –fuel mixtures?

1. Chemically correct mixture 2. Rich mixture 3. Lean mixture.

29. What are the different ranges of throttle operation?

1. Idling 2. Cruising 3. High power.

UNIT – II COMPRESSION IGNITION ENGINES

1. What are the stages of combustion in C.I engine?

The stages of combustion in C.I engine are four stages:

Stage I: ignition delay period (preparatory phase)

Stage 2: Period of rapid combustion.

Stage 3: Period of controlled combustion.

Stage 4: Period of after burning

2. What is ignition delay period?

The fuel does not ignite immediately upon injection into the combustion chamber. There is a definite period of inactivity between the time when the first droplet of fuel hits the hot air in the combustion chamber and the time it starts through the actual burning phase. This period is known as ignition delay period.

3. What are two delays occur in ignition delay period?

The two delays occur in ignition delay period are the physically delay and chemically delay. Physical delay is the time between the beginning of injection and the attainment of chemical reaction conditions. Chemical delay is the reaction starts slowly and then accelerates until the inflammation or ignition takes place.

4. List the factors affecting the delay period?

The factors affecting the delay period are: 1. Compression ratio. 2. Atomization of the fuel. 3. Quality of the fuel. 4. Intake temperature and pressure.

5. Explain the effect of quality of fuel factor on the delay period?

Self-ignition temperature is the most important property of the fuel which affects the delay period. A lower self-ignition temperature and fuel with higher cetane number give lower delay period and smooth engine operation. Other properties of the fuel which affects the delay period are latent heat, viscosity and surface tension.

6. Give a comparative statement various characteristics that reduces knocking in S.I and C.I engine (any four)?

S.No	CHARACTERISTICS	S.I ENGINE	C.I ENGINE
1	Ignition temperature of fuel	High	low
2	Ignition delay	long	short
3	Compression ratio	Low	high
4	Inlet temperature and pressure	Low	HIGH

7. Write the classification of combustion chamber in C.I engine?

Combustion chamber in C.I engine is classified into two categories: 1. Direct-injection type
2. Indirect-injection type.

8. What is called direct injection type of combustion chamber?

Direct injection type of combustion chamber is also called an open combustion In this type the entire volume of the combustion chamber is located in the main cylinder and the fuel is injected into this volume.

9. What are the types of open combustion chamber?

In open combustion chamber there are many designs some are a). Shallow depth chamber
b).Hemispherical chamber c).Cylindrical chamber d).Toroidal chamber

10. What are the advantages and disadvantages of open combustion chamber type?

Advantages:

1. Minimum heat loss during compression because of lower surface area to volume ratio

2. No cold starting problems 3. Fine atomization because of multi hole nozzle

Disadvantages:

1. High fuel injection pressure required and hence complex design of fuel injection pump
2. Necessity of accurate metering of fuel by the injection system, particularly for small engines.

11. What is indirect injection type of combustion?

Indirect injection type of combustion chamber in which the combustion space is divided in to two or more distinct compartment connected by restricts passages. This creates considerable pressure difference between them during the combustion process.

12. Write the classification of indirect injection chamber (divided combustion chamber)

Classification of divided combustion chamber is

- a. Swirl chamber – in which compression swirl is generation.
- b. Precombustion chamber – in which combustion swirl is induced.
- c. Air cell chamber – in which both compression and combustion swirl are induced.

13. What are the applications of swirl chamber?

Swirl chamber type finds application

- a. Where fuel quality is difficult to control
- b. Where reliability under adverse condition is more important than fuel economy
- c. Use of single hole of larger diameter for the fuel spray nozzle is often important consideration for the choice of fluid chamber engine.

14.) List the advantages and drawbacks of indirect injection chamber: Advantages:

1. Injection pressure required is low 2. Direction of spraying is not very important

Disadvantages:

1. Poor cold starting performance required heater plugs 2. Specific fuel consumption is high

15. Why specific fuel consumption is high in indirect injection type combustion chamber:

Specific fuel consumption is high because there is a loss of pressure due to air motion through the duct and heat loss due to large heat transfer area.

16. What is turbo charging?

Energy available in the engines exhaust gas is used to drive the the turbocharger compressor, which raises the inlet fluid density prior to entry to each engine cylinder. This is called turbo charging.

17. What are the major parts of a turbocharger?

The major parts of a turbocharger are turbine wheel, turbine housing, turbo shaft, compressor wheel, compressor housing and bearing housing.

18. Explain the term turbo lag.

In case of turbo charging there is a phenomenon called turbo lag, which refers to the short delay period before the boost or manifold pressure, increase. This is due to the time the turbocharger assembly takes the exhaust gases to accelerate the turbine and compressor wheel to speed up.

19. Explain the function of waste gate.

In the turbocharger assembly there is a control unit called waste gate. It is a diaphragm operated valve that can bypass part of the gases around the turbine wheel when manifold pressure is quite high this unit limits the maximum boost pressure to prevent detonation in S.I engines and engine damage.

20. Why there is a large pressure differences across the injector nozzle are required?

The fuel is introduced in to the cylinder of a diesel engine through a nozzle with a large pressure differences across the nozzle jet will enter the chamber at high velocity to 1. Atomize in to small sized droplets to enables rapid evaporation and
2. Traverse the combustion chamber in the time available and fully utilize the air charge.

21. What is called break up length?

The liquid column bearing the nozzle disintegrates within the cylinder over a finite Length called the break up length in to drops of different sizes.

22. What are the different designs of nozzle used?

The different design of nozzle used is single orifice, multi orifice, throttle or pintle depending on the needs of the combustion system employed.

23. What are the two types of photographic technique used?

To distinguish the liquid – containing core of the jet and the extracts of the fuel vapor region of the spray, which surrounds the liquid core, two types of photographic technique used are backlighting and shadow graph.

24. Explain photographic techniques method.

Back lighting identifies region where sufficient liquid fuel (as ligaments or drops) is present to attenuate the light.

The shadowgraph technique responds to density gradients in the test section so it identifies regions where fuel vapor exists.

25. List the droplet size depends on various factors.

The droplet sizes depends on various factors are

1. Mean droplet size decreases with increases in a. Injection pressure b. air density
2. Mean droplet size increases with increases in fuel viscosity.
3. Size of droplets increases with increases in the size of the orifice.

26. Define flame development angle.

The crank angle interval between the spark discharge and the time when a small but significant fraction of the cylinder mass has burned or fuel chemical energy has been released

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27. Define rapid burning angle.

The crank angle interval required to burn the bulk of the charge is defined as the interval between the end of the flame development stage and the end of the flame propagation process.

UNIT - III ENGINE EXHAUST EMISSION CONTROL

1. What are the major exhaust emissions?

The major exhaust emissions are

- a. Unburnt hydrocarbons (HC) b. Oxides of carbon (co and co₂)

- c. Oxides of nitrogen (NO and NO₂)
- d. Oxides of sulphur (SO₂ and SO₃)
- e. Particulates
- f. Soot and smoke

2. What are the causes for hydrocarbon emission from S.I engine?

The causes for hydro carbon emission from S.I engine are

1. Incomplete combustion.
2. Crevice volume and flow in crevices.
3. Leakage past the exhaust valve.
4. Valve over lap.
5. Deposits on walls.
6. Oil on combustion chamber walls.

3. What are the reasons for incomplete combustion in SI engine?

Incomplete combustion is due to

- a. Improper mixing due to incomplete mixing of the air and fuel. Some fuel particles do not find the oxygen to react with this cause the emissions.
- b. Flame quenching: As the flame goes very close to the walls it gets quenched at the walls leaving a small volume of un reacted air fuel mixture.

4. What are the reasons for flame quenching?

The reason for flame quenching is the expansion of gases. (i) As the piston moves down from TDC to BDC during power stroke, expansion of the gases lowers both pressure and temperature within the cylinder. This makes combustion slow and finally quenches the flame and causes the emissions. (ii) High exhaust gas contamination causes poor combustion and which in turn causes quenching during expansion. (iii) As the flame goes very close to the walls it gets quenched at the walls leaving a small volume of un reacted air-fuel mixture.

5. How the oil consumption increases in IC engines and what are the effects?

Often as engines ages, due o wear, clearance between the pistons and cylinder wall increases. This increases oil consumption contributes to increases in the emissions in three ways.

- a. There is an added crevices volume.
- b. There is added absorption – desorption of fuel in the thicker oil film on cylinder walls
- c. There is oil burned in the combustion process

6. Write a short note on carbon monoxide emissions.

Carbon monoxide is a colorless and odorless but a poisonous gas. It is generated in an engine when it is operated with a fuel rich equivalence ratio. Poor mixing, local rich regions, and incomplete combustion will also be the source for co emissions.

7. What is photochemical smog?

NO_x is the primary causes of photochemical smog, Smog is formed by the photochemical reaction of automobiles exhaust and atmospheric air in the presence of sunlight.

NO₂ + energy from sunlight ---- NO + O +smog

8. What are soot particles?

Soot particles are clusters of solid carbon sheres. These spheres have diameter from 9nm to 90nm (1nm = 10⁻⁹). But most of them are within the range of 15 – 30nm. The spheres are solid carbon with HC and traces of other components absorbed on the surface. Single soot particles may contain up to 5000 carbon spheres.

9. Which is the most effective after treatment for reducing engine emissions?

The catalytic converter is the most effective after treatment for reducing engine emissions found on most automobiles. Co can be oxidized to CO₂ and H₂O in exhaust system and thermal converters if the temperature is held at 600- 700⁰ C. If certain catalysts are present,

the temperature needed to sustain these oxidation processes is reduced to 250 - 300⁰C, making for a much more attractive system.

10. What is a catalyst?

A catalyst is a substance that accelerates chemical reaction by lowering the energy needed for it to proceed. The catalyst is not consumed in the reaction and so functions indefinitely unless degraded by heat age contaminants or other factors.

11. List the materials used as catalyst.

The catalyst materials most commonly used are a. platinum **b.** palladium **c.** rhodium.

12. Why catalytic converter called as three way converters?

Catalytic converters are called as three way converters because they are used to reduce the concentration of CO, HC and NO_x in the exhaust.

13. What are the types of ceramic structure used in catalytic convertor?

Inside the container is a process ceramic structure through which the exhaust gas flows.

- a. The ceramic is a single honey comb structure with many flow passages.
- b. Some converters use loose granular ceramic with the gas passing between the packed spheres.

14. List out the drawbacks of catalytic converters.

- a. Sulphur offers unique problems for catalytic converters some catalyst promote the conversion of SO₂ to SO₃ which eventually converted to sulphuric acid. This degrades the catalytic convertor and contributes to acid rain.
- b.** Catalytic converters are not very efficient when they are cold. When an engine is started after not being operated for several hours it takes several minute for the converter to reach an efficient operating temperature called as cold start up problem.

15. What are the methods of catalytic converters preheating?

The methods of catalytic converters preheating included the following

- a. By locating the converters close to the engine
- b. By having super insulation
- c. By employing electric preheating
- d. By using flame heating
- e. Incorporating thermal batteries.

16. List the invisible and visible emission.

Invisible emission: Water vapor, carbon dioxide, oxides of nitrogen, unburnt hydrocarbons, carbon monoxide, aldehydes.

Visible emission: Smoke, particulate.

17. What are the methods of measuring the following emission?

- a.** Oxides of nitrogen = CHEMILUMINESCENCE ANALYZER
- b.** Carbon monoxide = NON DISPERSIVE INFRARED ANALYZER
- c.** Unburned hydrocarbons = FLAME IONIZATION DETECTOR (FID)

UNIT-IV ALTERNATE FUELS

1. Write the advantage and disadvantage of alcohol as a fuel?

Advantages

1. it is a high octane fuel with antiknock index number (octane number) of over 100.
2. Alcohols have low sulphur content in the fuel.

3. It produces less overall emissions when compared with gasoline

Disadvantages:

1. Alcohols have poor ignition characteristics in general.
2. There is a possibility of vapor lock in fuel delivery system.
3. It has poor cold weather starting characteristics due to low vapor pressure and evaporation.

2. What is the problem with gasoline-alcohol mixture as a fuel?

Problems with gasoline-alcohol mixture as a fuel are the tendency for alcohol to combine with any water present. When this happens the alcohol separates to locally from the gasoline, resulting in a non-homogenous mixture. This causes the engine to run erratically due to the large air-fuel ratio difference between the two fuels.

3. Write the sources for methanol?

Methanol can be obtained from many sources, both fossil and renewable. These include coal, petroleum, natural gas, biomass, wood landfills and even the ocean.

4. Write the source for ethanol?

Ethanol can be made from ethylene (or) from fermentation of grains and sugar. Much of it is made from sugarcane, sugar beets, and even cellulose (wood and paper).

5. What are the techniques of using alcohol in diesel engine fuel?

The techniques of using alcohol in diesel engine are:

1. Alcohol diesel emulsions.
2. Dual fuel injection.
3. Alcohol fumigation.
4. Surface ignition of alcohols.

6. What are the methods are adopted for induction of alcohol into intake manifold?

The methods are adopted for induction of alcohol into intake manifold micro fog unit, pneumatic spray nozzle, vaporizer, carburetor and fuel injector.

7. List the advantages of hydrogen as an IC engine?

Advantages

1. Low emissions.
2. Fuel availability.
3. Fuel leakage to environment is not a pollutant
4. High energy content per volume when stored as a liquid.

8. List the disadvantages of using hydrogen as a fuel?

Disadvantages

- a. Difficult to re fuel.
- b. Fuel cost would be high at present day's technology and availability.
- c. Poor engine volumetric efficiency.
- d. High NO_x emission because of high flame.

9. Write the methods for hydrogen can be used in SI engines?

Hydrogen can be used in SI engines by three methods

- a. By manifold induction
- b. By direct introduction of hydrogen into the cylinder.
- c. By supplementing gasoline.

10. List the advantages and disadvantages of natural gas?

Advantages:

- a. Octane number is around 120, which makes it a very good SI engines fuel.
- b. Low engine emissions
- c. Fuel is fairly abundant worldwide.

Disadvantages:

- a. Low energy density resulting in low engine performance.
- b. Low engine volumetric efficiency because it is a gaseous fuel.
- c. Refueling is a slow process.

11. Write the two types of LPG used in automobiles engine?

Two type of LPG used in automobile engines: One is propane and the other is butane, sometimes in mixture of propane and butane is used as LPG in auto mobile engine.

12. What are the advantages of LPG?

- a. LPG mixes with air at all temperatures.
- b. LPG has high antiknock characteristics.
- c. There is no crack case dilution, because the fuel is in the form of vapor.

13. Write the disadvantages of LPG?

- a. A special fuel feed system is required for liquid petroleum gas.
- b. A good cooling system is quite necessary.
- c. The vehicle weight is increased due to the use of heavy pressure cylinder for storing LPG.

14. Write the improvements required for the LPG vehicle in future?

- a. Effort must be made to have more LPG filling stations at convenient locations, so that LPG tank can be filled up easily.
- b. Safety devices are to be introduced to prevent accidents due to explosion of gas cylinders (or) Leakage in the gas pipes.

UNIT-V RECENT TRENDS

1. What is lean burn engine?

Lean burn engine is a layout of Otto cycle engine designed to permit the combustion of lean air fuel mixture and to obtain simultaneously low emission values as high fuel economy. It is designed to operate effectively in the air fuel ratio **14:1-16:1** to **20:1-22:1**. When the lean compression ratio, combustion chamber shape, ignition system, the lean limit are successfully optimized, the engine is referred to as a lean burn engine.

2. Why lean mixture is preferred in SI engine?

Lean mixture is preferred in SI engine because of the following facts:

- a. Lower pollutants.
- b. Good fuel economy.
- c. Heat transfer losses to the cooling medium are reduced because of lower peak temperatures.
- d. Since lean mixture are less prone to knocking.

3. What are the modifications to be made to convert an existing engine as a lean burn engine?

The modifications to be made to convert an existing engine as a lean burn engine are:

- a. Increasing the compression ratio of the engine to accurate flame propagation.
- b. Increasing the swirl and turbulence of the mixture in order to increase flame speed.
- c. Catalytic activation of the charge in the combustion chamber.

4. How the stratified charge engine can be characterized?

The stratified charge engine can be characterized by the following features:

- a. Relatively high compression ratio
- b. Ability of direct cylinder fuel injection variations to run unthrottled.
- c. Stratification of the charge mixture into distinctly different rich and lean air fuel ratios.

5. List the advantages of the stratified charge engine.

The advantages of the stratified charge engines are:

Low octane fuels (cheaper fuels) can be used at higher compression ratios.

- a. Load control can be achieved without air throttling
- b. Quiet in operation.
- c. Multi fuels give more or less equal performance.

6. What are the main disadvantages of the stratified charge engine?

The main disadvantages of the stratified charge engines are:

- a. Maximum output (from the air in the cylinder (i.e.) complete utilization of air) is not achieved.
- b. The added cost of the injection/modified combustion systems.
- c. Added complication of injection and spark ignition systems.

7. Write short notes on plasma jet ignition system.

The plasma jet ignition system uses a plasma jet spark plug. This system can be considered as a form of electrical torch ignition, since the ignition source is hot jet plasma which project well away from the spark plug. The plasma jet ignition sources is turbulent and electrode less, both desirable features for igniting marginal mixtures.

8. What are the factors that influence the operation of the plasma jet plug?

The factors that can influence the operation of the plasma jet plug are the amount of the applied electrical energy, the rate of energy delivery, the cavity volume, the cavity dimensions, the orifice size, the ambient gas pressure and the quantity of fuel present in the cavity.

9. What are the reasons for automotive engines equipped with gasoline injection system?

Some of the recent automotive engines are equipped with gasoline injection system, instead of a carburetion for the reasons: (1) To have uniform distribution of fuel in a multi cylinder engine. (2) To improve breathing capacity (i.e.) volumetric efficiency. (3) To reduce or eliminate detonation.

10. What are the types of injection systems?

1. Gasoline Direct Injection (GDI) in to the cylinder 2. Port injection (a) timed (b) continuous 3. Manifold injection

11. What are the objectives of the fuel injection system?

The objectives of the fuel injection system are to meter, atomize and uniformly distribute the fuel throughout the air mass in the cylinder.

12. What are the components of injection system?

The components of injection system are:

1. Pumping element
2. Metering element
3. Mixing element
4. Mixture control
5. Timing control

13. Write notes on continuous injection system.

Continuous injection system usually has a rotary pump. The pump maintains the fuel line gauge pressure of about **0.75 to 1.5 bars**. The system injects the fuel through a nozzle located in manifold immediately downstream of the throttle plate.

14. Explain the functions of the following components.

(a) Pumping element, (b) Metering element, (c) Timing control, (d) Ambient control.

(a) Pumping element- moves the fuel from the fuel tank to the injector. This include necessary piping, filter etc.

(b) Metering element- measures and supplies the fuel at the rate demanded by load and speed conditions of the engine.

(c) Timing control- fixes the start and stop of the fuel-air mixing process.

(d) Ambient control- compensates for changes in temperature and pressure of either air or fuel that may affect the various elements of the system.

15. Write the advantages of homogeneous charge compression ignition engine?

1. Lower NO_x and particulate emissions
2. High thermal efficiency

16. What are the fuels used in HCCI engines?

Diesel, gasoline, methanol, natural gas and hydrogen

17. List the disadvantages of homogeneous charge compression ignition engine?

- a. The major problem is controlling the ignition timing over a wide load and speed.
- b. Power density is limited by combustion noise and high peak pressure.

PRODUCTION PLANNING AND CONTROL

UNIT- I: INTRODUCTION

PART A (2 Marks)

1. What is production?

Production consists of a series sequential operation to produce a desirable product acceptable to customer and meets the customer demand, with respect to the quality and intendedfunction.

2. Define – Production Planning and Control

Production planning control defined as Direction and coordination of firm's resources towards attaining the prefixed goals.

3. What are the objectives of production planning and control?

- a. Systematic planning of production activities to achieve the highest efficiency in production of goods/services.
- b. To organize the production facilities like machines, men, etc., to achieve stated production objectives w.r.t. quantity and quality time cost.
- c. Optimum scheduling of resources.
- d. To conform to delivery commitments.
- e. Materials planning and control.

4. What are the functions of production planning and control?

- a. Material function, b. Machines and equipment, c. Methods, d. Routing,
- e. Estimating f. Loading and scheduling, g. Dispatching, h. Expediting, i. Inspection.

5. Define – Durability

Durability refers to the length of the active life of the product under given working condition.

6. Define – Dependability

Dependability refers to the reliability with which the product serves its intended function.

7. Define –Standardization

Standardization is a process of defining and applying the conditions necessary to ensure that given range of requirements can normally be met with a minimum of variety and in a reproducible and economic manner on the basis of the best current techniques.

8. What are the objectives of Standardization?

- i) Interchangeability of parts, components, etc.
- ii) Keeping the variety minimum.
- iii) Helps to achieve a better control due to reduced variety.

9. What are the advantages of Standardization?

- i) Reduction of waste and obsolescence.
- ii) Reduction in inventory
- iii) Reduced efforts in book keeping and accounting.
- iv) Standardization reduces the price because of economy of scale.
- v) Ease in procurement because of availability.

10. What is simplification?

It is a process of reducing types of products within a definite range.

11. What is specialization?

It is a process where in particular firms concentrate on the manufacture of limited number of product types.

12. What are the disadvantages of simplification?

- i) Not able to meet the needs of wide range of customer preferences.
- ii) Possibility of losing orders to competitors
- iii) Creates a constant source of conflict between marketing and production.

13. Define – Break-Even Point

Break-even point refers to the level of sales at which the sale income equal the total costs.

14. What is margin of safety?

It is the difference between the existing level of output and the level of output at BEP.

15. What are the phases of PPC?

- i. Preplanning Phase
- ii. Planning Phase
- iii. Control phase

16. What are the main functions of PPC?

- 1. Materials planning
- 2. Methods Planning
- 3. Facility planning
- 4. Process Planning
- 5. Estimating Planning
- 6. Scheduling and Loading
- 7. Dispatching
- 8. Expediting (Follow-up)
- 9. Inspection and testing
- 10. Evaluation

17. What are the types of production?

- 1. Job shop production
- 2. Batch Production
- 3. Mass Production

18. What are the two types of continuous production?

- a) Mass Production
- b) Flow Production

19. What is the use of break-even point analysis?

It is used to make a choice between two machines tools to produce a given component.

20. Define – Contribution

The difference between selling price and variable cost per unit is known as contribution or contribution margin.

Contribution = Selling price - Variable cost

21. What is break even chart?

It is a graphical representation of the relationship between costs and revenue at a given time.

22. What is product Design?

Design is the conversion of knowledge and requirement into a form, convenient and suitable for use of manufacture.

23. What are the various aspect of product?

- a) Functional aspect
- b) Operational aspect
- c) Durability and Dependability
- d) Aesthetic aspect

24. What is angle of incidence?

The angle at which sales revenue line cuts the total cost line.

Part - B (16 marks)

1. What do you understand by production planning and control? Discuss its main elements.
2. Explain different types of production systems. Differentiate between them.
3. Explain in detail the production aspects of product design.
4. Write detailed notes on:
 - i) Standardisation
 - ii) Simplification
 - iii) Specialisation
5. Give detailed account of the various factors considered while designing a product.
6. Discuss in detail:
 - i) Breakeven Analysis
 - ii) Samuel Eilon model
7. Explain the characteristic features of (i) batch production and (ii) mass production system.
8.
 - a. Discuss the benefits of PPC.
 - b. Differentiate between product design and product development.
 - c. A manufacturer sells an item for Rs. 13 per unit. He incurs a fixed cost of Rs. 60,000 and a variable cost of Rs. 8 unit. Find the break even production quantity and also the no. of units to be produced to get a profit of Rs. 12000.
9. Explain the different aspects of product design and development.
10.
 - a. What are the objectives of product analysis?
 - b. List the various factors that influence the product design.

UNIT-II WORK STUDY

PART – A (2 Marks)

1. What is method study?

It is the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective method reduced costs.

2. What are the objectives of method study?

- i) To present and analyze true facts concerning the situation.
- ii) To examine those facts critically.
- iii) To develop the best answer possible under given circumstances based on critical examination of facts.

3. What are the charts used for method study?

- i) Operation process chart, ii). Flow process chart. iii). Multiple activity chart,
- iv) Two handed process chart, v). Travel chart, vi). Simo chart.

4. What are the diagrams used for method study?

- i) Flow and string diagram, ii). Models and templates, iii). Cycle graph and chronocycle graph.

5. What is outline process chart?

The chart gives the bird's-eye view of the whole process by recording only the major activities and inspections involved in the process.

6. What is time study?

The application of techniques designed to establish the timer for a qualified worker to carry out a specified job at a defined level of performance.

7. What is work sampling?

A technique in which a statistically competent number of instantaneous observations are taken, over a period of time, of group of machines, process or workers. Each observations recorded for a particular activity or delay is a measure of the percentage of time observed by the occurrence.

8. What is multiple activity chart?

It is a chart on which the activities of more than one subject are each recorded on a common time scale to show their interrelationship.

9. What is Simo chart?

It is used to record simultaneously on a common time scale the activities of two hands or other parts of worker's body during the performance of single cycle of operation being investigated.

10. What are therbligs?

Therbligs are the symbols used to denote the various activities and movements done for different purposes.

11. What is memo motion study?

Memo motion study is a form of time-lapse photography which records activity by the use of cine camera adapted to take picture at longer intervals than normal.

12. What is PMTS?

A work measurement technique whereby times established for basic human motions are used to build up the time for a job at the defined level of performance.

13. Define – Work-Study

It is a term used to embrace the techniques of method study and work measurement which is employed to ensure the best possible use of human and other resources in carrying out a particular activity.

Work study=Method study+Workmeasurement

14. Define – Productivity

It is the ratio of output produced to the input resources utilized in the production.

15. What is the various procedure of method study?

1. Select
2. Record
3. Examine
4. Develop
5. Define
6. Install
7. Maintain

16. What are the various techniques used for work Measurement?

1. Stopwatch time study
2. Work sampling

17. Define – Outline Process Chart

An outline process chart is a process chart given an overall picture by recording in sequences only the main operations and inspections.

18. What is flow process chart?

It is a process chart setting out the sequence of the flow of a product (Or) a procedure by recording all events under review using the appropriate process chart symbols.

19. What are the types of flowchart?

- (i)Man Type
- (ii)Material Type
- (iii)Equipment Type

20. What is two handed process Chart?

It is a process chart in which the activities of a workers hand (or limbs) are recorded in the irrelation ship to one another.

21. Define – Multiple Activity Charts

It is a chart on which the activities of more than one subject are each recorded on a common time scale to shoe their inter relation ship.

22. What is string diagram?

It is a scale plan or model on which a thread is used to thread is used to trace and measure the path of workers, material or equipment during a specified sequence of events.

23. What is cycle graph?

It is a record of path movement, usually traced by a continuous source of light on a photograph.

24. What is chronocycle graph?

It is a special form of cycle graph in which the light source is suitably interrupted so that the path appears as a series of pear-shaped dots.

25. What is micro motion study?

It is used to make a detailed motion study employing either videotapes or motion pictures operating at a constant and known speed, when picture camera is utilized for study, then the procedure is known as micro motion study.

Part - B (16 marks)

1. Explain briefly the various steps involved in conducting the work study.
2. State and explain in brief the steps involved in conducting the method study procedure.
3. Briefly explain the various techniques of work measurement.
4. Define time study. List down the various steps in conducting a stopwatch time study.
5. Write short notes on:
 - a) Micro motion study
 - b) Memo motion study
6. Briefly explain the different tools and techniques used in the recording phase of method study.
7. Explain the procedural steps involved in the work sampling study and illustrate how work sampling is used for the computation of standard time for an operation which involves both manual and machine elements.
8. Discuss two types of each of the charts and diagrams used in the recoding phase of the method study.
9. List the principles of motion economy as applied to the use of human body, arrangement of workplace and design of tools and equipment.
10. a. Write short notes on (i) Symbols of process chart (ii) Therbligs
b. Distinguish between cumulative timing and fly back timing.

UNIT-III PRODUCTION PLANNING AND PROCESS PLANNING

PART – A (2 Marks)

1. What is production planning?

It is the determination, acquisition and arrangement of all facilities necessary for future production products.

2. What are the factors affecting production planning?

- i. Non-availability of materials
- ii. Plant, equipment and machine breakdown
- iii. Changes in demand and rush orders.
- iv. Absenteeism of workers.
- v. Lack of coordination and communication between various functional areas of business.

3. What is value analysis?

Value analysis is the systematic application of recognized techniques which identify the function of a product or service, establish a monetary value for the function and provide the necessary function reliably at that lowest overall cost.

4. When to apply value analysis?

- i. Company's products are losing in the market and there is a decline in sales.
- ii. Company's products are priced higher than the competitors.
- iii. New design of products being undertaken.
- iv. Symptoms of disproportionate increase in cost of production.
- v. Decreasing profitability and return on investment.
- vi. Company failing to meet its delivery commitment.

5. What is process planning?

It is defined as the systematic determination of methods by which a product is to be manufactured economically and competitively.

6. What are the activities associated with process planning?

1. List of operations to be performed and their sequence.
2. Specifications of the machines and equipment required.
3. Necessary toolings jigs and fixtures.
4. Gives the manufacturing details with respect to feed, speed, and depth of cut for each operation to be performed. It gives the estimated or processing times of operations.

7. What is the information required for process planning?

- a. Assembly and component drawings and bill of materials.
- b. Machine or equipment details.
- c. The standard times for operation and details of set-up time for each job.
- d. Availability of toolings.

8. What are the factors affecting process planning?

- i. Volume of production
- ii. Delivery dates for components
- iii. Accuracy and process capability of machines.
- iv. The skill and expertise of manpower.
- v. Material specifications
- vi. Accuracy requirements of components or parts.

9. What are the steps in process planning?

- a. Detailed study of the component drawings, process and machine selection, inspection stages and toolings required.
- II. List the surfaces to be machined.
- b. Determine the work centre, tools, cutting tools, jigs and fixtures and inspection stages and equipment required.
- III. Determine the speed, feed and depth of cut for each operation.
- b. Estimate the operation time.
- c. Find the total time to complete the job.
- d. Represent the details on the process sheet.

10. What is machine capacity?

MC- Machine capacity

MP-Max production

UC-Utilization capacity

N – Number of machines

ST-Standard time

$MC = ST \times MP/N \times UC.$

11. What is meant by balancing?

It refers to the procedure of adjusting the times at work centres to conform as much as possible to the require cycle time.

12. Define – Machine Loading

It is the process of assigning specific jobs to machines, men (or) work centres based on relative priorities and capacity utilization.

13. Define – Process

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

14. What are the purposes of process planning?

- a. Specific requirements are established for which machines, tools and other equipment can be designed or selected.
- b. The efforts of all engaged in manufacturing the product is coordinated.
- c. A guide is furnished to show the best way to use the existing or the providing facilities.

15. What are the factors used for selection of machine and equipment?

- a. Accuracy
- b. Rate of output
- c. Cost of product

16. What is the main function of process planning?

'Make or buy' decision is the main function of process planning. Here decision is made about which parts are to be made in the factory and which parts are to be bought from outside. Decision on whether to make or buy is taken by break even analysis.

17. How the process selection is determined?

Process selection determines how the product (Or service) will be produced, It determines the most economical method of performing an activity.

18. What are the types of process planning?

- a) Generative process planning
- b) Retrieval process planning

19. What is the function of CAPP?

A computer aided process planning (CAPP) system offers the potential for reducing the routine work of manufacturing engineers. It provides the opportunity to generate production routings which are rational, consistent and optimal.

20. What are the advantages of generative process planning?

- a. Generate consistent process planning rapidly.
- b. New components can be planned easily.

PART- B (16 marks)

1. What is value analysis? Describe the basic steps involved in the value analysis.
2. Explain the importance of process planning with reference to production control. Discuss the activities in process planning.
3. a. Compare and contrast the manual process planning with CAPP.
b. Explain the steps involved in product planning.
4. What is meant by machine loading? Also enumerate the various methods to the cycle time to a minimum.
5. What do you mean by machine balancing? Also explain the effect of balancing on number of machines required with an illustration.
6. Write short notes on analysis of process capacities in a multiproduct system.
7. Write short notes on:
 - a) Quantity determination in batch production
 - b) Analysis of process capability in a multi-product system
8. A gear manufacturer has gear shaper and gear hobbers. The gear can be processed on gear shaper as well as gear hobber. The following is given. Which of the two machines will you choose to do the job if the order quantity is (i) 1000 numbers and order is unlikely to repeat and (ii) 1000 numbers and the order is likely to repeat for 3 years?

Gear shaper	Gear hobber	
Machine time per piece (min)	12	04
Machine cost per hour	45	120
Set up time (min)	60	90
Tooling up cost (Rs)	400	200
9. What is meant by product planning? Explain, in detail, the various steps involved in the product planning process.
- 10 a. Explain the various phases of value engineering.
b. What are commandant of value analysis?

UNIT-IV PRODUCTION SCHEDULING

PART – A (2 Marks)

1. What is loading?

It is defined as the assignment of work to a facility. The facility may be men, machine, a department, a group of men, group of machines of a plant.

2. What is scheduling?

It is time phasing of loading. It is defined as the assignment of work to a facility specifying the particular sequence of the work and the time of actual performance.

3. What are the different techniques of loading and scheduling?

- a. Master scheduling
- b. Perpetual loading
- c. Order scheduling
- d. Loading by schedule period

4. What is master scheduling?

It gives an overall picture of the jobs. It is mainly used for small corners such as research and development laboratories, computer centre, foundries, repair shop etc.

5. What are the advantages of master scheduling?

- i) The overall cost of operating is minimum than any other loading and scheduling systems.
- ii) This method is very simple to understand.
- iii) This could be even maintained by clerical staff.
- iv) It could be easily kept current.

6. What are the disadvantages of master scheduling?

- i) The detailed information cannot be obtained.
- ii) It is efficient for small units only.

7. What is line balancing?

Assembly line balancing is associated with a product layout in which products are processed as they pass through a line of work centres. An assembly line can be considered as a production sequence where parts are assembled together to form an end product. The operations are carried out at different workstations situated along the line.

8. What are the advantages of assembly line?

- i) Uniform rate of production.
- ii) Less material handling
- iii) Less work-in-process.
- iv) Easy production control.
- v) Effective use of facilities/labour.
- vi) Less congesting.

9. What are the disadvantages of assembly line?

- i) More capital intensive.
- ii) Low flexibility.
- iii) Monotony of work for operators.

10. What are the steps in solving line balancing problems?

- i) Define task
- ii) Identify precedence requirements.
- iii) Calculate minimum number of workstations required to produce desired output.
- iv) Apply heuristics to assign task to each station.
- v) Evaluate effectiveness and efficiency.
- vi) Seek further improvement.

11. What are the advantages of Gantt load chart?

- i) This system is quite simple.
- ii) This could be maintained even by electrical staff after some training.
- iii) Overall cost of operation is small.

12. What are the disadvantages of Gantt load chart?

From the load chart it is not possible to learn the exact time of a work. It tells only the total load ahead of a department or a facility.

13. What is Kanban system?

Kanban system is a simple information system used by a work centre to signal its supplier work centre to request a replacement container and to authorize production of another container of that particular item.

14. What is production sequencing?

Determining the order of processing of all jobs at each work centre.

15. What is expediting?

Monitoring progress, taking corrective actions to minimize deviations.

16. What are the main objectives of loading?

- i. To check the feasibility of production programmes
- ii. To assist in the efficient planning of new work
- iii. To assist in balancing the plant to the existing load
- iv. To assist in fixing of reliable delivery promises.

17. Define – Capacity

It can be defined as the time available for work at work centres expressed in machine hours or in man hours

18. What is Gantt chart?

Gantt chart is simple bar graphs that can be used to schedule any type of operation.

19. What is Gantt Work load chart?

It is used to depict workload levels for equipment, workstations (Or) departments.

20. What is MRP?

It is a computational technique that converts the master schedule for final product into a detailed schedule for the raw material and parts used in the final product.

21. What is MPS?

It is a detailed plan that states how many end items will be available for sale (Or) distribution during specific periods.

22. What is dispatching?

It is the routine of setting productive activities in motion through the release of orders and instructions in accordance with previously planned times and sequences embodied in route sheets and schedule charts.

23. Define – Priority Sequencing

It is a systematic procedure for assigning priority to waiting jobs thereby determining the sequence in which the jobs will be performed.

24. What is bill of materials?

It designates what items and how many of each are used to make up a specified final product.

Par t- B (16 marks)

1. Explain the procedure by which scheduling 2 jobs in m machines can be done with suitable example

2. Write short notes on:

- a) Aggregate run-out method of batch scheduling.
- b) Line of balance method

3. Discuss the concepts, inputs, characteristics, working, outputs, and benefits of MRP.

4. What are the functions of dispatching? Explain the various documents raised by dispatching department.

5. What is progressing? Explain its function and recording.

- 6. a. Describe the information flow for master scheduling.
- b. With an example explain Gantt chart.

7. Discuss in detail about the various factors that affect scheduling. Explain any one technique used in loading and scheduling process.

- 8. a. Explain the common methods adopted in industries for progress reporting.
- b. Explain the priority rules used for job sequencing.

9. Discuss the scheduling approaches followed in job and flow shops along with their merits and demerits.

10. a. What are the common causes for delay? How can they be avoided? Explain.

b. Explain the various techniques adopted for aligning completion time and due dates.

UNIT- V INVENTORY CONTROL AND RECENT TRENDS IN PPC

PART – A (2 Marks)

1. What are the types of inventories?

i) Raw materials, ii) Bought out parts, iii) Work-in-process inventories, iv) Finished goods inventories v) Maintenance, repair and operating stores.

2. What are the benefits of inventory control?

i) Improvement in customer's relationship because of the timely delivery of goods and services.

ii) Smooth and uninterrupted production and hence no stock out.

iii) Efficient utilization of working capital.

iv) Helps in minimizing loss due to deterioration, obsolescence damage and pre-liferage.

v) Economy in purchasing.

vi) Eliminates the possibility of duplicate ordering.

3. What is inventory turnover?

If the company maintains inventories equal to 3 months consumption. It means that inventory turnover is 4 times a year, i.e., the entire inventory is used up and replaced 4 times a year.

4. Define – Re-order level

It is the point at which the replenishment action is initiated. When the stock level reaches R.O.L., the order is placed for the item.

5. Define – Re-order quantity

This is the quantity of material to be ordered at the re-order level. Normally this quantity equals the economic order quantity.

6. What is demand?

It is the number of items required per unit of time. The demand may be either deterministic or probabilistic in nature.

7. Define – Order Cycle

The time period between two successive orders is called order cycle.

8. What is lead time?

The length of time between placing an order and receipt of items is called lead time.

9. What are the various costs associated with inventory?

i) Purchase cost, ii) Capital cost, iii) Ordering cost, iv) Holding costs, v) Shortage cost.

10. What is an Economic order quantity?

It is the quantity to be ordered is one that strikes a balance between the inventory carrying

cost and the inventory carrying cost. This quantity is referred to as Economic order quantity.

11. What is safety stock?

The additional stock of material to be maintained in order to meet the unanticipated increase in demand arising out of uncontrollable factors.

12. What are the advantages of ABC analysis?

This approach helps the manager to exercise selective control and focus his attention only on a few items.

13. What are the limitations of ABC analysis?

ABC analysis is a fundamental tool for exercising selective control over numerous inventory items but in present for do not precise consideration of all relevant problems of inventory management.

14. What is inventory?

An inventory is a stock of an item (or) idle resource held for future use.

15. What is inventory control?

It may be defined as the scientific method of determining what to order, when to order & how much to order and how much to stock so that costs associated with buying and storing are optimal without interrupting production and sales.

16. Define – Ordering costs

It is the cost associated with the placement of an order for the acquisition of inventories.

17. What is holding (Or) inventory carrying costs?

The cost associated with holding a given level of inventory on hand.

18. What is shortage (Or) stock out costs?

When the stock of an item is depleted and there is a demand for it, then the shortage cost will occur.

19. What is demand?

It is nothing but the no of items required per unit of time.

20. What is order cycle?

The time period between two successive orders is called order cycle .When orders are placed at equal time intervals it is known as fixed order interval system (Or) cycle review system.

21. Define – Lead Time

The time gap between placing of an order and its actual arrival in the inventory is known as lead time.

22. What is Re-order point (Or reorder level)?

The level of inventory at which an order is placed is known as reorder point or reorderlevel.

23. What is safety stock?

This represents the minimum stock which must be maintained at all times.

24. What is Re-order Quantity?

The quantity of items to be ordered at the re-order level is known as re-order quantity.

25. What is inventory turn over?

It is defined as the ratio of the value of materials consumed to the average investment in inventories for the same period.

Inventory turn over= $\frac{\text{Value of the material consumed}}{\text{Value of average inventory}}$

Value of average inventory

Part - B (16 marks)

1. What do you understand by inventory control? Explain the purpose of maintaining inventory in any production unit.
2. What is EOQ? Derive the expression for EOQ when the demand of the item is uniform, the production rate is infinite and no stock-outs are allowed.
3. a) Explain the terms: lead time, stock out, buffer stock, inventory carrying cost.
b) Distinguish between in-process inventory, safety stock inventory and seasonal inventory.
4. Describe the fixed period quantity inventory model? Also compare and contrast P-system with Q- System.
5. What is selective control of inventory and explain various selective control techniques.
6. What is ABC analysis? Explain its significance in the inventory control with suitable example.
7. Discuss in detail: a) JIT b) ERP
8. Discuss in detail about the P and Q systems of inventory replenishment along with their merits and demerits.
9. a. Explain the various costs associated with the inventory control with suitable examples.
b. A manufacturer has to supply his customers 3600 units of his product per year. Shortages are not permitted. Inventory carrying cost amounts Rs. 12 per unit per annum. The set up cost per run is Rs. 80. Find (i) Economic order quantity (ii) Optimum number of orders per annum (iii) Average annual inventory cost (iv) Optimum period of supply per optimum order.
10. Write short notes on (i) ABC analysis (ii) Computer integrated production planning systems (iii) Manufacturing resource planning (iv) Enterprise resource planning.

MG - 6863 ENGINEERING ECONOMICS
TWO MARK QUESTIONS WITH ANSWERS

UNIT-I INTRODUCTION TO ECONOMICS

1. What is elasticity of Demand?

Elasticity of demand may be defined as the degree of responsiveness of quantity demanded to a Change in price.

2. Define the term 'cost'?

Cost may be defined as a total of all expenses incurred, whether paid or outstanding In the manufacture and sale of a product.

3. What is opportunity cost?

Opportunity cost may be defined as the potential benefit that is given up as you seek an alternative course of action. In other words, the expected return or benefit foregone in rejecting one course of action for another.

4. What do you mean by marginal cost?

The Institute of Cost & Works Accountants of India defined marginal cost as, "the amount at any given volume of output by which aggregate cost are changed, if the volume of output is increased or decreased by one unit.

5. What is marginal costing?

Marginal costing is defined by the ICWA as, "the ascertainment by differentiating between fixed costs, of marginal costs and of the effect on profit of changes in volume or type of output".

6. What is meant by marginal revenue?

The revenue that can be obtained from selling one more unit of product is called marginal revenue.

7. Give a short note on sunk cost.

A cost which was incurred or sunk in the past and is not relevant to the particular decision making is a sunk cost or sunk loss. It may be variable or fixed or both.

8. List out the elements of cost?

The elements of cost are: a. V Materials b. Labor cost c.
Expenses

9. Define the term costing?

Institute of Costs and Management Accountants, (I.C.M.A) London has defined costing as the ascertainment of costs. "it refers to the techniques and process of ascertaining costs and studies the principles and rules concerning the determination of costs of products and services".

10. What is Break-even point?

The Break-even point is, therefore, the volume of output at which neither a profit is made nor a loss is incurred. It is a point where the total sales are equal to total cost.

11. Define P/V ratio.

Profit-Volume ratio expressed as a percentage indicates the relative profitability of different products

$$\begin{aligned} \text{PV ratio} &= \frac{\text{Contribution}}{\text{Sales}} \\ &= \frac{\text{Fixed cost} + \text{Profit}}{\text{Sales}} \\ &= \frac{\text{Sales} - \text{Variable cost}}{\text{Sales}} \end{aligned}$$

12. What are all the economic goals?

- a) A high level of employment
- b) Price stability
- c) Efficiency
- d) An equitable distribution of income
- d) Growth

13. What is mean by equilibrium point?

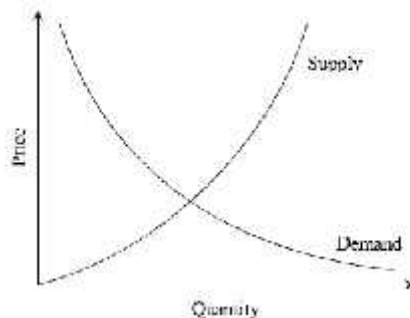
The point of intersection of the supply curve and the demand curve is known as the equilibrium *point*. At the price corresponding to this point, the quantity of supply is equal to the quantity of demand. Hence, this point is called the *equilibrium point*.

14. What are the Factors influencing demand?

The shape of the demand curve is influenced by the following factors:

- a) Income of the people
- b) Prices of related goods
- c) Tastes of consumers

15. Draw the demand and supply curve.



16. What are the Factors influencing supply?

The shape of the supply curve is affected by the following factors:

- a) Cost of the inputs
- b) Technology
- c) Weather
- d) Prices of related goods

17. Define technical efficiency.

It is the ratio of the output to input of a physical system. The physical system may be a diesel engine, a machine working in a shop floor, a furnace, etc.

$$\text{Technical efficiency (\%)} = \frac{\text{Output}}{\text{Input}} \times 100$$

18. Define Economic efficiency.

Economic efficiency is the ratio of output to input of a business system.

$$\text{Economic efficiency (\%)} = \frac{\text{Output}}{\text{Input}} \times 100 = \frac{\text{Worth}}{\text{Cost}} \times 100$$

19. What are the ways of improving productivity?

Increased output for the same input

Decreased input for the same output

By a proportionate increase in the output which is more than the proportionate increase in the input. By a proportionate decrease in the input which is more than the proportionate decrease in the output. Through simultaneous increase in the output with decrease in the input.

20. Define engineering economics.

Engineering economics deals with the methods that enable one to take economic decisions towards minimizing costs and/or maximizing benefits to business organizations.

UNIT-II VALUE ENGINEERING

1. What do you mean by 'Make or Buy Decisions'?

Make or buy decision is a determination whether to produce a component part internally or to buy it from an outside supplier. The Organization should evaluate the costs and benefits of manufacturing a product or product component against purchasing it and then select the alternative which results in the lower cost.

2. What are the different approaches followed in make or buy decision?

The following are the approaches followed in make or buy decision.

- a) Simple cost analysis b) Economic analysis c) Break-even analysis

3. What is mean by value analysis/value engineering?

Value analysis is a special type of cost reduction technique. It critically investigates and analyses the different aspects of materials, design, cost and production of each and every component of the product in produce it economically without decreasing its utility, function or reliability.

4. What do you mean by value of a product?

Value differs from both price and cost in the sense that it is the cost proportionate to the function. We can express value mathematically as $\text{Value} = \frac{\text{function or utility}}{\text{cost}}$

5. Define 'function'.

Function specifies the purpose of the product or what the product does, what is its utility etc.

6. What are the different types of values?

- a) Cost value b) Exchange value c) Use value d) Esteem value

7. What are the various functions of a product?

Functions can be classified into the following three categories:

- a) Primary functions b) Secondary functions c) Tertiary functions

8. Write any four objectives of value analysis?

- a) Reduce the cost of the product
b) Simplify the product
c) Use (new) cheaper and better materials
d) Modify and improve product design so as to make it acceptable to consumer.

9. Differentiate value analysis and value engineering.

The following table represents the major differences between the two terms.

Value analysis	Value engineering
Value analysis the application of a set of techniques to an existing products with a view to improve its value	Value engineering is the application of exactly the same set of techniques to a new product at design stage
It is a remedial process	It is preventive process

10. List any four advantage of value engineering.

- Value engineering/analysis identify and reduce the product cost.
- It modifies and improve the product design
- It increases the performance/utility of the product by economical means.
- It helps to generate new ideas.

11. What is meant by simple and compound interest rate?

In simple interest, the interest is calculated, based on the initial deposit for every interest period. In this case, calculation of interest on interest is not applicable. In compound interest, the interest for the current period is computed based on the amount (principal plus interest up to the end of the previous period) at the beginning of the current period.

12. What is mean by single payment compound factor?

The formula to obtain the single-payment compound amount is

$$F = P(1 + i)^n = P(F/P, i, n)$$

Where $(F/P, i, n)$ is called as single-payment compound amount factor.

13. A person deposits a sum of Rs. 20,000 at the interest rate of 18% compounded annually for 10 years. Find the maturity value after 10 years.

Solution

$$P = \text{Rs. } 20,000$$

$$i = 18\% \text{ compounded annually}$$

$$n = 10 \text{ years}$$

$$F = P(1 + i)^n = P(F/P, i, n)$$

$$= 20,000 (F/P, 18\%, 10)$$

$$= 20,000 \times 5.234 = \text{Rs. } 1,04,680$$

The maturity value of Rs. 20,000 invested now at 18% compounded yearly is equal to Rs. 1,04,680 after 10 years.

14. What is mean by single payment present worth payment factor?

The formula to obtain the present worth is

$$P = \frac{F}{(1 + i)^n} = P(P/F, i, n)$$

where

$(P/F, i, n)$ is termed as *single-payment present worth factor*.

15. What is mean by equal-payment series compound amount factor?

A = equal amount deposited at the end of each interest period

n = No. of interest periods

i = rate of interest

F = single future amount

The formula to get F is

$$F = A \frac{(1 + i)^n - 1}{i} = A(F/A, i, n)$$

where

$(F/A, i, n)$ is termed as *equal-payment series compound amount factor*.

16. What is mean by equal-payment series sinking fund factor?

A = equal amount to be deposited at the end of each interest period

n = No. of interest periods

i = rate of interest

F = single future amount at the end of the n th period

The formula to get F is

$$A = F \frac{i}{(1+i)^n - 1} = F(A/F, i, n)$$

where

$(A/F, i, n)$ is called as *equal-payment series sinking fund factor*.

17. Give the expression for Uniform Gradient Series Annual Equivalent Amount.

The formula to compute A under this situation is

$$\begin{aligned} A &= A_1 + G \frac{(1+i)^n - in - 1}{i(1+i)^n - i} \\ &= A_1 + G (A/G, i, n) \end{aligned}$$

where

$(A/G, i, n)$ is called *uniform gradient series factor*.

18. What are several bases for comparing the worthiness of the projects?

1. Present worth method
2. Future worth method
3. Annual equivalent method
4. Rate of return method

19. A person wishes to have a future sum of Rs. 1,00,000 for his son's education after 10 years from now. What is the single-payment that he should deposit now so that he gets the desired amount after 10 years? The bank gives 15% interest rate compounded annually.

Solution

$F = \text{Rs. } 1,00,000$ $i = 15\%$, compounded annually $n = 10$ years

$$P = F/(1+i)^n = F(P/F, i, n)$$

$$= 1,00,000 (P/F, 15\%, 10)$$

$$= 1,00,000 _ 0.2472$$

$$= \text{Rs. } 24,720$$

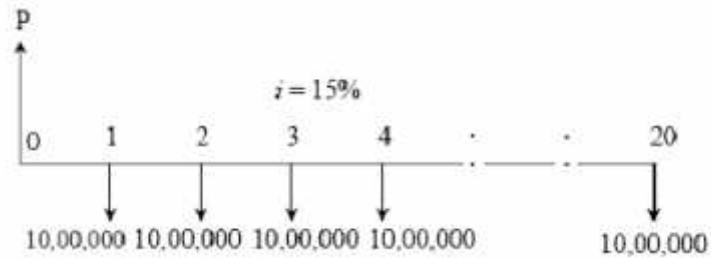
The person has to invest Rs. 24,720 now so that he will get a sum of Rs. 1,00,000 after 10 years at 15% interest rate compounded annually.

20. A company wants to set up a reserve which will help the company to have an annual equivalent amount of Rs. 10,00,000 for the next 20 years towards its employees welfare measures. The reserve is assumed to grow at the rate of 15% annually. Find the single-payment that must be made now as the reserve amount.

Solution

$A = \text{Rs. } 10,00,000$ $i = 15\%$ $n = 20$ years $P = ?$

The corresponding cash flow diagram is illustrated in Fig



$$\begin{aligned}
 P &= A \frac{(1+i)^n - 1}{i(1+i)^n} = A(P/A, i, n) \\
 &= 10,00,000 \times (P/A, 15\%, 20) \\
 &= 10,00,000 \times 6.2593 \\
 &= \text{Rs. } 62,59,300
 \end{aligned}$$

The amount of reserve which must be set-up now is equal to Rs. 62, 59,300.

UNIT –III CASH FLOW

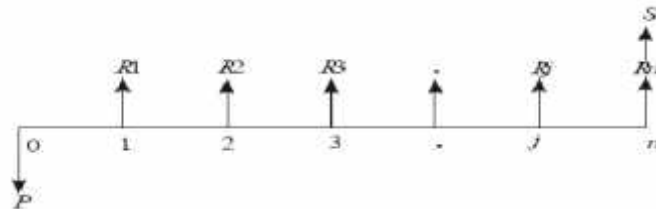
1. Give the expression for the revenue-dominated cash flow.

To find the present worth of the above cash flow diagram for a given interest rate, the formula is

$$PW(i) = -P + R_1[1/(1+i)^1] - R_2[1/(1+i)^2] + \dots + R_j[1/(1+i)^j] + R_n[1/(1+i)^n] + S[1/(1+i)^n]$$

In this formula, expenditure is assigned a negative sign and revenues are assigned a positive sign.

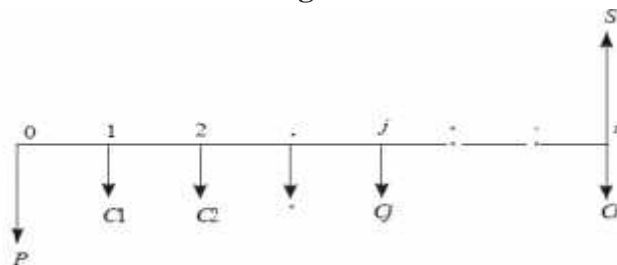
2. Draw the revenue-dominated cash flow diagram for Present worth method.



3. What is meant by Present worth method?

In this method of comparison, the cash flows of each alternative will be reduced to time zero by assuming an interest rate i . Then depending on the type of decision, the best alternative will be selected by comparing the present worth amounts of the alternative.

4. Draw the Cost dominated cash flow diagram for Present worth method.



5. Give the expression for the Cost dominated cash flow.

The n th year. To compute the present worth amount of the above cash flow diagram for a given interest rate i , we have the formula

$$PW(i) = -P + C_1[1/(1+i)^1] + C_2[1/(1+i)^2] + \dots + C_j[1/(1+i)^j] + C_n[1/(1+i)^n] - S[1/(1+i)^n]$$

6. What are the limitations of cash flow diagrams?

1. Cash flow statement cannot be equated with the income statement. An income statement takes into account both cash as well as non-cash items, and therefore, net cash flow does not necessarily mean net income of the business.

2. The cash balance as dislocated by the flow statement may not represent the real liquid position of the business since it can be easily influenced by postponing purchases and other payments.

3. Cash flow statement cannot be replace the income statement or the funds flow statement.

7. What is mean by Future worth method?

In the future worth method of comparison of alternatives, the future worth of various alternatives will be computed. Then, the alternative with the maximum future of net revenue or with the minimum future worth of net cost will be selected as the best alternative for implementation.

8. Give the expression for the Future worth method.

The formula for the future worth of the above cash flow diagram for a given interest rate, i is

$$FW(i) = -P(1 + i)^n + R1(1 + i)^{n-1} + R2(1 + i)^{n-2} + \dots + Rj(1 + i)^{n-j} + \dots + Rn + S$$

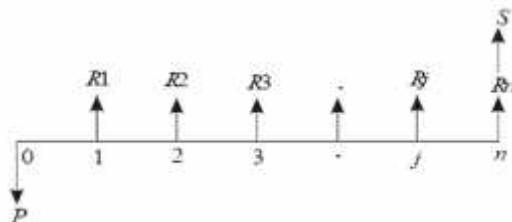
In the above formula, the expenditure is assigned with negative sign and the revenues are assigned with positive sign.

If we have some more alternatives which are to be compared with this alternative, then the corresponding future worth amounts are to be computed and compared. Finally, the alternative with the maximum future worth amount should be selected as the best alternative.

9. What is mean by Annual Equivalent method?

In the annual equivalent method of comparison, first the annual equivalent cost or the revenue of each alternative will be computed. Then the alternative with the maximum annual equivalent revenue in the case of revenue-based comparison or with the minimum annual equivalent cost in the case of cost based comparison will be selected as the best alternative.

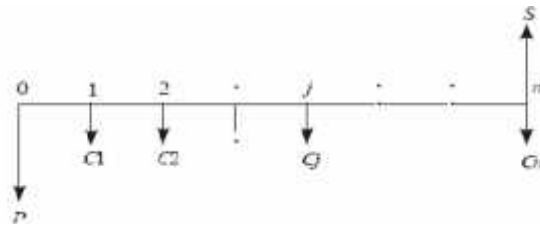
10. Draw the diagram for revenue-dominated cash flow diagram in Annual Equivalent method.



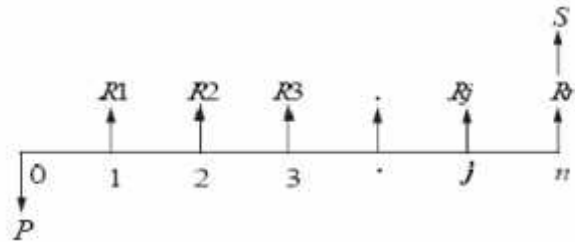
11. What is mean by Rate of return method?

The rate of return of a cash flow pattern is the interest rate at which the present worth of that cash flow pattern reduces to zero. In this method of comparison, the rate of return for each alternative is computed. Then the alternative which has the highest rate of return is selected as the best alternative.

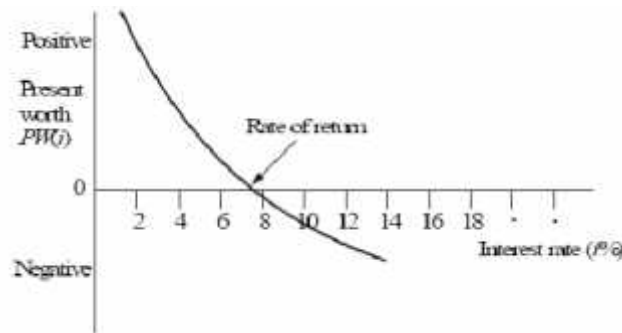
12. Draw the diagram for Cash-dominated cash flow diagram in Annual Equivalent method.



13. Draw the cash flow diagram for Rate of return method.



14. Draw the present worth function graph for Rate of return method.



15. Give the expression for to find the net present worth in rate of return method.

$$PW(i) = -P + R1/(1+i)^1 + R2/(1+i)^2 + \dots + Rj/(1+i)^j + \dots + Rn/(1+i)^n + S/(1+i)^n$$

16. What are the constructions of cash flow statement?

- a) Issue of shares b) Issue of debentures c) Sale of investments d) Sales of assets
e) Cash from business operations

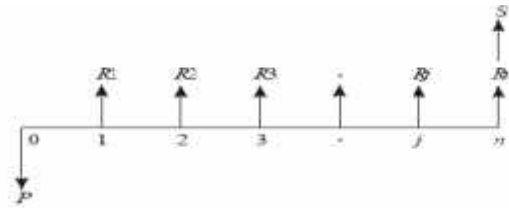
17. What are the advantages in cash flow diagrams?

- a) Helps in efficient cash management. b) Helps in internal financial management
c) Discloses the movements of cash d) Discloses success or future of cash planning

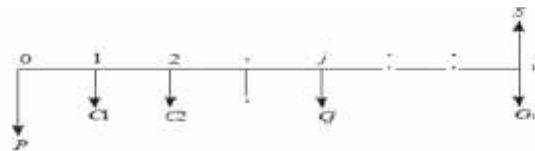
18. What are the types of cash flow?

- a) Present worth method b) Future worth method
c) Annual Equivalent method d) Rate of return method

19. Draw the revenue-dominated cash flow diagram for Future worth method.



20. Draw the Cost dominated cash flow diagram for Future worth method.



UNIT-IV REPLACEMENT AND MAINTENANCE ANALYSIS

1. What are the reasons considering the replacement of an equipment?

- a) Physical impairment of the various parts
- b) Obsolescence of the equipment

2. How to determination of economic life of an asset?

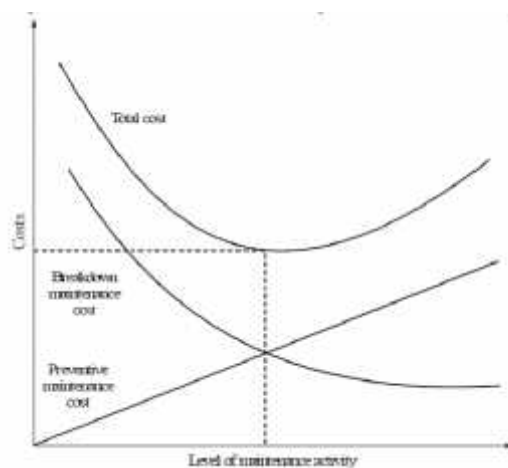
Any asset will have the following cost components:

Capital recovery cost (average first cost), computed from the first cost (purchase price) of the machine.

Average operating and maintenance cost (O & M cost)

Total cost which is the sum of capital recovery cost (average first cost) and average maintenance cost.

3. Draw the curve for Maintenance costs.



4. What are the types of replacement?

Replacement study can be classified into two categories:

(a) Replacement of assets that deteriorate with time (Replacement due to gradual failure, or wear and tear of the components of the machines)

This can be further classified into the following types:

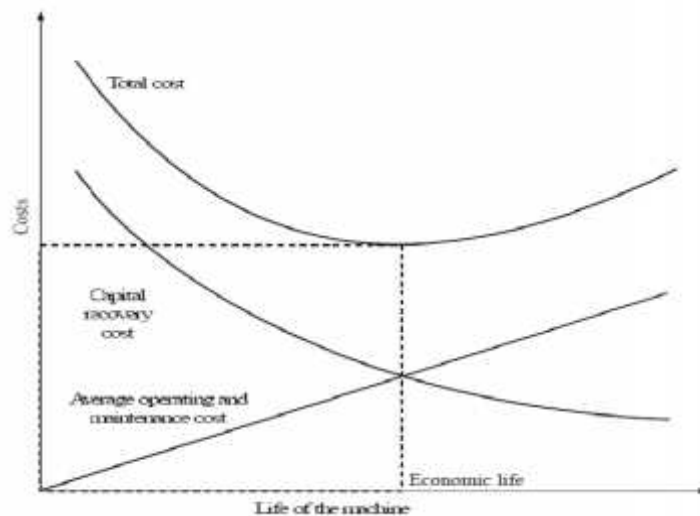
- (i) Determination of economic life of an asset.

- (ii) Replacement of an existing asset with a new asset.
- (b) Simple probabilistic model for assets which fail completely (replacement due to sudden failure).

5. What is meant by Economic life?

The capital recovery cost (average first cost) goes on decreasing with the life of the machine and the average operating and maintenance cost goes on increasing with the life of the machine. From the beginning, the total cost continues to decrease up to a particular life and then it starts increasing. The point where the total cost is minimum is called the *economic life* of the machine.

6. Draw curve for the Economic life of a machine.

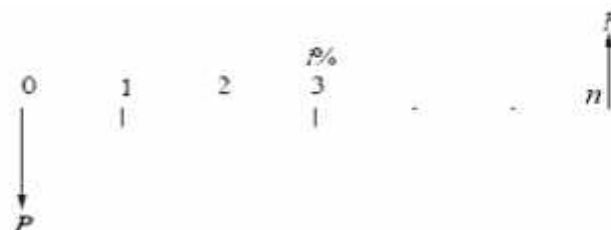


7. Write the expression for capital recovery with return?

$$AE(\bar{i}) = (P - F) \times (A/P, \bar{i}, n) + F \times \bar{i}$$

- P = purchase price of the machine,
- F = salvage value of the machine at the end of machine life,
- n = life of the machine in years, and
- i = interest rate, compounded annually

8. Draw the cash flow diagram for Capital Recovery with Return.



9. What is meant by Concept of Challenger and Defender?

If an existing equipment is considered for replacement with a new equipment, then the existing equipment is known as the *defender* and the new equipment is known as *challenger*.

10. What are the types of are the replacement policies?

- (i) Individual replacement policy.
- (ii) Group replacement policy.

11. What is mean by Group replacement policy?

Under this policy, the following decision is made:

At what equal intervals are all the items to be replaced simultaneously with a provision to replace the items individually which fail during a fixed group replacement period?

There is a trade-off between the individual replacement policy and the group replacement policy. Hence, for a given problem, each of the replacement policies is evaluated and the most economical policy is selected for implementation. This is explained with two numerical problems.

12. What is mean by Individual replacement policy?

Under this policy, an item is replaced immediately after its failure.

13. What are the objectives of plant maintenance?

a) The objective of plant maintenance is to achieve less break down and to keep the plant in good working condition at the lowest cost.

b) Maintenance division of the factory ensures the availability of the machines, buildings and services required by other sections of the factory for the performance of their functions at optimum return on investment whether this investment be in material, machinery.

c) Machines and other facilities should be kept in such a condition which permits them to be used their optimum capacity without any interruption.

14. What are the types of maintenance?

- a) Corrective or breakdown maintenance
- b) Scheduled maintenance
- c) Preventive maintenance
- d) Predictive maintenance

15. What is meant by maintenance planning?

Maintenance planning is the task of organizing resources to carry out a job satisfactory at reasonable cost within a specified period of time, maintenance planning involve the assignment of jobs to the maintenance crew.

16. Give the types of maintenance organization.

- i) centralized,
- ii) decentralized,
- iii) partially centralized

17. What are the principles of planned maintenance activity?

- a) Plant management in maintenance work,
- b) production and maintenance objectives,
- c) Establishment of work order and recording system.
- d) Information based decision making,
- e) adherence to planned strategy.

18. What are the benefits of sound maintenance system?

Minimization of downtime, b) improvement in availability of system, c) extended life of equipment d) safety and smooth operation of the process, e) provide adequate back up supply, vi) minimization of normal expected wear and tear of equipment.

19. Define machine availability.

Availability is the ratio of the time at which equipment is available for the designated operation/service to the total time of operation and maintenance of equipment. It is also defined as the ratio of equipments uptime to the equipment uptime and downtime over a specified period of time.

20. What is maintenance economics?

Maintenance economics is the application of economic principles in the maintenance of engineering system. It includes the life of equipments, maintenance cost and budget.

21. Define maintenance.

Maintenance is the routine and recurring process of keeping a particular machine or asset in its normal operating condition so that it can deliver the expected performance or service without any loss or damage.

UNIT V DEPRECIATION

1. What are the methods of depreciation?

1. Straight line method of depreciation
2. Declining balance method of depreciation
3. Sum of the years—digits method of depreciation
4. Sinking-fund method of depreciation
5. Service output method of depreciation

2. What is Straight Line Method of Depreciation?

In this method of depreciation, a fixed sum is charged as the depreciation amount throughout the lifetime of an asset such that the accumulated sum at the end of the life of the asset is exactly equal to the purchase value of the asset. Here, we make an important assumption that inflation is absent.

Let P = first cost of the asset,

F = salvage value of the asset,

n = life of the asset,

B_t = book value of the asset at the end of the period t ,

D_t = depreciation amount for the period t .

The formulae for depreciation and book value are as follows:

$$D_t = (P - F)/n$$
$$B_t = B_{t-1} - D_t = P - t \times [(P - F)/n]$$

3. What is Service Output Method of Depreciation?

In some situations, it may not be realistic to compute depreciation based on time period. In such cases, the depreciation is computed based on service rendered by an asset. Let

P = first cost of the asset

F = salvage value of the asset

X = maximum capacity of service of the asset during its lifetime

x = quantity of service rendered in a period.

Then, the depreciation is defined per unit of service rendered:

$$\text{Depreciation/unit of service} = (P - F)/X$$

$$\text{Depreciation for } x \text{ units of service in a period} = \frac{P - F}{X} \times x$$

4. The first coat of a road laying machine is Rs. 80,00,000. Its salvage value after five years is Rs. 50,000. The length of road that can be laid by the machine during its lifetime is 75,000 km. In its third year of operation, the length of road laid is 2,000 km. Find the depreciation of the equipment for that year.

Solution

$$P = \text{Rs. } 80,00,000$$

$$F = \text{Rs. } 50,000$$

$$X = 75,000 \text{ km}$$

$$x = 2,000 \text{ km}$$

$$\text{Depreciation for } x \text{ units of service in a period} = \frac{P - F}{X} \times x$$

$$\begin{aligned} \text{Depreciation for year 3} &= \frac{(80,00,000 - 50,000)}{75,000} \times 2,000 \\ &= \text{Rs. } 2,12,000 \end{aligned}$$

5. What are procedures to adjust inflation?

1. Estimate all the costs/returns associated with an investment proposal in terms of today's rupees.

2. Modify the costs/returns estimated in step 1 using an assumed inflation rate so that at each future date they represent the costs/returns at that date in terms of the rupees that must be expended/received at that time, respectively.

3. As per our requirement, calculate either the annual equivalent amount or future amount or present amount of the cash flow resulting from step 2 by considering the time value of money.

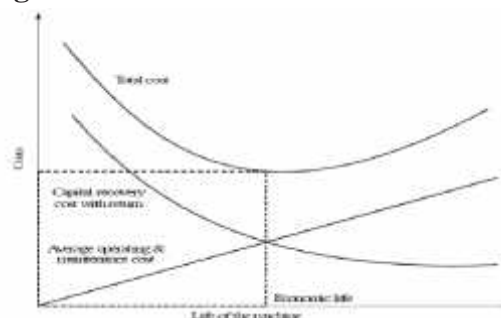
6. What is replacement analysis?

A machine which is purchased today cannot be used forever. It has a definite economic lifetime. After the economic life, the machine should be replaced with a substitute machine with similar operational capabilities. This kind of analysis is called replacement analysis.

7. What are the elements of costs involved in the replacement analysis?

1. Purchase cost (initial cost)
2. Annual operation and maintenance cost
3. Salvage value at the end of every year, if it is significant

8. Draw the Chart showing economic life.



9. What is economic life of the machine?

It is clear that the sum of operation and maintenance cost increases with the life of the machine. But the capital recovery with return decreases with the life of the machine. The total cost of the machine goes on decreasing initially but it starts increasing after some years. The year with the minimum total cost is called as the economic life of the machine.

10. What are the limitations of Existing models?

1. Initial cost
2. Operation and maintenance cost
3. Salvage value

11. Write the expression for sinking fund method?

$$D = \frac{R(C-S)}{(1+R)^N - 1}$$

D= Rate of interest on invested fund

S= Scrap value

N= Number of years of the life of the asset

12. Define rate of depreciation.

$$\text{Rate of depreciation} = \frac{\text{Value of asset}}{\text{Number of production hours}}$$

13. Define Benefit-cost ratio.

$$\text{Benefit-cost ratio} = \frac{\text{Equivalent benefits}}{\text{Equivalent costs}}$$

14. Define inflation.

Inflation may be defined as a sustained rise in the general price level. It is an economic condition where there is a rise in prices resulting in the fall in the purchasing power of money.

15. Define creeping inflation.

This is slow moving and a very mild inflation. When the general price level rises rapidly say to 20% annually, we may say that creeping inflation prevails.

16. Define running inflation.

The rate of increase in the general price level reaches double digit in the case of running inflation.

17. Define Galloping inflation.

In the case of galloping inflation, the general price level reaches double digits or even triple digits. The rate of increase in inflation may be 50% or 500%.

18. Define demand inflation.

It is an inflation which is mainly induced by excessive demand when supply constantly falls to keep up with demand.

19. Define cost inflation.

It is an inflation which is mainly induced by rising costs of production, particularly rising wages.

20. What are the causes of inflation?

- a) Unmanageable demand in the economy for goods and services
- b) Increase in input costs
- c) Deficit-induced inflation
- d) Ratchet inflation