ELECTRICAL & MECHANICAL ENGINEERING

Section B **MECHANICAL**

BRIHANMUMBAI MUNICIPAL CORPORATION

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PREFACE

Dear Students,

It is with immense pleasure that we present our highly useful book set tailored for the Brihan-Mumbai Muncipal Corporation (BMC) Mechanical & Electrical Engineering for the post of Sub Engineer & Junior Engineer Examination. This set caters to Mechanical Engineering and Electrical Engineering aspirants who are diligently preparing for this examination.

As one part of a two-book set, this volume strictly aligns with the revised and updated syllabus. At the end of each chapter, we have given important MCQ for practice, along with their respective weightage. Additionally, for your convenience, we have included the Question Paper of Previously taken examination by TCS and IBPS, allowing aspirants to easily gauge the importance of each subject.

This book has been meticulously designed and authored by experts, and its final shape has been refined based on the invaluable feedback from selected aspirants. The author has maintained a logical flow of topics, aiding aspirants in recalling information effortlessly. The primary purpose behind crafting this book set is to provide a singular resource that covers all aspects required to excel in SE & JE posts in upcoming examinations.

Our sincere gratitude extends to Infinity Academy and its Publication department for the encouragement and unwavering support they have provided. We also express our thanks to the director and staff members of Infinity Academy for their dedicated efforts in shaping this book. Every attempt has been made to eliminate errors, but if you come across any, please reach out to us via WhatsApp at 7057492418. Your feedback is crucial in helping us improve further.

We acknowledge the collective efforts of Team Infinity, without whom it would not have been possible to publish this book within a short time span while maintaining the highest quality standards.

All efforts have been made to avoid mistakes, and Team Infinity is thankful to all the members who have contributed to making this book a reality.

GIRISH KHEDKAR

INFINITY ACADEMY

INDEX

BASICS OF MECHANICAL ENGINEERING

1 BASICS OF MECHANICAL ENGINEERING

MILLING

i)Milling is a machining process in which metal is removed by means of a revolving cutter with many teeth, each tooth having a cutting edge which removes metal from a work piece.

ii)In milling process, the work is supported by various method on the worktable of milling machine and fed into a rotating cutting tool known as milling cutter.

iii)Equally spaced peripheral teeth on the cutter come in contact with the work piece intermittently and machine the work piece and is called intermittent cutting.

iii)In some milling machines, the work piece remains stationary and the cutter is fed into the work piece.

Parts having flat, curved and intricate shapes, can be machined on the milling machine.

Face Milling
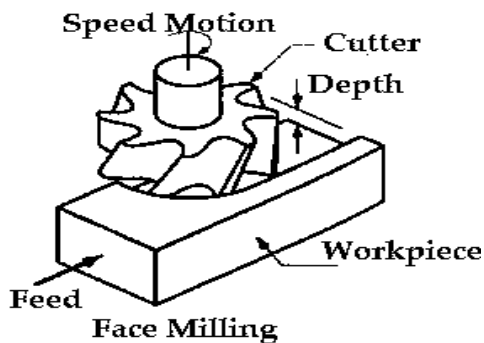
MILLING PROCESSES

There are two types of milling processes
I) Up milling (or conventional milling) process
ii) Down milling (or climb milling) process.

i) Up Milling (Or Conventional Milling) Process
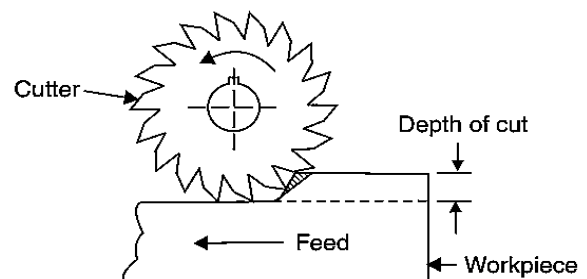
Up milling process

i)In this up milling process, the work piece is fed opposite to the cutter's tangential velocity.

ii)Each tooth of the cutter starts the cut with zero depth of cut, which gradually increases and reaches the maximum value as the tooth leaves the cut. The chip thickness at the start is zero increases to maximum at the end of the cut.

ii)The action of the cutter, forces the work piece and the table against the direction of table feed, thus each 'tooth' enters a clean metal gradually thus the shock load on each tooth is minimised.

iii)Difficulty is experienced in pouring coolant on the cutting edge and as a result, chips accumulate at the cutting zone and may be carried over with the cutter, thus spoiling the surface finish. The surface becomes slightly wavy, as the cut does not begin as soon as the cutter touches the work piece.

iv)While making deep cuts, the cutter tends to pull the work piece out of the vice or the fixture, because the cutting force is directed upward at an angle; This requires secured clamping of work piece.

ii) Down Milling (Or Climb Milling) Process
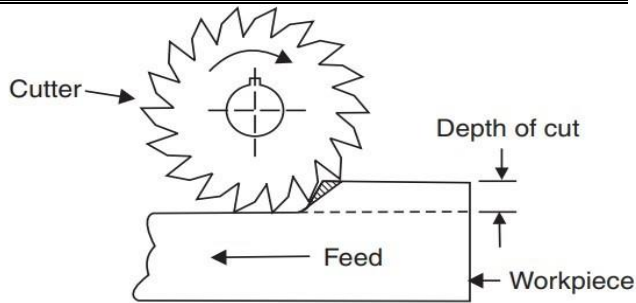
Down milling process.

In down milling process the work piece is fed in the same direction as that of the cutter's tangential velocity. The cutter enters the top of the work piece and removes the chip that gets progressively thinner as the cutter tooth rotates.

Advantages of down milling process:

• The cutting force of the cutter tends to hold the work piece against the machine table due to which lower clamping forces are required to clamp the work piece.

• Down milling produces better finish and better dimensional accuracy.

• Coolant can be fed easily.

• The chips are disposed off conveniently and they do not interfere with the cutting due to which the machined surface of the work piece is not spoiled.

Down milling is performed on the materials that are free from the scales and surface imperfections.

CLASSIFICATION OF MILLING MACHINES

Milling machines are classified as below:

Column And Knee Type

(i) Horizontal milling machine
(ii) Vertical milling machine
(iii) Universal milling machine

(iv) Omniversal milling machine

Manufacturing or fixed bed type

(i) Simplex milling machine
(ii) Duplex milling machine
(iii) Triplex milling machine

Simplex, duplex or triplex machines

These are smaller versions of planer type milling machines. In simplex milling machine one spindle is on one side, in duplex milling machine two spindles on two sides and in triplex milling machine two spindles on two sides and one on the overhead.

These machines are larger, heavier and have greater rigidity than the column and knee type and are not adapted to tool room.
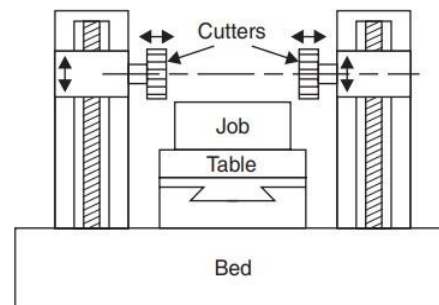
Duplex bed type milling machine.

Planer type

This machine looks like a double column planer, but has milling heads mounted in various planes, vertical milling heads on cross rail and horizontal heads at the sides. Due to which it can machine a work piece on sides simultaneously.

This machine is primarily intended for producing long straight surfaces on large and heavy machine parts.

Special type

(i) Rotary table milling machine
(ii) Drum milling machine
(iii) Planetary milling machine

2 WELDING

WELDING

Welding is a localised coalescence of similar of dissimilar metals, wherein coalescence is obtained by with or without application of heat and pressure, with or without the use of filler metal. The filler metal has melting point approximately same as the base metal.

Based on the composition of the joint after welding, welding can be classified as,

1.   Autogenous process: No filler material is added during the joining

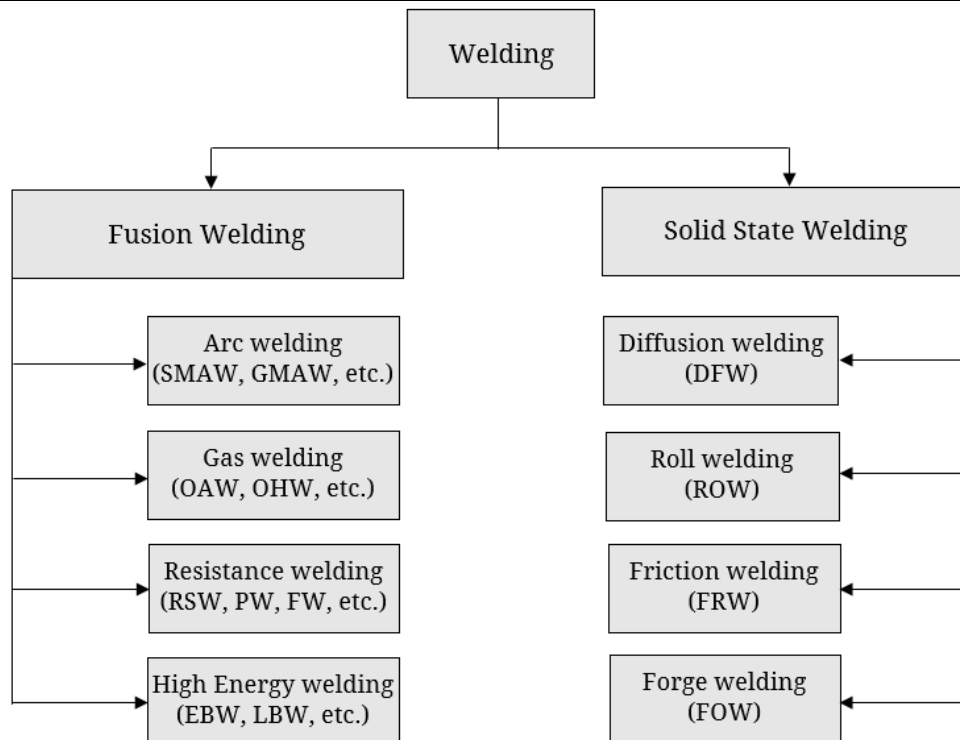2.   Homogeneous process: This process makes use of filler metal but of same composition as the parent metal

3.   Heterogeneous process: The filler material is soluble in both the parent metals which themselves are insoluble in each other.

CLASSIFICATION OF WELDING PROCESS

```
                          ┌──────────┐
                          │ Welding  │
                          └────┬─────┘
              ┌────────────────┴────────────────┐
      ┌───────────────┐                 ┌─────────────────────┐
      │ Fusion Welding│                 │ Solid State Welding │
      └───────────────┘                 └─────────────────────┘

      Arc welding                        Diffusion welding
      (SMAW, GMAW, etc.)                 (DFW)

      Gas welding                        Roll welding
      (OAW, OHW, etc.)                   (ROW)

      Resistance welding                 Friction welding
      (RSW, PW, FW, etc.)                (FRW)

      High Energy welding                Forge welding
      (EBW, LBW, etc.)                   (FOW)
```

6 DESIGN OF SCREW & BOLT

Basically most important joints forms are two type one is threaded joint & another one is welded Joint In this chapter we are going to study the design of this two joints.

THREADED JOINT

I)This type of Joint is formed by cutting contineous helical groove on cylindrical Surface, when there is single helical groove is called as single stort threaded Screw Then. there is space between grooves of the first the it is called as double started threaded screw.

II)Screwed joint is mainly composed of two elements. Screw & (bolt) & nut.

III)These type of joints are used in machine port to readily connect & disconnect machine part without causing any damage to machine or fastening.

APPLICATIONS OF SCREWED THREAD JOINTS

I) Threads having high strength & low efficiency so Loosing during Service so it used in radially joint.

II)It also helpful in transmitting power or energy because of high efficiency.

various forms of threads-

1) whit worth thread
2) Buttress thread
3) knuckle thread
4)Acme thread
5) square thread

out of this 'v' thread & square threads be used.

I)Because 'V' threads used in bolts, a studs, nuts, tighten the Parts together.

II)'V' threads are stronger than Square thread.

III)'V' threads the cheaper, because of easiness to cut by die or on machine.

TERMINOLOGY FOR SCREW THREADS

1)Major Diameter (do) = It is the longest dimeter by which screw is specified.

2)Minor Diameter (dc) = It is smallest diameter of external & internal screw threads also called as root or come diameter.

3)Pitch Circle Diameter(de) = It is an imaginary diameter of cylinder on Cylindrical screw thread as the surface pass through thread at Such point as make equal width of thread & width of space between thread.

4)Pitch= It is nothing but a distance between one point on one thread to corresponding point on another or next thread

$$p = \frac{1}{No\ of\ threds\ per\ unit\ length\ of\ screw}$$

5)lead= It is defined as distance through which, a screw advance axially in one rotation of nut.

Lead =2x pitch
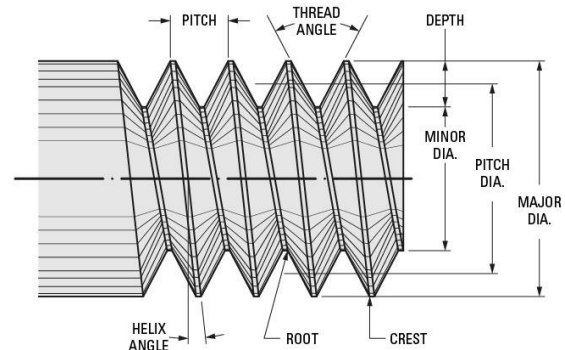
TYPE OF SCREW FASTENING

There are three type of Screw Fastening
1)Through bolt
2) Tap bolt

THERMAL ENGINEERING

A] THERMODYNAMICS

1 BASICS OF THERMODYNAMICS

Thermodynamics is branch of science which deals with **3E**

i.e.,

1st E-**Equilibrium**

2nd E-**Energy**

3rd E -**Entropy**

EQUILIBRIUM

(i) It simply means balance Any kind of Balance is equilibrium like balance of forces, balance reaction, etc.

(ii) Thermodynamic equilibrium means balance of thermal, mechanical, chemical Equilibrium.

(iii) Thermal equilibrium means equality of temperature

(iv) mechanical equilibrium means equality of force

(v) chemical equilibrium means Stability in chemical potentials

Note-

If in Exam, question is asked about equilibrium then

1)IF they ask Thermal equilibrium, then there is equality of Temperature.

2)If they ask thermodynamic equilibrium then there is all their equilibrium, exist that is thermal, mechanical &chemical equilibrium.

ENERGY

Energy is nothing but a capacity to do work.

In thermodynamics we deal with thermal energy of any Component/System.

ENTROPY

i) entropy is degradation of heat energy.

ii) Basically, entropy is the loss of energy of system.

SYSTEM

System is controlled region & space over which our attention of Focus.

i) Basically, System is region in Space in which we are focusing our study

SURROUNDING

- everything which is not part of system is Surrounding

BOUNDARY

It is the region which is separating system from Surrounding Boundaries can be real or imaginary. Boundaries can be fixed or movable:

ii) Boundaries are having zero thickness.

universe- universe is nothing but a consideration of Summation of System & Surrounding.

Types of System -There are 3 type of system.

1) close system

2) open System

3) isolated system

1)close system

i) It is type of by system where only Energy Can transfer from the system, but mass is not capable of transfer from the systems but get into the Systems

ii)Only energy interaction between System & Surrounding.

THEORY OF MACHINES

1. The relation between the no. of pairs (p) forming a kinematic chain and the no. of links (1) is
A. 1=2p-2   B. 1=2p-3
C. 1=2p-4   D. 1=2p-5

2. The Grubler's criterion for obtaining the degree of freedom (F) of a planar mechanism with 'n' number of links and 'j' number of binary joints, is given by:
A. F=3(n-1)-j   B. F=3(n-1)-2j
C. F=2(n-1)-j   D. F=2(n-1)-2j

3. A planar mechanism has 8 links and 10 rotary Joints. The number of degrees of freedom of the mechanism, using Grubler's criterion, is:
A. 0   B. 1   C. 2   D. 3

4. Mechanism is said to be converted to structure if the degree of freedom of mechanism reduced to:
A. 3   B. 1   C. 0   D. 2

5. If the elements of a kinematic pair make surface contact when in motion, then it is called a:
A. Lower pair   B. Closed pair
C. Higher pair   D. Surface pair

6. Inversion of a mechanism means
A. turning it upside down
B. fixing different links in a kinematic chain
C. changing a higher pair to lower pair
D. changing the input and output links

7. In a four-bar chain or quadratic cycle chain
A. each of the four pairs is a turning pair
B. one is a turning pair and three are sliding pairs
C. two are turning pairs and two are sliding pairs
D. three are turning pairs and one is a sliding pair

8. In a 4- bar linkage, if the lengths of shortest, longest and the other two links are denoted by s, 1, p and q, then it would result in Grasshof's linkage provided that:
A. l+p<s+q   B. l+s<p+q
C. l+p=s+q   D. None of these

9. In kinematic chain, a quarternary joint is équivalent to
A. one binary joint
B. two binary joints
C. three binary joints
D. six binary joints

10. The number of degree of freedom of a five link place mechanism with five revolute pairs as shown in the figure is
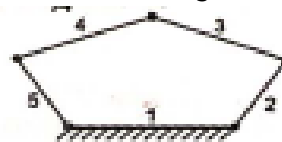
A. 3   B. 4
C. 1   D. 2

11. A planar linkage having 8 links and 9 joints of single degree of freedom will have degree of freedom.
A. 1   B. 2   C. 3   D. 4

12. A mechanism is an assemblage of:
A. three links
B. four links or more than four links
C. None of three mentioned here.
D. two links

13. Which of the following is the inversion of double slider crank chain?
A. Beam Engine
B. Elliptical Trammel
C. Watt's indicator mechanism
D. Quick return mechanism

14. The following is not the inversion of slider crank mechanism

POWER PLANT ENGINEERING

1. The efficiency of superheat Rankine cycle is higher than that of simple Rankine cycle because.
A. the enthalpy of main steam is higher for superheat cycle
B. the mean temperature of heat addition is higher for superheat cycle
C. the temperature of steam in the condenser is high
D. the uality of steam in the condenser is low.

2. Which of the following is a water-tube boiler?
A. Cochran boiler
B. Babcock and Wilcox boiler
C. Lancashire boiler
D. Locomotive boiler

3. In steam power cycle, reheat factor is usually in the range:
A. 1.02 to 1.05   B. 1.12 to 1.15
C. 1.5 to 1.8.   D. 1.9 to 2.1

4. In steam power cycle, the process of removing non-condensable gases is called
A. scavenging process
B. deaeration process
C. exhaust process
D. condensation process

5. Thermal power plant works on
A. Carnot cycle
B. Joule cycle
C. Rankine cycle
D. Brayton cycle

6. Reheating of Rankine Cycle will
A. not alter turbine efficiency
B. improve the steam uality
C. decrease the nozzle and blade efficiency
D. decrease the turbine efficiency

7. An air preheater is installed
A. before the economiser
B. before the superheater
C. between the economiser and chimney
D. none of these

8. In a Rankine cycle, regeneration results in higher efficiency because
A.Pressure inside the boiler increases
B. Heat is added before steam enters the low pressure turbine
C. Average temperature of heat addition in the boiler increases
D. Total work delivered by the turbine increases

9. Reheat factor is defined as the:
A. ratio of cumulative enthalpy drop to isentropic enthalpy drop
B. product of cumulative entropy drop to isentropic enthalpy drop
C. ratio of isentropic enthalpy drop to cumulative enthalpy drop
D. sum of isentropic and cumulative enthalpy drops

10. The thermal efficiency of an ideal Rankine cycle is less than that of Carnot cycle operating between the same maximum and minimum temperature limits because:
A. Heat addition does not takes place at constet temperature
B. The expansion process is not reversible z adiabatic
C. Heat rejections does not take place constant temperature
D. The compression process is not reversible and adiabatic.