Subject Name & Code:

MANUFACTURING PROCESSES-BE04000191

ASSIGNMENT-1: Basic Machine Tools and Metal Cutting Principles (CO-1)

Q1. Describe working and auxiliary motions in machines.

Working Motions (Cutting Motions):

- **Primary/Cutting Motion:** Main movement causing chip removal; consumes maximum power.
    - Example: Workpiece rotation in lathe, drill rotation in drilling.
- **Feed Motion:** Brings fresh material into contact with tool.
    - Example: Tool movement along bed in lathe.

Auxiliary Motions (Non-Cutting Motions):

- Motions that support machining but do not directly remove material.
- **Approach motion:** Moving tool towards workpiece.
- **Return motion:** Quick return in shaper/slotter to reduce idle time.
- **Indexing motion:** Rotating workpiece to new cutting position (milling).
- **Relieving motion:** Retracting tool to avoid rubbing during return stroke.
- **Clamping/Unclamping:** Holding and releasing workpiece.

Q2. Differentiate between orthogonal and oblique cutting.

Parameter	Orthogonal Cutting	Oblique Cutting
Cutting Edge	Perpendicular (90°) to cutting velocity	Inclined at angle ($\lambda \neq 90°$)
Active Edges	Single cutting edge	Two or more edges
Chip Flow	Straight up tool face (2D)	Sideways, helical (3D)

Parameter	Orthogonal Cutting	Oblique Cutting
Force Components	Two forces (Fc and Ft)	Three forces
Tool Life	Lower (heat concentrated)	Higher (heat distributed)
Surface Finish	Poorer	Better
Example	Broaching, sawing, orthogonal turning	Turning with side cutting edge, drilling, milling
Analysis	Simple 2D (research use)	Complex 3D
Practicality	Mostly theoretical	Most practical operations

Q3. Explain the classification of machine tools. Explain types of motion in machine tools with example.

Classification of Machine Tools:

1. Based on Operation Type:

- **General Purpose:** Lathe, milling, drilling (versatile, low production).
- **Special Purpose:** Gear hobbing, thread rolling (specific operation).
- **Single Purpose:** Dedicated machines for mass production.

2. Based on Automation:

- Manual, Semi-Automatic (Capstan/Turret), Automatic (CNC).

3. Based on Size:

- Light Duty, Medium Duty, Heavy Duty.

4. Based on Precision:

- Ordinary precision, High precision (Jig boring, precision grinding).

5. Based on Cutting Motion:

- **Rotary Primary Motion:** Lathe, Drilling, Milling, Grinding.
- **Reciprocating Primary Motion:** Shaper, Planer, Slotter.

Types of Motion in Machine Tools:

Motion Type	Description	Example
Rotary	Circular movement about axis	Spindle rotation in lathe; Drill rotation
Reciprocating	Back-and-forth linear motion	Ram movement in shaper; Table in planer
Translatory	Linear movement without rotation	Tool slide movement in lathe
Intermittent	Movement at intervals	Indexing in milling; Ratchet feed
Oscillatory	Angular back-and-forth movement	Tool head swivel in shaper

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Q4. What is Tool Signature and Tool Geometry? Explain importance of tool angles for single point cutting tool in brief.

Tool Geometry:

- Overall shape, size, and arrangement of tool parts including angles, surfaces, and cutting edges.

Tool Signature:

- Numerical code specifying complete geometry of single point cutting tool in standard sequence.
- **ASA System (7 elements):** Back Rake Angle - Side Rake Angle - End Relief Angle - Side Relief Angle - End Cutting Edge Angle - Side Cutting Edge Angle - Nose Radius.
- **Example:** 8°-14°-6°-6°-15°-15°-0.8 mm

Importance of Tool Angles:

Angle	Function/Importance
Rake Angle	Controls chip flow; positive rake reduces cutting force; negative rake increases strength for hard materials.

Angle	Function/Importance
Relief/Clearance Angle	Prevents rubbing of tool flank against workpiece; ensures smooth cutting.
Cutting Edge Angle	Distributes cutting forces; affects chip thickness and surface finish.
Nose Radius	Strengthens tool point; improves surface finish; dissipates heat.