Subject Name & Code:

MANUFACTURING PROCESSES-BE04000191

ASSIGNMENT-2: Metal Cutting Lathes (CO-2,3,4)

Q1. Give the comparison between a turret lathe and capstan lathe.

Parameter	Capstan Lathe	Turret Lathe
Turret Mounting	On **short slide (ram)** moving on saddle	**Directly on saddle**
Movement	Ram-type; limited stroke	Saddle-type; full bed length
Workpiece Size	Smaller bar stock (up to 60mm dia)	Larger, heavier workpieces
Rigidity	Less rigid (overhanging ram)	More rigid (full saddle support)
Production Rate	Higher for small parts	Lower for small parts
Cutting Forces	Light to medium cuts	Heavy cuts possible
Cost	Lower	Higher
Application	Screws, bolts, small bushings	Flanges, gear blanks, pulleys

Q2. Explain various types of chucks used on lathe machine.

Chuck Type	Key Features	Applications
Three-Jaw (Self-Centering)	Jaws move together by scroll plate; quick centering	Round/hexagonal bar stock
Four-Jaw (Independent)	Each jaw adjusted separately; high accuracy; high gripping force	Irregular shapes, eccentric work, castings
Collet Chuck	Split steel sleeve contracts around workpiece; extreme accuracy	Precision small diameter bar work
Magnetic Chuck	Uses electromagnets to hold ferromagnetic parts	Thin discs, plates for facing
Combination Chuck	Both scroll and independent adjustment	Jobs needing quick setup + accuracy
Air/Hydraulic Chuck	Power operated; fast and consistent	High production, automated lathes
Drill Chuck	Small 3-jaw with tapered shank for tailstock	Holding drills, reamers, taps

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Q3. List the common operations which can be carried out on lathe.

External Operations:

- Straight Turning, Taper Turning, Step Turning, Facing, Chamfering
- Grooving/Necking, Parting/Cutting Off, Form Turning, Knurling, Filing/Polishing

Internal Operations:

- Drilling, Boring, Reaming, Counterboring, Countersinking
- Internal Threading, Internal Grooving, Taper Boring

Threading Operations:

- External Threading (V, Square, ACME), Taper Threading, Multi-Start Threading

Special Operations:

- Eccentric Turning, Spherical Turning, Relieving, Winding (springs)

Q4. Draw a line sketch diagram of lathe machine and indicate principle parts on it.

Diagram:

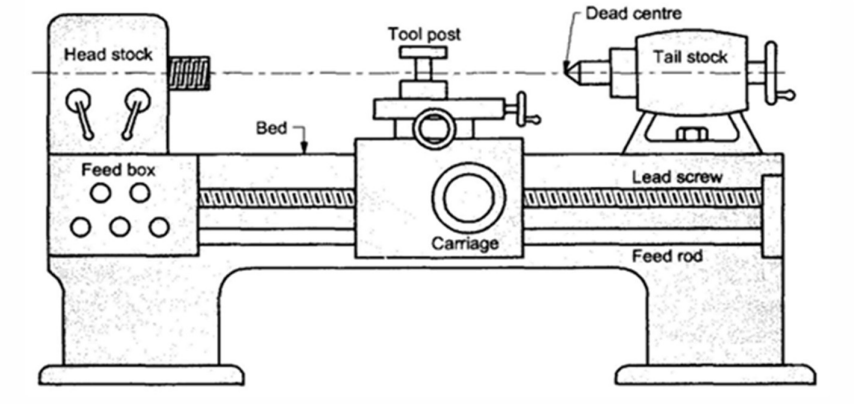

Fig.2.2 Parts of Lathe Machine

Q5. List various taper turning methods use in lathe machine and explain taper turning by setting over the tailstock.

Taper Turning Methods:

1. Form Tool Method (Broad nose tool)
2. Compound Rest Swiveling Method
3. **Tailstock Set-Over Method**
4. Taper Turning Attachment Method

Tailstock Set-Over Method:

- **Principle:** Workpiece axis is inclined by offsetting tailstock centre from headstock centre. Tool moves parallel to lathe axis, generating taper.
- **Procedure:**
    - Workpiece mounted between centres.
    - Tailstock body offset laterally by calculated amount 'S'.
    - Offset towards operator: smaller diameter at tailstock end.
    - Offset away from operator: smaller diameter at headstock end.
    - Multiple passes taken to achieve required taper.

Formula:
$S = [L \times (D - d)] / (2 \times l)$

Where: S = Set-over (mm), L = Total workpiece length (mm), l = Taper length (mm), D = Larger diameter (mm), d = Smaller diameter (mm).

When entire length is tapered (L = l): **S = (D - d) / 2**

Advantages: Long tapers with power feed, good finish, simple setup.
Limitations: Only external tapers between centres, cannot produce steep tapers, uneven centre wear.

Q6. State the functions of live centre and dead centre in a lathe.

Parameter	Live Centre	Dead Centre
Location	Headstock spindle	Tailstock quill
Rotation	Rotates with workpiece	Stationary
Function	Drives and supports workpiece; transmits rotation	Supports free end; maintains alignment
Friction	No relative motion; minimal friction	Sliding friction at contact point
Lubrication	Internal bearing lubrication only	Requires grease/oil at contact point
Wear	Minimal	Subject to wear and heat
Type	Plain or ball bearing live centre	Plain dead centre or revolving dead centre

Note: Revolving dead centre has bearings and rotates with workpiece, eliminating friction.

Q7. Explain the function of a thread chaser in lathe operation.

Thread Chaser: Multi-toothed cutting tool used for finishing, cleaning, or restoring existing threads.

Functions:

1. **Thread Finishing:** Improves surface finish and accuracy after single-point threading.

2. **Thread Restoration:** Repairs damaged threads on existing components.
3. **Thread Sizing:** Brings thread to exact final dimensions.
4. **Deburring:** Removes burrs from thread crests and roots.
5. **Quick Thread Production:** For soft materials, can produce complete threads in one pass (capstan/turret lathes).

Types: Hand chasers, Machine chasers, Internal chasers, External chasers.

Advantages over Single-Point Tool:

- Multiple teeth share cutting load; less wear.
- Better surface finish due to burnishing action.
- Faster operation for finishing passes.
- Self-aligning.

Limitations: Cannot cut threads from solid; specific to one pitch and form; not for hard materials.

Q8. Explain why a lathe bed is made from cast iron. Explain the lathe bed with a neat sketch.

Reasons for Using Cast Iron:

Property	Significance for Lathe Bed
High Compressive Strength	Supports heavy workpieces and cutting forces
Excellent Damping Capacity	Graphite flakes absorb vibrations; prevents chatter
Good Wear Resistance	Hardened guideways resist sliding friction wear
Good Castability	Can be cast into complex shapes with ribs
Dimensional Stability	Stable after seasoning; maintains alignment
Low Cost	Economical for large castings
Self-Lubricating	Graphite provides inherent lubricity

Types Used: Grey Cast Iron (FG-200/260), Nodular Iron (heavy-duty), Meehanite (premium).

Construction Features:

- Box-section with internal ribbing for rigidity.
- Hardened and ground guideways (45-55 HRC).
- Vee and flat guideways combination.
- Seasoned to relieve casting stresses.

Diagram:

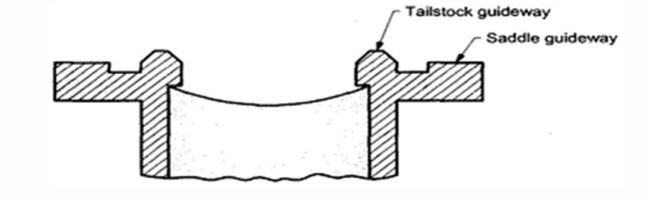

Fig.2.3 Function of Machine ToolS

Q9. Name the parts of an engine lathe. Name the accessories used on a lathe.

Principal Parts of Engine Lathe:
Bed, Headstock, Spindle, Tailstock, Carriage, Saddle, Cross Slide, Compound Rest, Tool Post, Apron, Lead Screw, Feed Rod, Feed Gearbox, Legs/Base, Chip Pan.

Accessories:

Category	Examples
Work Holding	3-Jaw Chuck, 4-Jaw Chuck, Collet Chuck, Face Plate, Lathe Dog, Mandrels, Steady Rest, Follower Rest
Tool Holding	Tool Holder, Boring Bar, Drill Chuck, Tap/Die Holders, Knurling Tool Holder
Attachments	Taper Turning Attachment, Milling Attachment, Grinding Attachment, Copying Attachment
Measuring	Calipers, Micrometers, Dial Indicators, Thread Gauges

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Q10. What tests are carried out to check the alignment of a lathe?

Key Alignment Tests (As per IS 1878):

1. **Levelling of Bed:** Spirit level on cross slide; tolerance 0.02 mm/1000 mm.
2. **Parallelism of Spindle Axis with Bedways (Vertical):** Test mandrel, dial indicator on top; 0.02 mm/300 mm (free end rising only).
3. **Parallelism of Spindle Axis with Bedways (Horizontal):** Dial indicator on side; 0.02 mm/300 mm (free end towards tool pressure only).
4. **True Running of Spindle Nose:** 0.01 mm TIR.
5. **Alignment of Headstock and Tailstock Centres:** Test mandrel between centres; 0.02 mm height difference (tailstock higher only).
6. **Squareness of Cross Slide to Spindle Axis:** 0.02 mm/300 mm (concave only).
7. **Axial Slip of Spindle:** 0.01 mm maximum.
8. **Parallelism of Lead Screw with Bedways:** 0.10 mm/1000 mm.
9. **Accuracy of Lead Screw Pitch:** ±0.03 mm/300 mm cumulative.

Q11. Write a short note on: "Apron Mechanism"

Apron Mechanism:

- **Definition:** Front portion of carriage housing controls, gears, and clutches that transmit motion from feed rod and lead screw to carriage.

Functions:

- Convert rotary motion to linear motion for feeds.
- Provide manual and power longitudinal/cross feeds.
- Engage/disengage feeds via clutches.
- House half-nut for thread cutting.
- Safety interlocks prevent simultaneous engagement.

Working:

- **Manual Feed:** Handwheel → Pinion on rack → Carriage moves.
- **Power Feed:** Feed rod → Worm/Worm wheel → Clutch → Pinion on rack → Carriage moves.
- **Cross Feed:** Same drive diverted through bevel gears → Cross feed screw → Cross slide moves.
- **Threading:** Lead screw → Half-nuts engaged → Carriage moves at precise pitch.

Q12. Compare the benefits and limitations of a three jaw chuck vis-à-vis a four jaw chuck.

Parameter	Three-Jaw Chuck	Four-Jaw Chuck
Centering	Automatic (scroll plate)	Manual (independent screws)
Setup Time	Very quick	Time-consuming
Accuracy	Moderate; deteriorates with wear	Very high (0.01mm TIR possible)
Workpiece Shape	Only round, hexagonal, symmetric	Any shape: round, square, irregular, eccentric
Gripping Force	Moderate	Very high
Eccentric Work	Cannot hold	Ideal for eccentric turning
Rough Castings	Poor grip	Excellent grip
Cost	Lower	Higher
Operator Skill	Minimal	Skilled required
Applications	Bar turning, production runs	Tool room, repair, jobbing work

Summary: Three-jaw for speed and convenience; Four-jaw for versatility and precision.

Q13. Explain the thread cutting operation on lathe machine.

Principle:
Producing helical groove by precise relationship between workpiece rotation and tool longitudinal movement. One revolution of spindle = tool moves exactly one thread pitch.

Procedure:

1. **Workpiece Preparation:** Turn to major diameter of thread. Cut chamfer at start.
2. **Machine Setting:**

- Set lathe to required thread pitch via gearbox.
- Engage lead screw (half-nut lever).
- Set tool exactly on centre height using centre gauge.
- Align tool perpendicular to workpiece axis (threading gauge).

3. **Tool Setting:**
   - Set compound rest at 29° (for 60° V-thread) or 0° (alternate method).
   - Touch tool to workpiece and set cross slide dial to zero.
4. **Cutting Passes:**
   - First pass: Light cut (0.05-0.10 mm depth).
   - Engage half-nut at correct line on threading dial.
   - At end of cut, retract tool quickly and disengage half-nut.
   - Return carriage to start manually or using leadscrew reverse.
   - Repeat with increasing depth of cut using compound slide.
   - Final passes: Light cuts for finish; may use chaser.
5. **Thread Checking:** Use thread pitch gauge, thread micrometer, or mating nut.

Thread Cutting Methods:

- **Compound Rest at 29°:** Tool feeds at angle; only one cutting edge active; better finish.
- **Cross Slide Feeding (Plunge Cut):** Both edges cut; faster but rougher finish.

Q14. Compare Capstan Lathe, Turret Lathe and Centre Lathe.

Parameter	**Centre Lathe (Engine Lathe)**	**Capstan Lathe**	**Turret Lathe**
Turret Head	No turret; single tool post only	Turret mounted on **ram/slide** moving on saddle	Turret mounted **directly on saddle**
Tool Changing	Manual tool change for each operation	Multiple tools preset in turret; **quick indexing**	Multiple tools preset; indexing
Production Rate	Low; suitable for jobbing/repair work	**High** for small parts	High for larger parts

Parameter	Centre Lathe (Engine Lathe)	Capstan Lathe	Turret Lathe
Workpiece Size	Any size within machine capacity	Small diameter bar stock (up to 60 mm)	Larger and heavier workpieces
Setup Time	High for multiple operations	**Low**; tools preset on turret	Low
Operator Skill	Skilled operator required	Semi-skilled operator sufficient	Semi-skilled operator
Rigidity	Good	Less rigid (ram overhang)	**More rigid** (saddle support)
Stroke/Travel	Full bed length available	Limited by ram stroke length	Full bed length available
Cutting Forces	Can handle medium to heavy cuts	Light to medium cuts only	Heavy cuts possible
Automation	Manual feeds; thread cutting via lead screw	Power feeds to both turret and cross slide	Power feeds; some automatic cycles
Bar Feeding	Not automatic	Bar stock can be fed through spindle	Bar feeding possible
Cost	Lowest	Moderate	Highest
Applications	Prototype, repair, tool room, one-off jobs	Mass production of small screws, bolts, bushings	Batch production of larger flanges, gear blanks, pulleys