GUJARAT TECHNOLOGICAL UNIVERSITY

BE-4 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK SOLUTION

Subject Name & Code:
Manufacturing Processes (3141908)

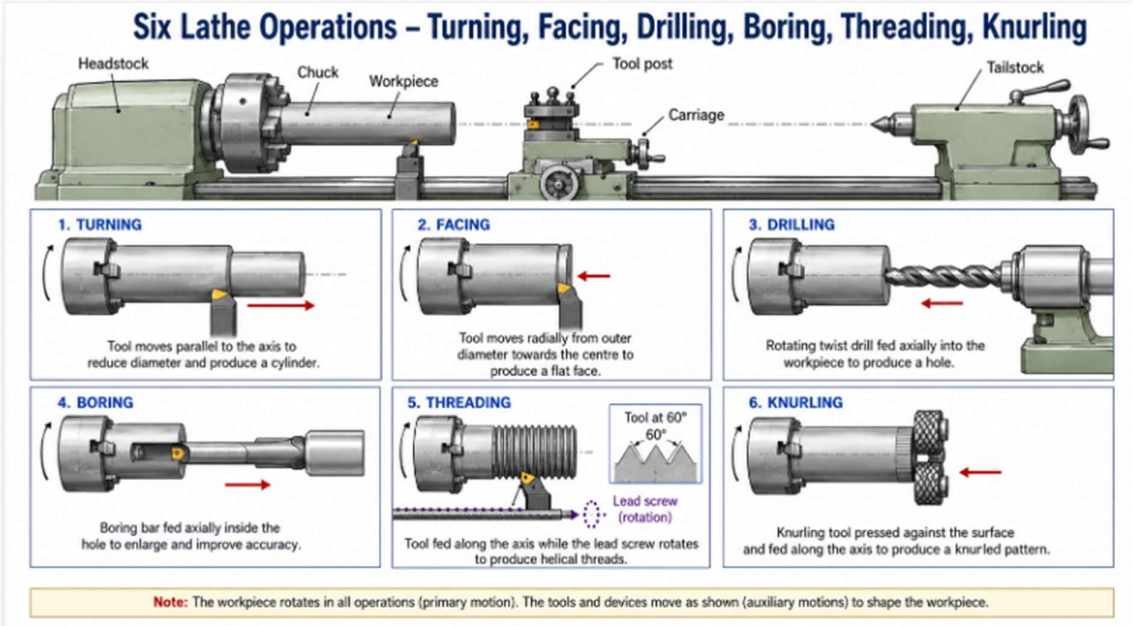
🔧 UNIT 2: Lathe Machines

Q.1 – List operations carried out on engine lathe machine tools. (3 marks)
Appeared in: S25(3)
Ans:
Six basic operations:

1. Turning (rough & finish)
2. Facing
3. Drilling (with tailstock)
4. Boring
5. Threading (external & internal)
6. Knurling

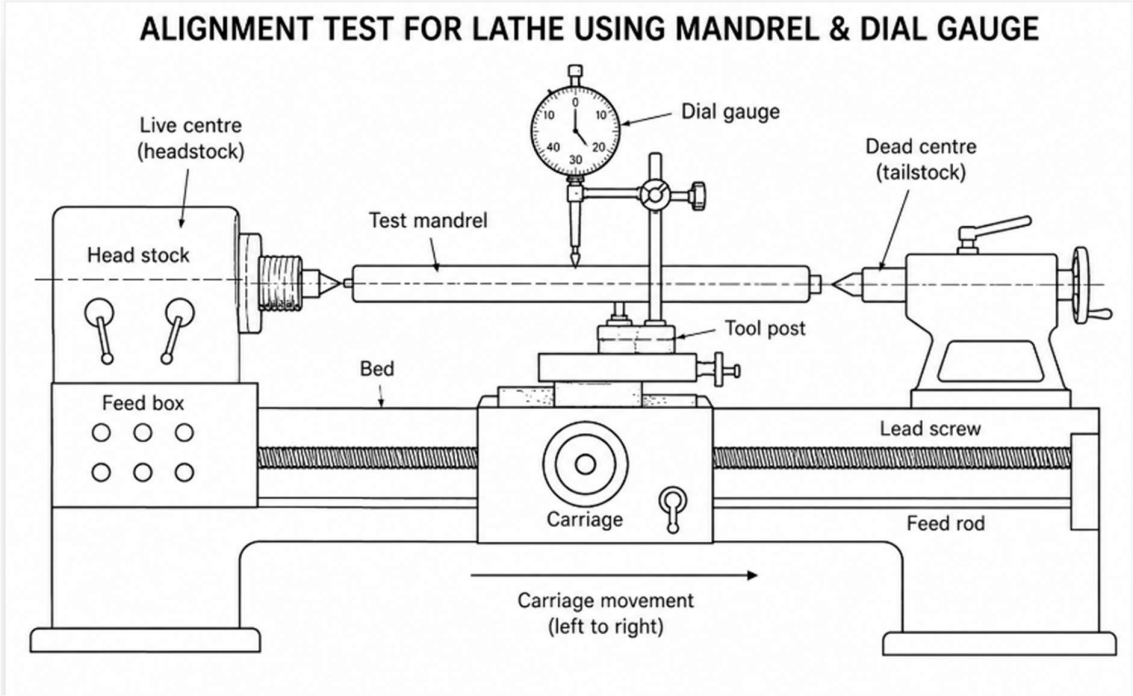
Also: Parting off, Taper turning, Grooving, Reaming.

Q.2 – Explain any six operations carried out on the lathe machine. (7 marks)
Appeared in: S24(4), S22(7), W23(7), W25(4) → Highest: 7 marks
Ans:
1. Turning – Reduces diameter. Tool moves parallel to axis.
2. Facing – Creates flat end surface. Tool moves perpendicular to axis.
3. Drilling – Drill bit in tailstock; hole made by rotating work.
4. Boring – Enlarges existing hole with single-point boring bar.
5. Thread cutting – Lead screw engages half-nut; tool follows helix angle.
6. Knurling – Presses patterned wheel to create grip texture.
[DG]



Real-world application: Crankshaft journal turning & threading (automotive).
Advantages: Versatile, low cost
Limitations: Low production rate, skilled operator required.

Q.3 – What is an alignment test? Describe alignment process for a lathe machine. (7 marks)
Appeared in: S25(4), S22(3), W23(3), W22(7) → Highest: 7 marks
Ans:
Alignment test: Checking geometric accuracy of machine tool components relative to each other under no-load condition.
Test on lathe:
[DG]



Steps:

1. Place ground test mandrel between centres.
2. Mount dial gauge on carriage touching mandrel top surface.
3. Move carriage over full length – observe runout.
4. Permissible error: ≤ 0.02 mm over 300 mm length.
5. Test for tailstock alignment: gauge on mandrel side.
6. Test spindle concentricity: gauge inside Morse taper.

Real-world: New lathe installation follows IS 1878 (1976) alignment standards.

Q.4 – Describe construction and key components of an engine lathe. (7 marks)

Appeared in: S25(7)

Ans:

[DG PROMPT]

Title: Construction of engine lathe – key components

Description: Draw a 3D isometric line diagram of centre lathe. Show:

1. **Bed** – long horizontal base with V & flat guideways.
2. **Headstock** – left end containing spindle, gears, clutch. Inside show stepped pulley or gear train.
3. **Tailstock** – right end adjustable on bed; has barrel, handwheel, centre.
4. **Carriage** – slides on ways; comprises apron, saddle, cross-slide, compound rest, tool post.
5. **Feed mechanism** – lead screw (for threading) and feed rod (for turning).
6. **Chuck** (3-jaw / 4-jaw) on spindle.

   Arrows indicate movable parts.

Key components & function:

- **Spindle:** Hollow bore for bar work.
- **Quick-change gearbox:** Selects feed rate or thread pitch.
- **Half-nut mechanism:** Engages lead screw for threading.

Example: Capstan lathe has additional turret for production.

Q.5 – Explain how thread cutting is performed on a lathe using gear train and chasing dial. (7 marks)

Appeared in: S25(7 OR), S22(7 OR), W22(7 OR)

Ans:

Principle: Tool moves along workpiece at same distance per revolution as thread pitch (p). This is achieved by connecting spindle rotation to lead screw via **gear train**.

Steps:

1. Select required pitch (p) from gearbox chart.
2. Set gear train (change gears) or quick-change box accordingly.
3. Engage **half-nut** after aligning **chasing dial** (to avoid cross-threading).

Chasing dial: A threaded dial meshing with lead screw; its graduated dial shows when to engage half-nut at start of each pass.

[DG PROMPT]

Title: Thread cutting mechanism – gear train & chasing dial

Description: Draw top view of lathe headstock to lead screw. Show: spindle → gear train (three interlocking gears) → quick-change gearbox → lead screw. On lead screw near apron, show chasing dial (small cylindrical dial with numbers). Arrow indicates half-nut lever. Label: Change gears, Gearbox, Lead screw, Chasing dial, Half-nut.

Real-world application: ACME threads for lead screws, metric threads on import lathes.

Numerical example:

Given: Lead screw pitch = 6 mm; required thread pitch = 1.5 mm.
Gear ratio = (work pitch)/(lead screw pitch) = 1.5/6 = 1/4.
So 4 rev of spindle = 1 rev of lead screw. Use 20:80 gear pair.

Q.6 – List methods of taper turning on a lathe. Describe a method suitable for long jobs. (7 marks)
Appeared in: W25(7), W24(7), W23(7)
Ans:
Methods of Taper Turning:

1. Form tool method
2. Tailstock set-over method
3. Compound rest swiveling method
4. Taper turning attachment method
5. Combining feeds method

Method Suitable for Long Jobs: Tailstock Set-over Method
Principle: Shifting tailstock center laterally makes workpiece axis at angle to lathe axis. Tool fed parallel to lathe axis generates taper.
Formula:

$$\text{Set-over} = \frac{L \times (D - d)}{2l}$$

Where:

- L = Total workpiece length
- D = Larger diameter
- d = Smaller diameter
- l = Taper length

Procedure:

1. Calculate set-over using formula
2. Loosen tailstock clamping nuts
3. Turn set-over screw to offset tailstock
4. Measure offset with dial indicator
5. Tighten tailstock clamps
6. Mount workpiece between centers
7. Feed tool parallel to lathe axis

Advantages:

- Suitable for long tapers (up to 500 mm)
- Simple setup, no special attachments
- Good for external tapers

Limitations:

- Maximum taper angle limited (~8°)
- Centers wear unevenly
- Not suitable for internal tapers

Diagram:

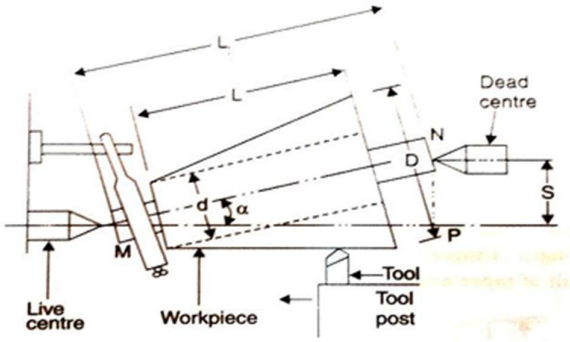


Fig.2.24 Taper turning by setting tail stock

Q.7 – Differentiate between Capstan and Turret lathe. (4 marks)
Appeared in: S23(3), S22(4), W23(4) → Highest: 4 marks
Ans:

Feature	Capstan Lathe	Turret Lathe
Hexagon turret	Mounted on ram (slides on saddle)	Mounted directly on saddle
Stroke length	Short (ram stroke)	Long (saddle moves entire bed)
Workpiece length	Short, small diameter	Long, large diameter
Tool setting	Quick, for small batches	Rigid, for heavy cuts
Weight	Light duty	Heavy duty

Q.8 – Why is the Lathe called the 'Mother of Machine Tools'? (3 marks)
Appeared in: W25(3)
Ans:

- All other machine tools (drill, mill, shaper) evolved from lathe.
- Lathe can produce components that are used to build other machines.
- First machine tool that introduced power feed, screw cutting, and interchangeable gears.
- Even modern machining centres use rotary workholding derived from lathe.

Q.9 – Name accessories commonly used to enhance lathe operations. Explain different types of mandrels. (7 marks OR)
Appeared in: W25(7 OR)
Ans:
Accessories:

- **Mandrels** (for holding work with bore)
- **Steady rest & follower rest** (support long jobs)
- **Faceplate** (irregular shapes)
- **Centres & chucks**
- **Taper turning attachment**

Mandrels – types & explanation:

Type	Use	Sketch description
Plain mandrel	Straight cylindrical, work held by friction	Solid bar with slight taper (0.02 mm/m)
Step mandrel	For multiple bore diameters	Different diameters along length
Collar mandrel	For longer bores	Collar at one end to locate work
Expanding mandrel	Split sleeve, expanded by nut	Longitudinal slots; turning nut expands sleeve

[DG PROMPT for expanding mandrel]
Title: Expanding mandrel
Description: Draw centre shaft with tapered cone at one end. Split sleeve over shaft. Nut at end; tightening nut pushes cone → expands sleeve. Label: Nut, Split sleeve, Tapered cone, Workpiece.
Application: Internal gear blank holding for turning outer diameter.

Q.10 – Explain half-nut mechanism with sketch. Also draw facing, parting off operations. (7 marks)
Appeared in: S23(7), W24(7 OR)
Ans:
Half-nut mechanism:

- Two split nuts that can be clamped onto the lead screw.
- Used for thread cutting to engage/disengage carriage quickly.
- Prevents damage to thread start.

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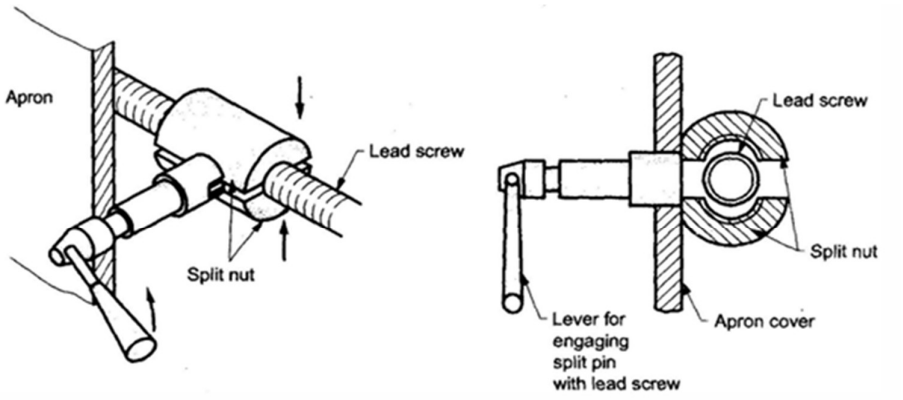
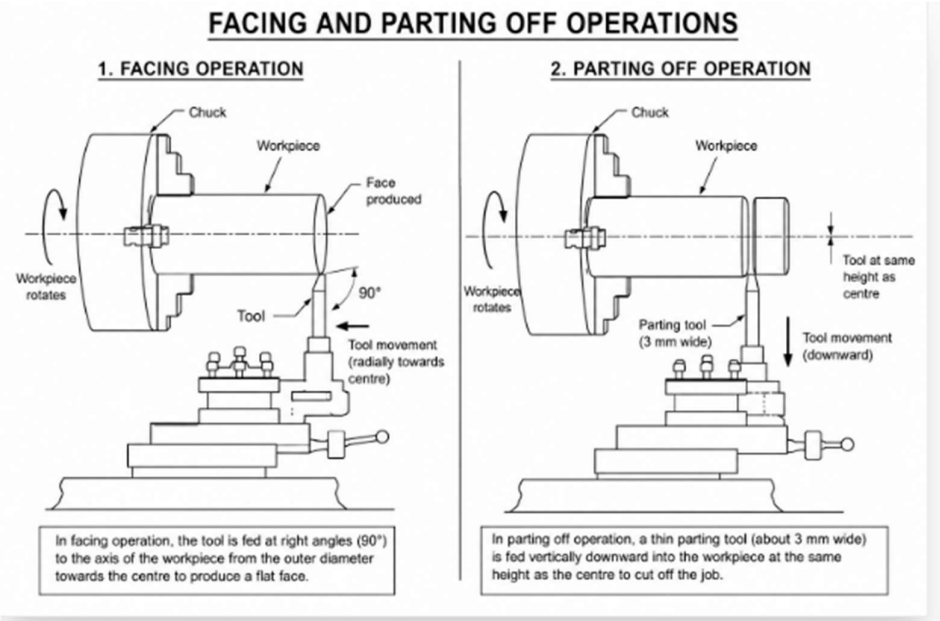


Fig.2.7 Working of Halfnut

Facing operation sketch: Tool moves radially inward; workpiece rotates – produces flat surface at end.
Parting off sketch: Thin blade tool feeds radially to cut work into two pieces.
[DG]



Real-world: Facing ensures square end; parting used to cut finished workpiece from bar stock.

Q.11 – What are the various methods for taper turning on centre lathe? Explain with sketch for steep tapers. (7 marks)

Appeared in: S23(7 OR)

Ans:

Methods of Taper Turning:

1. Form tool method
2. Tailstock set-over method
3. Compound rest swiveling method
4. Taper turning attachment method
5. Combining feeds method

Compound rest method for steep tapers (angle > 10°).

Working: Swivel compound rest to half taper angle (α/2). Feed by hand using compound crank.

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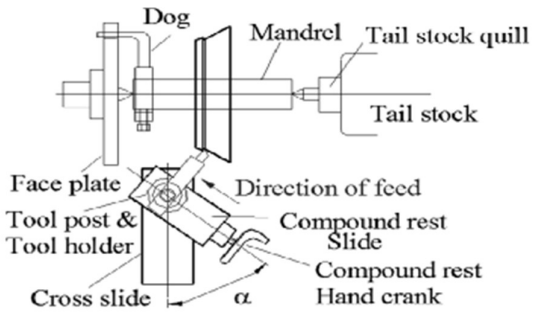


Fig.2.23 Taper Turning by Compound Rest

- Once the compound rest is set at the desired half taper angle, the rotation of the compound slide screw will cause the tool to be fed at that angle and generate a corresponding taper.
- This method is limited to turn a short taper owing to the limited movement of the compound rest.
- The movement of tool in this method being purely controlled by hand, this gives a low production capacity and poorer surface finish.

Application: Morse taper shank drilling – 1.5° to 3° typical.

Q.12 – Enlist work holding devices generally used in lathe. Explain any two. (4 marks)
Appeared in: S23(4), W24(4)
Ans:
Work holding devices:

- 3-jaw self-centring chuck
- 4-jaw independent chuck
- Collet chuck
- Faceplate
- Centres (live & dead)
- Mandrels
- Magnetic chuck (for thin work)

Explain any two:
1. 3-jaw chuck:

- Three jaws move simultaneously by scroll plate.
- Suitable for round & hexagonal bars.
- Fast centring but lower accuracy (runout up to 0.05 mm).

2. Four-jaw chuck:

- Each jaw moves independently.
- Can hold irregular shapes & offset work.
- High accuracy (0.01 mm) but slower to set.

Q.13 – How is a lathe specified? Explain with neat sketch. (4 marks)
Appeared in: S23(4)
Ans:
Specification of lathe (as per Indian Standard):

- Swing over bed (max diameter)
- Distance between centres (max length)
- Spindle bore diameter
- Spindle speed range (rpm)
- Feed range (mm/rev)
- Thread pitch range (metric/imperial)
- Motor power (kW)

Example: Lathe IS – 400 mm swing × 1000 mm B.C., 25–1500 rpm, 3 kW.
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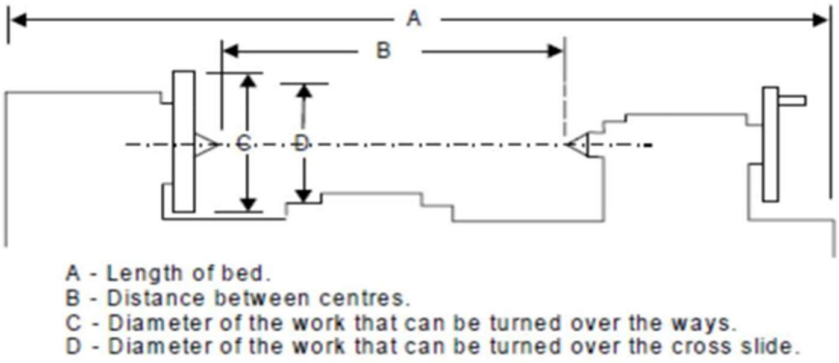


Fig.2.27 Function of Machine ToolS

Q.14 – Outline the specifications of Lathe machine. (3 marks)
Appeared in: S22(3)
Ans: (Brief version of above)

1. Max turning length
2. Max turning diameter (swing)
3. Spindle speed steps & range
4. Feed rates
5. Thread cutting range
6. Main motor power

Q.15 – Explain taper turning methods of Lathe machine. (3 marks)
Appeared in: W22(3)
Ans:
Four methods:

1. Swivelling compound rest (steep short tapers)
2. Offsetting tailstock (shallow long tapers)
3. Taper turning attachment (precise external tapers)
4. Form tool (very short tapers)

Preferred for accuracy: Taper attachment (repeatable for batch).
