ARUNAI ENGINEERING COLLEGE

VELU NAGAR, TIRUVANNAMALAI – 606 603.

DEPARTMENT OF MECHANICAL ENGINEERING

ME 8681 - CAD/CAM LAB

LABORATORY MANUAL

ME8681 CAD / CAM LABORATORY

OBJECTIVES:

• To gain practical experience in handling 2D drafting and 3D modelling software systems.
• To study the features of CNC Machine Tool.
• To expose students to modern control systems (Fanuc, Siemens etc.,)
• To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

LIST OF EXPERIMENTS

1. 3D GEOMETRIC MODELLING **24 PERIODS**

List of Experiments

1. Introduction of 3D Modelling software

Creation of 3D assembly model of following machine elements using 3D Modelling software

2. Flange Coupling 3. Plummer Block 4. Screw Jack 5. Lathe Tailstock
6. Universal Joint 7. Machine Vice 8. Stuffing box 9. Crosshead
10. Safety Valves 11. Non-return valves 12. Connecting rod 13. Piston
14. Crankshaft

* Students may also be trained in manual drawing of some of the above components

2. Manual Part Programming. 21 PERIODS

(i) Part Programming - CNC Machining Centre

a) Linear Cutting. b) Circular cutting.
c) Cutter Radius Compensation. d) Canned Cycle Operations.

(ii) Part Programming - CNC Turning Centre

a) Straight, Taper and Radius Turning. b) Thread Cutting.
c) Rough and Finish Turning Cycle. d) Drilling and Tapping Cycle.

3. Computer Aided Part Programming

e) CL Data and Post process generation using CAM packages.
f) Application of CAPP in Machining and Turning Centre.

TOTAL: 45 PERIODS

OUTCOMES

- Ability to develop 2D and 3D models using modeling softwares.
- Ability to understand the CNC control in modern manufacturing system.
- Ability to prepare CNC part programming and perform manufacturing.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Qty
HARDWARE		
1.	Computer Server	1
2.	Computer nodes or systems (High end CPU with atleast GB main memory) networked to the server	1 30
3.	A3 size plotter	1
4.	Laser Printer	1
5.	CNC Lathe	1
6.	CNC milling machine	1
SOFTWARE		
7.	Any High end integrated modeling and manufacturing CAD / CAM software	15 licenses
8.	CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC / Sinumeric and Heidenhain controller)	15 licenses
9.	Licensed operating system	Adequate
10.	Support for CAPP	Adequate

TABLE OF CONTENTS

FLANGE COUPLING

Ex.No: Date:

AIM

To create the flange coupling assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
1. PRO-E Wildfire Version – 4.0

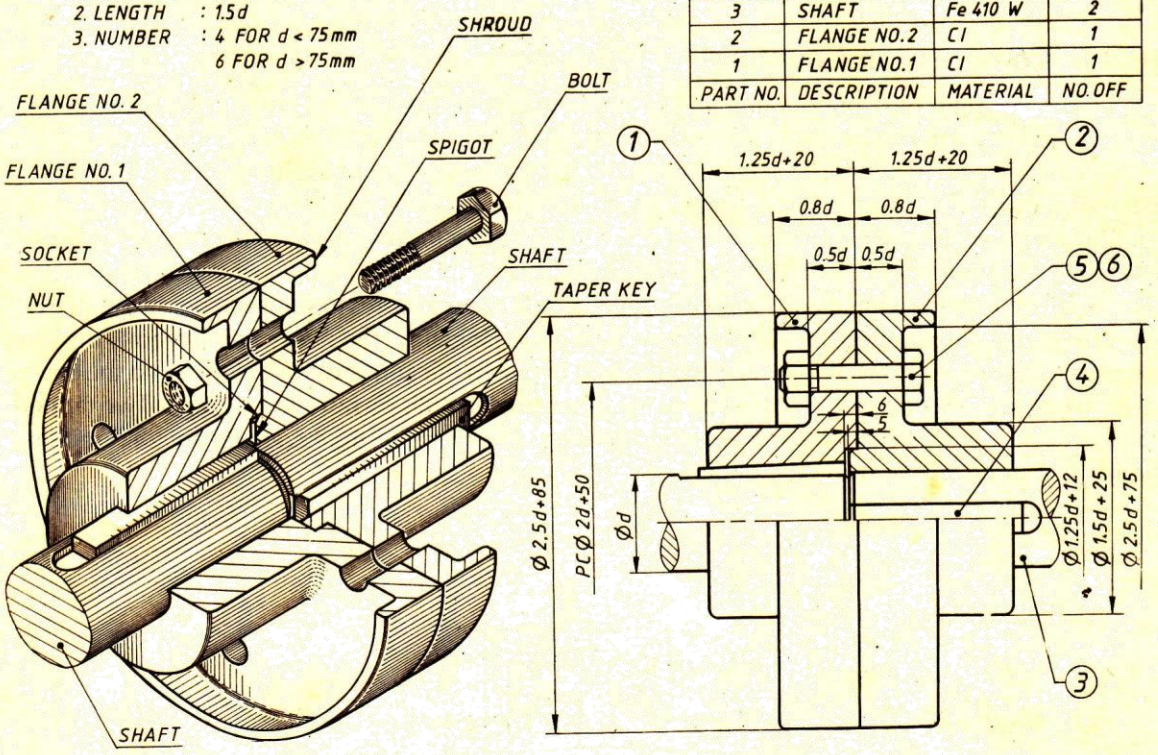
PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.

ALL FILLETS AND ROUNDS RADII 3mm

PART NO.	DESCRIPTION	MATERIAL	NO. OFF
6	HEX. NUT	Fe 410 W	4
5	HEX. BOLT	Fe 410 W	4
4	TAPER KEY	Fe 410 W	2
3	SHAFT	Fe 410 W	2
2	FLANGE NO.2	CI	1
1	FLANGE NO.1	CI	1

BOLT DETAILS:
1. DIAMETER : 0.2d+3mm
2. LENGTH : 1.5d
3. NUMBER : 4 FOR d < 75mm
6 FOR d > 75mm

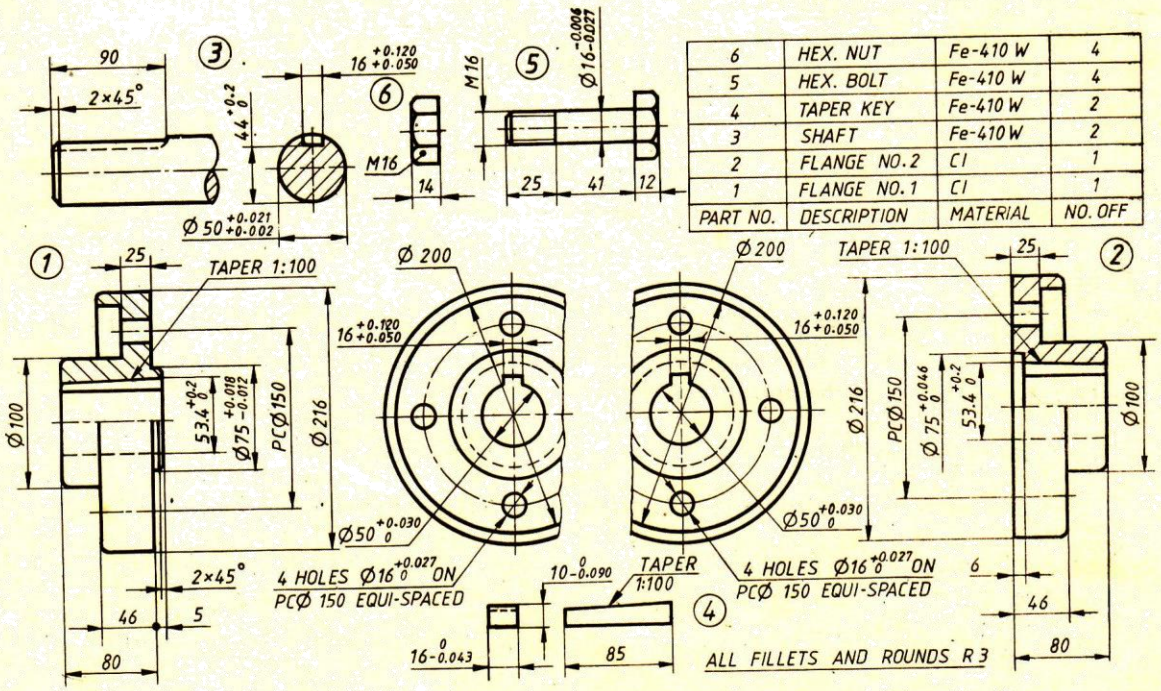


All Dimensions in mm

Flanged Coupling — Protected Type

Fig. 16.9

PART NO.	DESCRIPTION	MATERIAL	NO. OFF
6	HEX. NUT	Fe-410 W	4
5	HEX. BOLT	Fe-410 W	4
4	TAPER KEY	Fe-410 W	2
3	SHAFT	Fe-410 W	2
2	FLANGE NO.2	CI	1
1	FLANGE NO.1	CI	1



All Dimensions in mm

Details of Flanged Coupling — Protected Type

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the flange coupling has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. What is flange coupling?
This is a standard form of coupling. It consists of two cast iron flanges keyed to the end of shafts. The flanges are tightened together by means of a number of bolts

2. What is use of protected type flange coupling?
In this coupling, each flange is provided with a projection. This projection covers the bolt heads and nuts so that they do not catch the fingers or the clothes of workmen.

3. List out some of the modeling software currently available?
Solid works, CATIA, Pro-E, IDEAS

4. What is universal coupling?
A universal joint, universal coupling, U-joint, Cardan joint, Hardy-Spicer joint, or Hooke's joint is a joint or coupling in a rigid rod that allows the rod to 'bend' in any direction, and is commonly used in shafts that transmit rotary motion.

5. What are the parts of universal coupling?
It consists of a pair of hinges located close together, oriented at 90° to each other, connected by a cross shaft.

6. What is coupling?

A coupling is a device used to connect two shafts together at their ends for the purpose of transmitting power. Couplings do not normally allow disconnection of shafts during operation, however there are torque limiting couplings which can slip or disconnect when some torque limit is exceeded.

7. What are the types of couplings?

1. Rigid Couplings, 2.Flexible or Compensating Couplings

8. What is knuckle joint?

A knuckle joint is used to connect the two rods which are under the tensile load, when there is requirement of small amount of flexibility or angular moment is necessary. There is always axial or linear line of action of load

9. What are the applications of knuckle joint?

Knuckle joint has it applications in the rods for roof, chain link, steam engine valve rod, eccentric rods etc.

10. What is a screw jack?

Screw jack is a mechanical device that can increase the magnitude of an effort force.

KNUCKLE JOINT

Ex.No: Date:

AIM

To create the knuckle joint assembly as a 3D solid model.

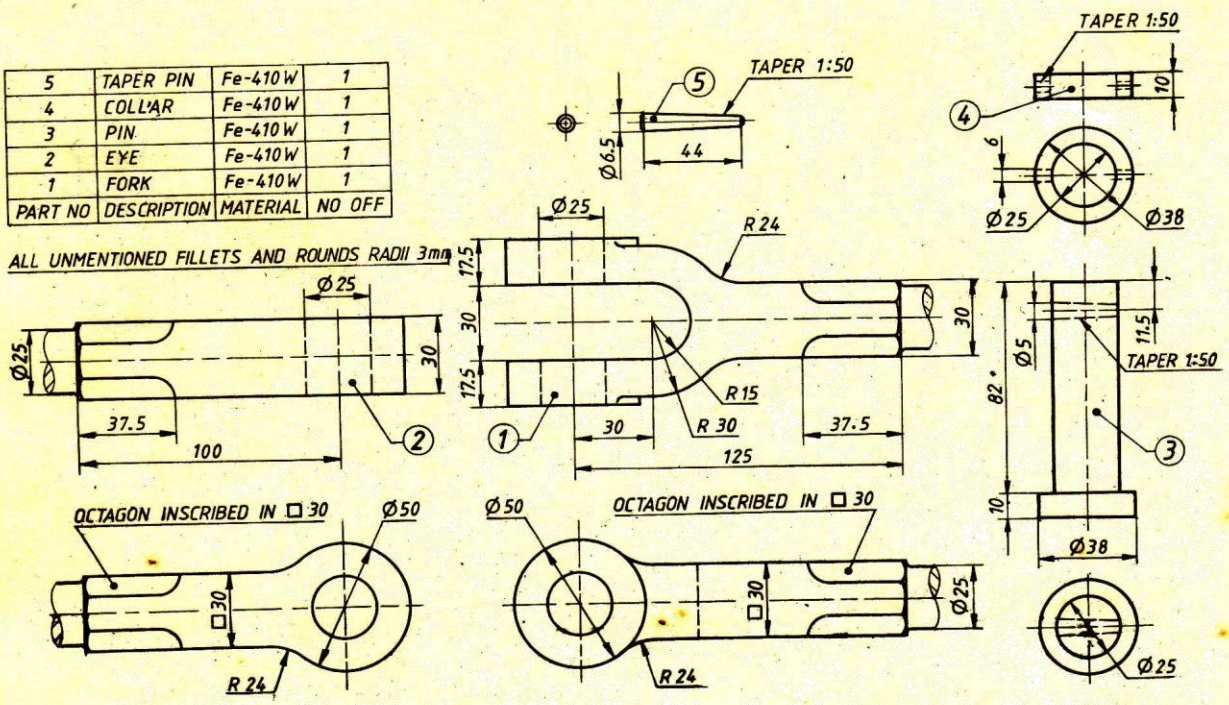
SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.

PART NO	DESCRIPTION	MATERIAL	NO OFF
5	TAPER PIN	Fe-410 W	1
4	COLLAR	Fe-410 W	1
3	PIN	Fe-410 W	1
2	EYE	Fe-410 W	1
1	FORK	Fe-410 W	1



Details of a Knuckle Joint

Fig. 15.11

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the knuckle joint has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. What are the applications of CAD?
   Design of machine elements, CNC machine tools, robotics etc _ Panel design and circuit layout Mapping ,building plans, contour plotting and structural drawing _ Interior design and modeling
2. Define absolute co-ordinates?
   Values locating a point in space that describe its displacement from origin (0,0,0) point of the drawing.

3. Define polar co ordinates.
   Values are locating a point in space that describes its location relative to the last point picked as defined by an angle and distance.

4. Define angular dimension?
   A dimension that measures the angle between two lines or the angle inscribed by an arc Segment

5. Define aligned dimension?
   A linear dimension measuring the distance between two points. The dimension line for an aligned dimension is parallel to a line between points.

6. Define MIRROR?
   A command that makes a copy of selected objects and flips the copy around a specified line to produce a reciprocal image of those objects.

7. What are the advantages of CAD?
   Greater productivity of the designer, improvement of design quality Easier design, calculation and analysis, quicker rate producing drawings, more accuracy of drawings, colour graphics is possible

SCREW JACK

Ex.No: Date:

AIM

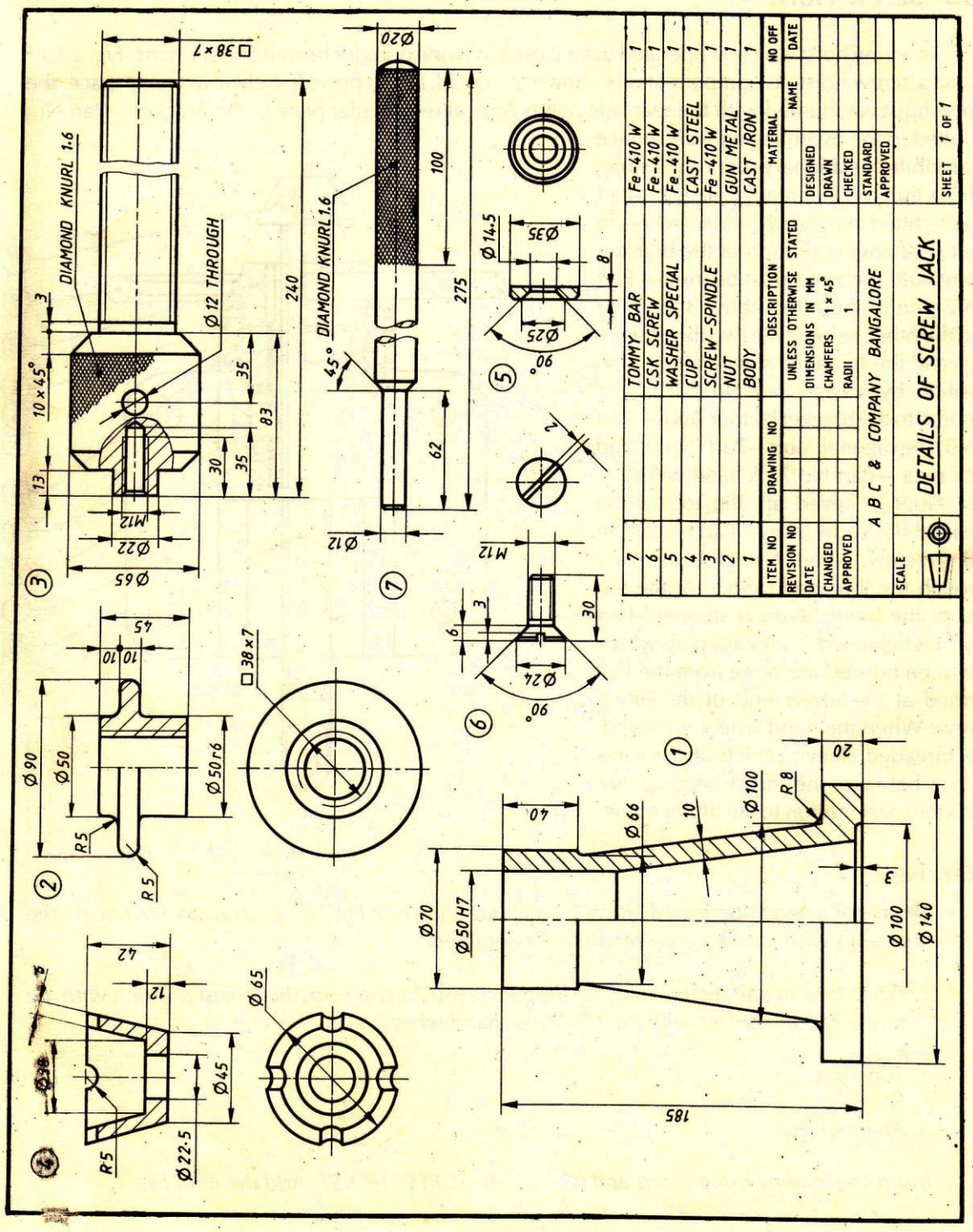
To create the screw jack assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.



Details of a Screw Jack
Fig.23.10

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the screw jack has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. Where did the dimension text is generally placed Above the dimension line

2. Which dimension tool will place the length of an angled line. Aligned

3. Which tolerance identify the maximum and minimum sizes of a feature Limits

4. A typical set of mechanical working drawings includes Exploded assembly, part details and parts list

5. The text used on a typical detail sheet should be _____. placed horizontally

6. Which primary unit of measurement is used for engineering drawings and design in the mechanical industries Millimeter

7. What are the two main types of projection Perspective and Parallel

8. What is flange coupling?
This is a standard form of coupling. It consists of two cast iron flanges keyed to the end of shafts. The flanges are tightened together by means of a number of bolts

9. What is use of protected type flange coupling?
In this coupling, each flange is provided with a projection. This projection covers the bolt heads and nuts so that they do not catch the fingers or the clothes of workmen.

10. List out some of the modeling software currently available?
Solid works, CATIA, Pro-E, IDEAS

PLUMMER BLOCK

Ex.No: Date:

AIM

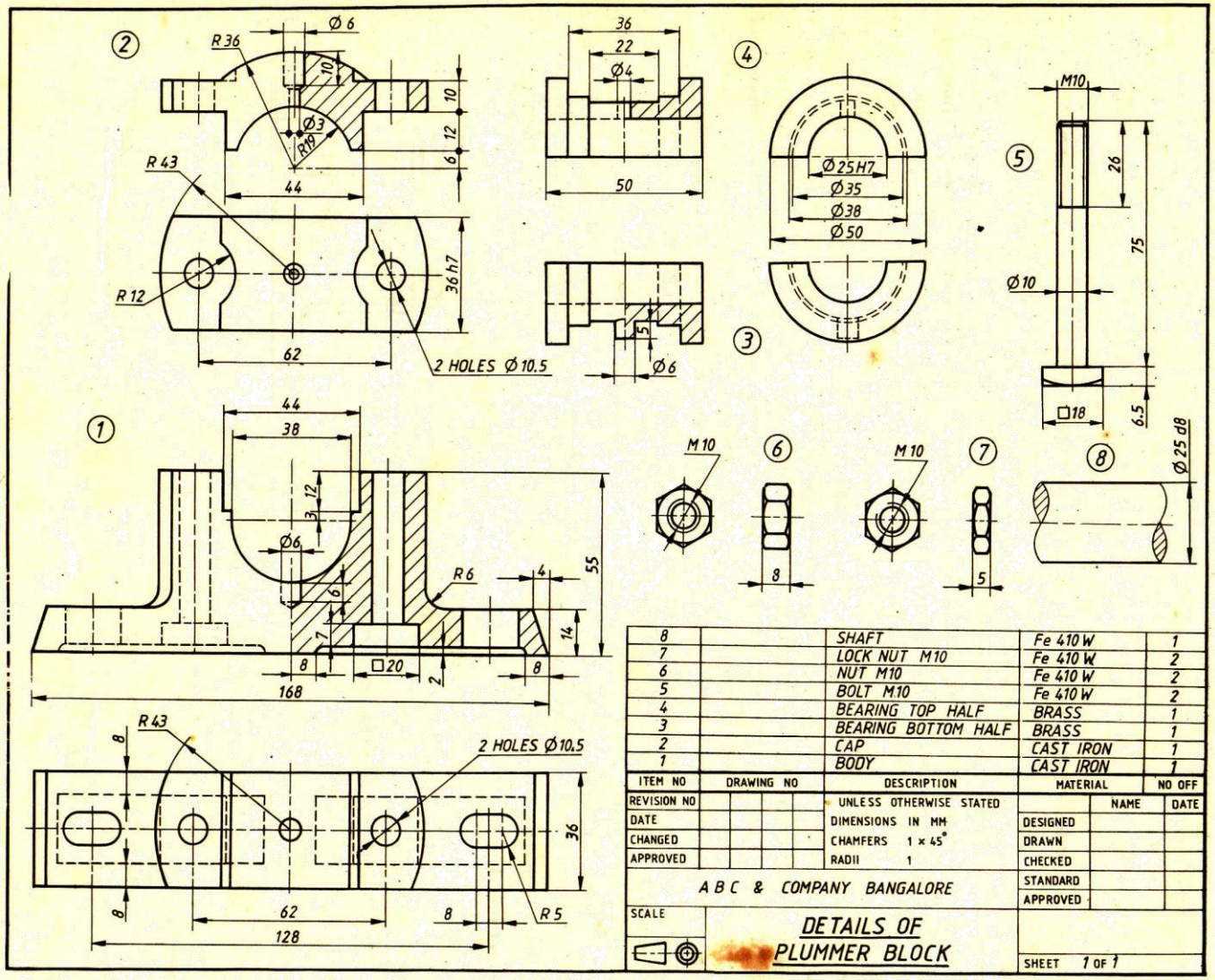
To create the plummer block assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.



ITEM NO	DRAWING NO	DESCRIPTION	MATERIAL	NO OFF
8		SHAFT	Fe 410 W	1
7		LOCK NUT M10	Fe 410 W	2
6		NUT M10	Fe 410 W	2
5		BOLT M10	Fe 410 W	2
4		BEARING TOP HALF	BRASS	1
3		BEARING BOTTOM HALF	BRASS	1
2		CAP	CAST IRON	1
1		BODY	CAST IRON	1

		NAME	DATE
REVISION NO	UNLESS OTHERWISE STATED	DESIGNED	
DATE	DIMENSIONS IN MM	DRAWN	
CHANGED	CHAMFERS 1 × 45°	CHECKED	
APPROVED	RADII 1	STANDARD	
	A B C & COMPANY BANGALORE	APPROVED	

SCALE

DETAILS OF PLUMMER BLOCK

SHEET 1 OF 1

MACHINE DRAWING

Details of a Plummer Block

Fig. 20.4

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the plummer block has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. What is universal coupling?
   A universal joint, universal coupling, U -joint, Cardan joint, Hardy-Spicer joint, or Hooke's joint is a joint or coupling in a rigid rod that allows the rod to 'bend' in any direction, and is commonly used in shafts that transmit rotary motion.
2. What are the parts of universal coupling?
   It consists of a pair of hinges located close together, oriented at 90° to each other, connected by a cross shaft.
3. What are the types of couplings?
   1. Rigid Couplings
   2. Flexible or Compensating Couplings
4. What is knuckle joint?
   A knuckle joint is used to connect the two rods which are under the tensile load, when there is requirement of small amount of flexibility or angular moment is necessary. There is always axial or linear line of action of load
5. What are the applications of knuckle joint?
   Knuckle joint has it applications in the rods for roof, chain link, steam engine valve rod, eccentric rods etc.
6. What is a screw jack?
   Screw jack is a mechanical device that can increase the magnitude of an effort force.
7. What is the application of Screw jack?
   screw jack it is commonly used to lift heavy weights such as the foundations of houses, or large vehicles.
8. What are the constraints available for assembly?
   Mate constraint, angle constraint, tangent constraint and insert constraint

UNIVERSAL COUPLING

Ex.No: Date:

AIM

To create the universal coupling assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.

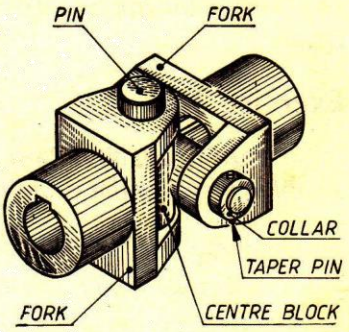
Exercise

*Details of a UNIVERSAL COUPLING ae shown in Fig.16.30. Draw the following views of the coupling showing all the parts assembled. The two shafts and the keys are not shown in the figure. The shafts are fitted with a push fit of **js7** tolerance. The tolerance for width of key way in the shafts for light drive fit is **N9**. Two parallel keys of 12 x 8 x 63 are used to connect the two shafts. The tolerance for keys are **h9** for width and **h11** for thickness. Indicate the actual tolerances on the dimensions.*

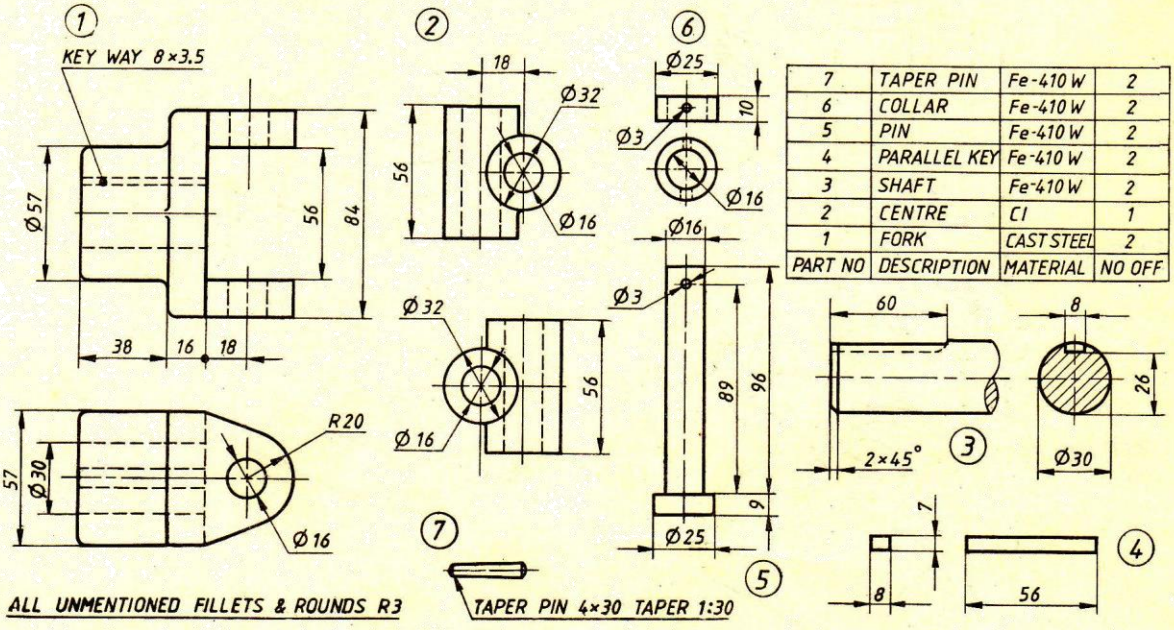
1. *Front view in half section.*
2. *Right view.*
3. *Top view in half section.*

16.5.3 Universal Coupling

Another type of universal coupling is shown in *Fig.16.31*, its various detailed components are shown are shown separately in *Fig.16.32*. It consists of two forks keyed to the ends of the two shafts. A central block consisting of two cylindrical bushes cast or welded at right angles, is placed between the two forks and connected to them by two pins.



Universal Coupling
Fig.16.31



PART NO	DESCRIPTION	MATERIAL	NO OFF
7	TAPER PIN	Fe-410 W	2
6	COLLAR	Fe-410 W	2
5	PIN	Fe-410 W	2
4	PARALLEL KEY	Fe-410 W	2
3	SHAFT	Fe-410 W	2
2	CENTRE	CI	1
1	FORK	CAST STEEL	2

Details of Universal Coupling
Fig.16.32

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the universal coupling has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. What is the use of RIB command?
   Ribs are defined as the thin walled structures that are used to increase the strength of the entire structure of the component, so that it does not fail under an increased load.

2. What is the extension SOLIDWORKS file? Sldprt

3. What are the difference between CAD and CAM?
   Computer aided drafting (CAD) is the process of creating a design, known as drafting, using computer technology. Computer aided manufacturing (CAM) is the use of computers and computer software to guide machines to manufacture something, usually a part that is mass-produced.

4. How to use Revolve command in SOLIDWORKS?
   Using this tool, the sketch is revolved about the revolution axis.

5. What are the important modeling operation?
   Extrude, revolve, sweep.

6. Explain about G codes?
   G-code is the common name for the most widely used numerical control (NC) programming language, which has many implementations. Used mainly in automation, it is part of computer-aided engineering. G-code is sometimes called G programming language

7. Mention few important G codes?
   G00 - Positioning at rapid speed; Mill and Lathe
   G01 - Linear interpolation (machining a straight line); Mill and Lathe
   G02 - Circular interpolation clockwise (machining arcs); Mill and Lathe
   G03 - Circular interpolation, counter clockwise; Mill and Lathe
   G20 - Inch units; Mill and Lathe
   G21 - Metric units; Mill and Lathe

8. What is the use M codes?
   A word used to signal an action from a miscellaneous group of commands. M codes change cutting tools, turn on or turn off the coolant, spindle, or workpiece clamps, etc

9. Write about some important M codes?
   M00 - Program stop; Mill and Lathe
   M01 - Optional program stop; Lathe and Mill
   M02 - Program end; Lathe and Mill
   M05 - Spindle off; Lathe and Mill

10. What is the use of box facing cycle?
    Fanuc G94 facing cycle is used for simple facing (one-pass facing) however multiple passes are possible by specifying the Z-axis location of additional passes

MACHINE VICE

Ex.No: Date:

AIM

To create the machine vice assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
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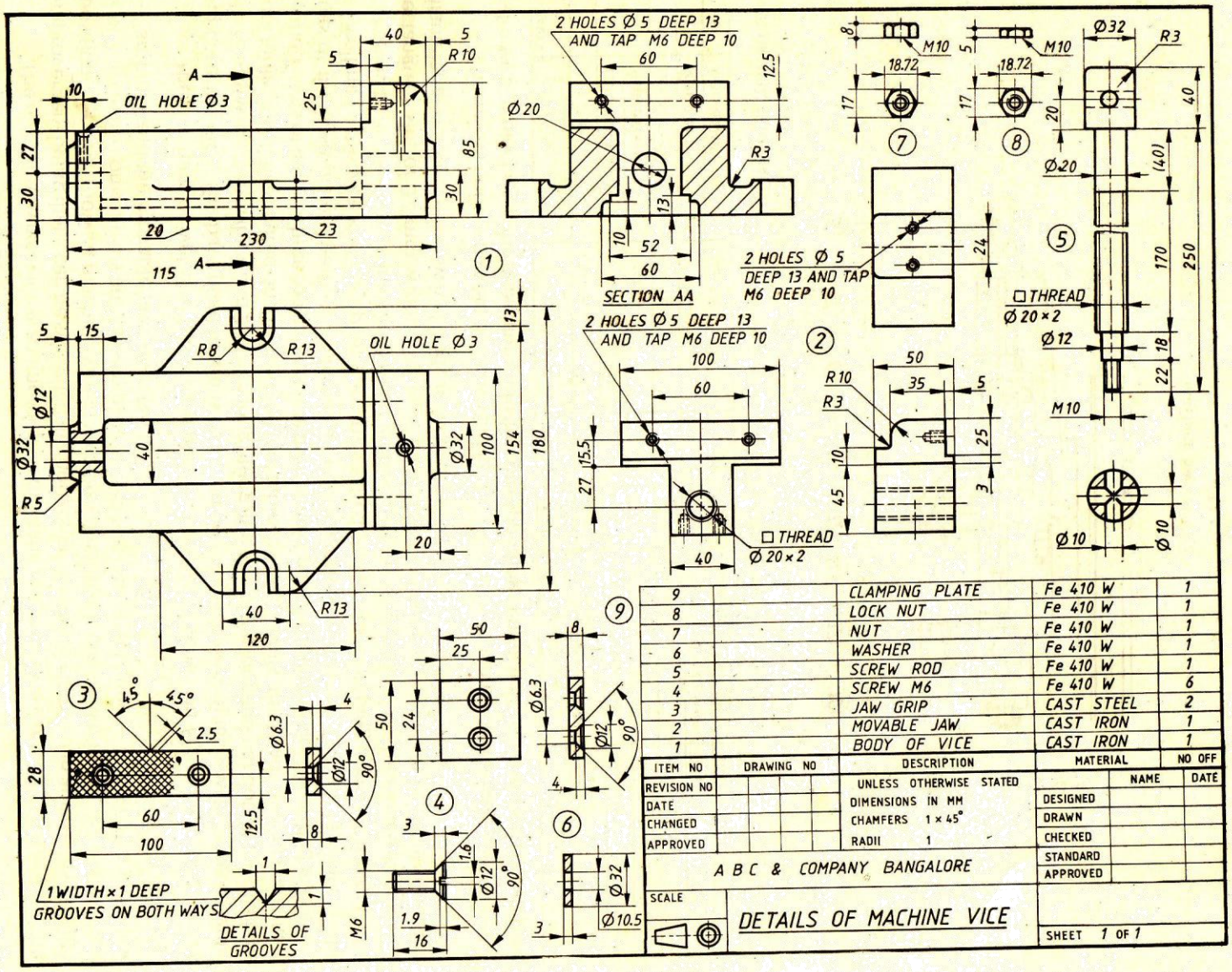

9		CLAMPING PLATE	Fe 410 W	1
8		LOCK NUT	Fe 410 W	1
7		NUT	Fe 410 W	1
6		WASHER	Fe 410 W	1
5		SCREW ROD	Fe 410 W	1
4		SCREW M6	Fe 410 W	6
3		JAW GRIP	CAST STEEL	2
2		MOVABLE JAW	CAST IRON	1
1		BODY OF VICE	CAST IRON	1
ITEM NO	DRAWING NO	DESCRIPTION	MATERIAL	NO OFF

		NAME	DATE
REVISION NO		DESIGNED	
DATE	UNLESS OTHERWISE STATED	DRAWN	
CHANGED	DIMENSIONS IN MM	CHECKED	
APPROVED	CHAMFERS 1 × 45°	STANDARD	
	RADII 1	APPROVED	

A B C & COMPANY BANGALORE

SCALE

DETAILS OF MACHINE VICE

SHEET 1 OF 1

VE PARTS

Details of a Machine Vice
Fig. 23.2

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the machine vice has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. What is universal coupling?
A universal joint, universal coupling, U -joint, Cardan joint, Hardy-Spicer joint, or Hooke's joint is a joint or coupling in a rigid rod that allows the rod to 'bend' in any direction, and is commonly used in shafts that transmit rotary motion.

2. What are the parts of universal coupling?
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3. What is coupling?
A coupling is a device used to connect two shafts together at their ends for the purpose of transmitting power. Couplings do not normally allow disconnection of shafts during operation, however there are torque limiting couplings which can slip or disconnect when some torque limit is exceeded.

4. What are the types of couplings?
1. Rigid Couplings
2. Flexible or Compensating Couplings

5. What is knuckle joint?
A knuckle joint is used to connect the two rods which are under the tensile load, when there is requirement of small amount of flexibility or angular moment is necessary. There is always axial or linear line of action of load

6. What are the applications of knuckle joint?
Knuckle joint has it applications in the rods for roof, chain link, steam engine valve rod, eccentric rods etc.

7. What is a screw jack?
Screw jack is a mechanical device that can increase the magnitude of an effort force.

8. What is the application of Screw jack?
screw jack it is commonly used to lift heavy weights such as the foundations of houses, or large vehicles.

9. What are the constraints available for assembly?
mate constraint, angle constraint, tangent constraint and insert constraint

10. What is the use of shell command?
Removes material from the selected face and creates a hollow block from a solid block

STUFFING BOX

Ex.No: Date:

AIM

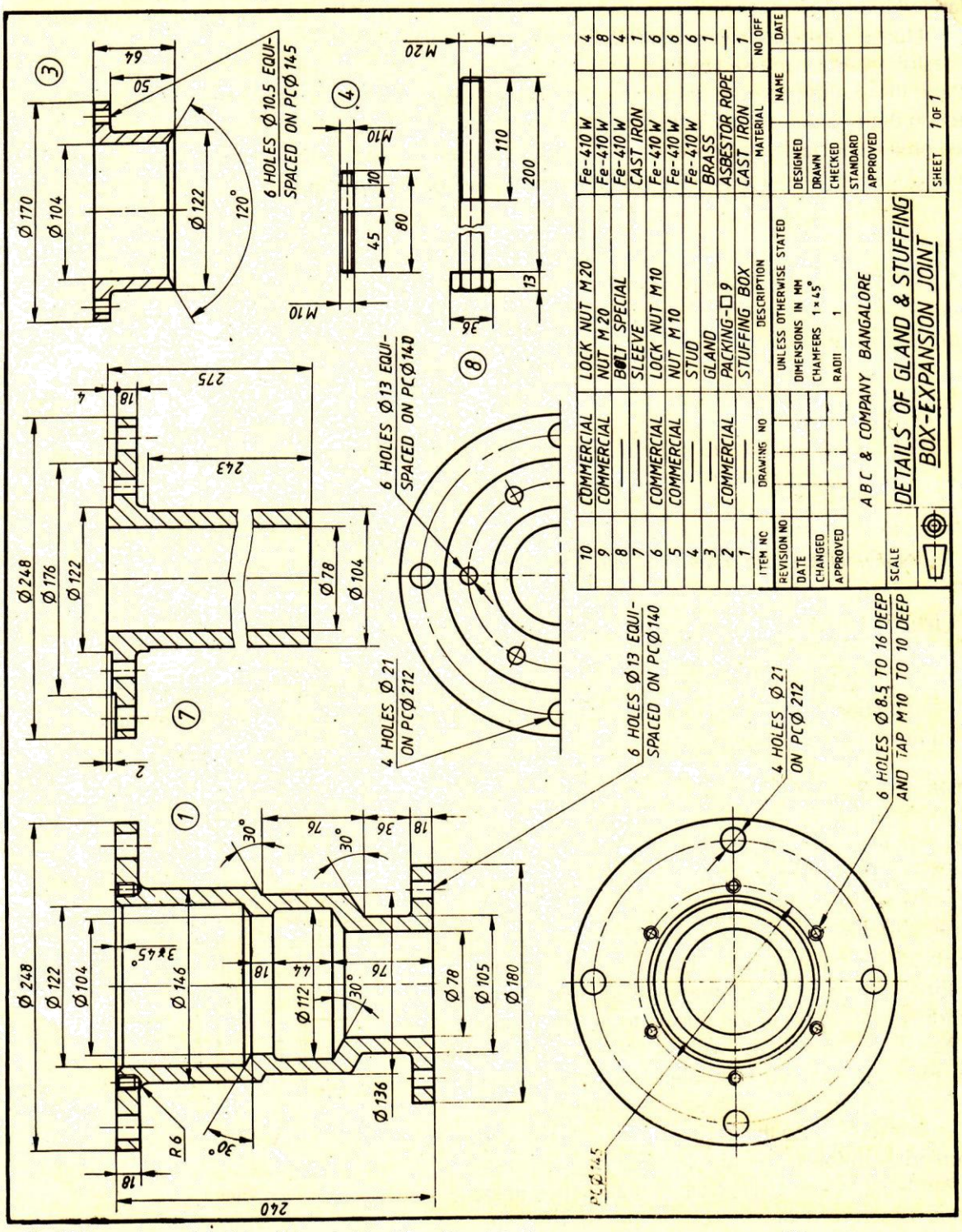
To create the stuffing box assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.



Details of Gland and Stuffing Box Expansion Joint

Fig. 19.5

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the stuffing box has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. Define angular dimension?
A dimension that measures the angle between two lines or the angle inscribed by an arc Segment

2. Define aligned dimension?
A linear dimension measuring the distance between two points. The dimension line for an aligned dimension is parallel to a line between points.

3. Define MIRROR?
A command that makes a copy of selected objects and flips the copy around a specified line to produce a reciprocal image of those objects.

4. What are the advantages of CAD?
Greater productivity of the designer, improvement of design quality
Easier design, calculation and analysis, quicker rate producing drawings, more accuracy of drawings, colour graphics is possible

5. What is the default position of the UCS icon 0,0,0

6. How can you create a cylinder by drawing a rectangular shape By revolving the rectangular shape

7. Which information does the MASSPROP shortcut provide Mass, Volume and Bounding box

CROSSHEAD

Ex.No: Date:

AIM

To create the crosshead assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.

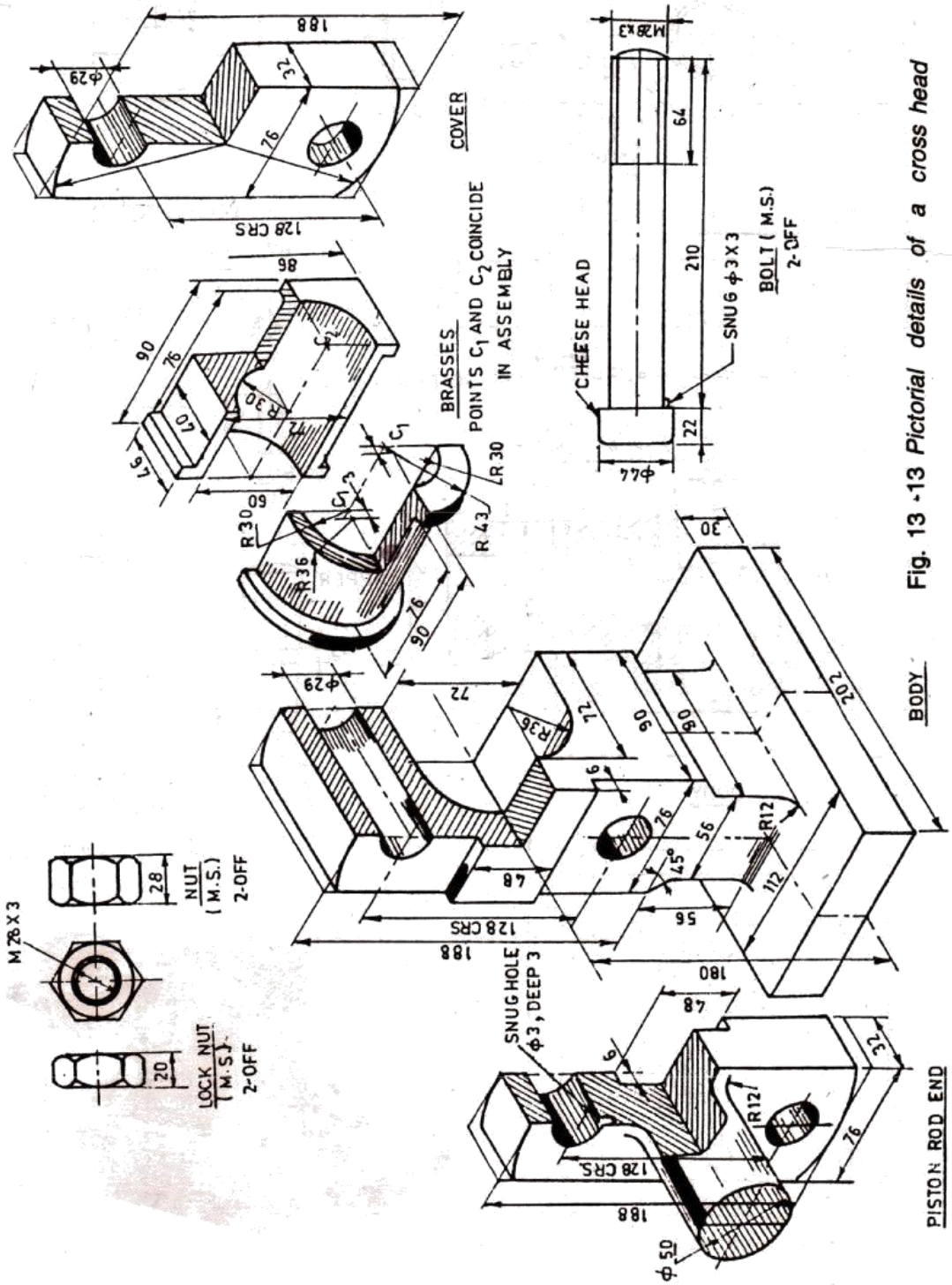


Fig. 13 -13 *Pictorial details of a cross head*

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the crosshead has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. A typical set of mechanical working drawings includes Exploded assembly, part details and parts list

2. The text used on a typical detail sheet should be _____. placed horizontally

3. Which primary unit of measurement is used for engineering drawings and design in the mechanical industries
Millimeter

4. What are the two main types of projection
Perspective and Parallel

5. What is flange coupling?
This is a standard form of coupling. It consists of two cast iron flanges keyed to the end of shafts. The flanges are tightened together by means of a number of bolts

6. What is use of protected type flange coupling?
In this coupling, each flange is provided with a projection. This projection covers the bolt heads and nuts so that they do not catch the fingers or the clothes of workmen.

7. List out some of the modeling software currently available? Solid works, CATIA, Pro-E, IDEAS

8. What is universal coupling?
A universal joint, universal coupling, U-joint, Cardan joint, Hardy-Spicer joint, or Hooke's joint is a joint or coupling in a rigid rod that allows the rod to 'bend' in any direction, and is commonly used in shafts that transmit rotary motion.

9. What are the parts of universal coupling?
It consists of a pair of hinges located close together, oriented at 90° to each other, connected by a cross shaft.

SAFETY VALVES

Ex.No: Date:

AIM

To create the safety valves assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.

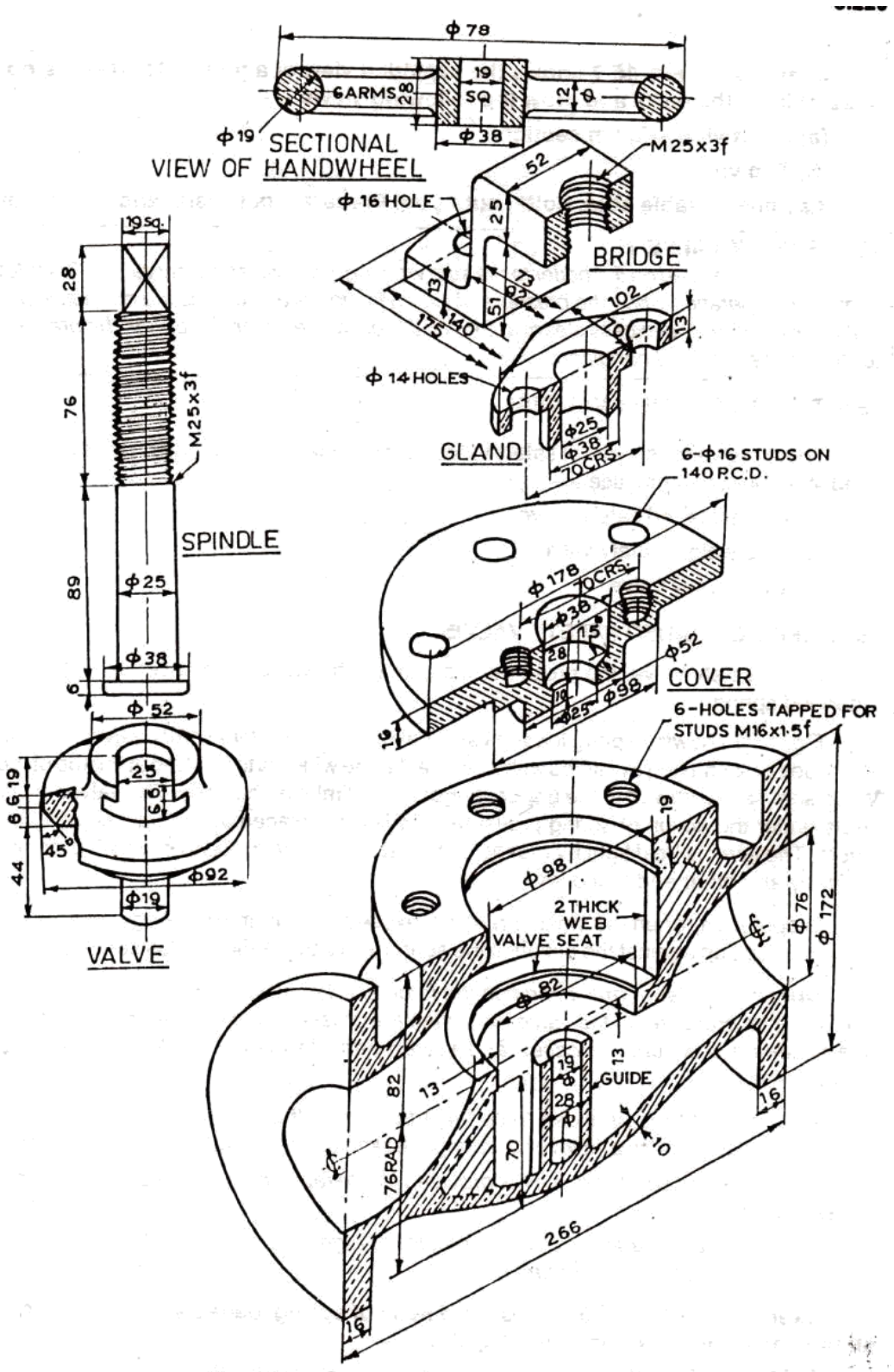


Fig. 15-7 *Gun metal steam stop valve*

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the safety valves has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. What are the types of couplings?
    1. Rigid Couplings
    2. Flexible or Compensating Couplings

2. What is knuckle joint?
A knuckle joint is used to connect the two rods which are under the tensile load, when there is requirement of small amount of flexibility or angular moment is necessary. There is always axial or linear line of action of load

3. What are the applications of knuckle joint?
Knuckle joint has it applications in the rods for roof, chain link, steam engine valve rod, eccentric rods etc.

4. What is a screw jack?
Screw jack is a mechanical device that can increase the magnitude of an effort force.

5. What is the application of Screw jack?
screw jack it is commonly used to lift heavy weights such as the foundations of houses, or large vehicles.

6. What are the constraints available for assembly?
mate constraint, angle constraint, tangent constraint and insert constraint

7. What is the use of shell command?
Removes material from the selected face and creates a hollow block from a solid block

8. What is the use of RIB command?
Ribs are defined as the thin walled structures that are used to increase the strength of the entire structure of the component, so that it does not fail under an increased load.

9. What are the parts of universal coupling?
It consists of a pair of hinges located close together, oriented at 90° to each other, connected by a cross shaft.

PISTON

Ex.No: Date:

AIM

To create the piston assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

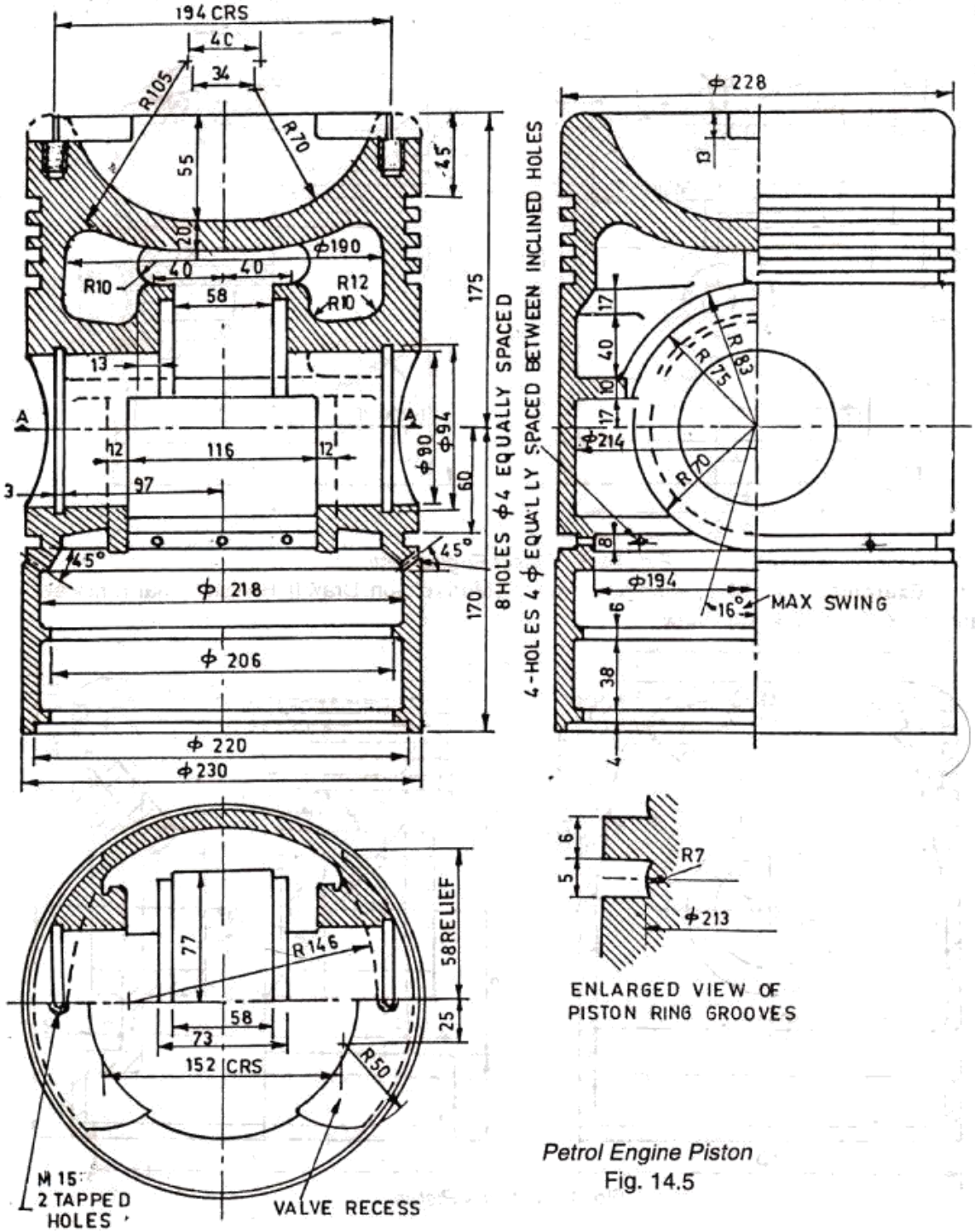
PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.

Exercise 4 : Fig. 14.5 show three views of a petrol engine piston. Draw following views :—

(a) Half sectional front view

(b) Half sectional side view projected from (a) (c) Top view.



Petrol Engine Piston

Fig. 14.5

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the piston has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. Define MIRROR?
A command that makes a copy of selected objects and flips the copy around a specified line to produce a reciprocal image of those objects.

2. What are the advantages of CAD?
Greater productivity of the designer, improvement of design quality
Easier design, calculation and analysis, quicker rate producing drawings, more accuracy of drawings, colour graphics is possible

3. What is the default position of the UCS icon 0,0,0

4. How can you create a cylinder by drawing a rectangular shape By revolving the rectangular shape

5. Which information does the MASSPROP shortcut provide Mass, Volume and Bounding box

6. Where did the dimension text is generally placed
Above the dimension line

7. Which dimension tool will place the length of an angled line. Aligned

8. Which tolerance identify the maximum and minimum sizes of a feature
Limits

9. A typical set of mechanical working drawings includes
Exploded assembly, part details and parts list

LATHE TAILSTOCK

Ex.No: Date:

AIM

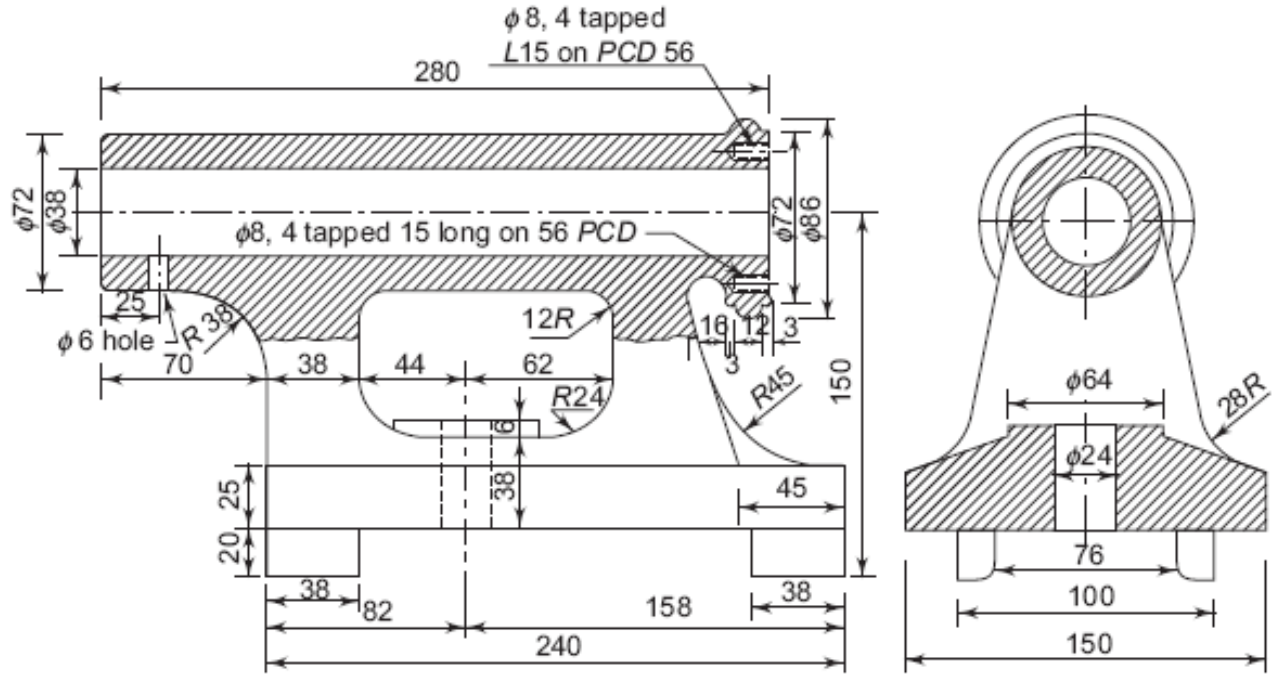
To create the machine vice assembly as a 3D solid model.

SOFTWARE REQUIRED

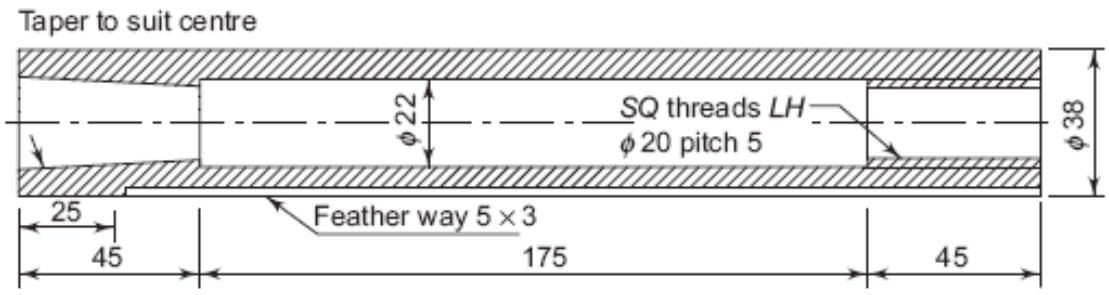
1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

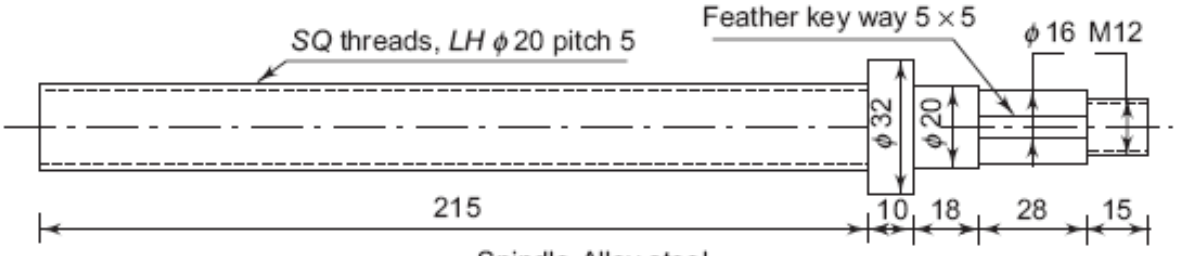
1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
6. For creating other parts, select sketch both parallel plane option or plane by 3points option and then select the required plane.
7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
8. Do the protrusions by using protrusion command and the revolution by revolved protrusion command.
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.



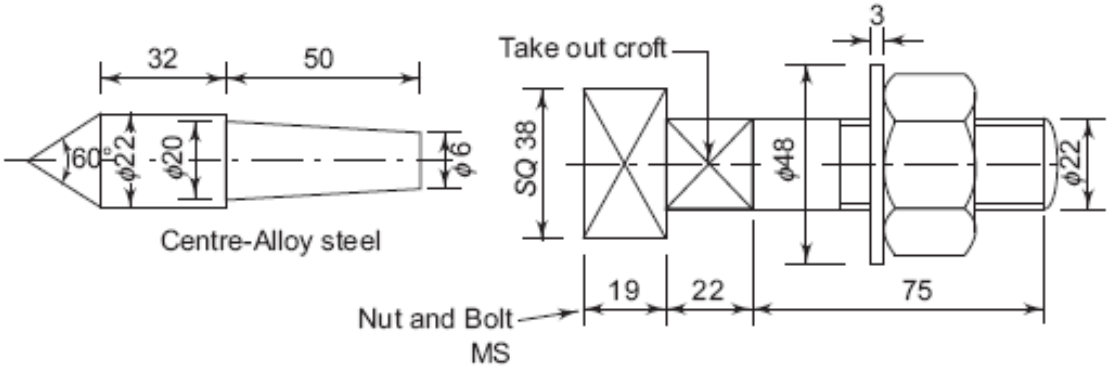
Body-*CS*



Barrel-Alloy steel



Spindle-Alloy steel



Centre-Alloy steel

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the piston has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. Define MIRROR?
A command that makes a copy of selected objects and flips the copy around a specified line to produce a reciprocal image of those objects.

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11. Which dimension tool will place the length of an angled line. Aligned

12. Which tolerance identify the maximum and minimum sizes of a feature Limits

13. A typical set of mechanical working drawings includes
Exploded assembly, part details and parts list

NON-RETURN VALVES

Ex.No: Date:

AIM

To create the machine vice assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
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7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
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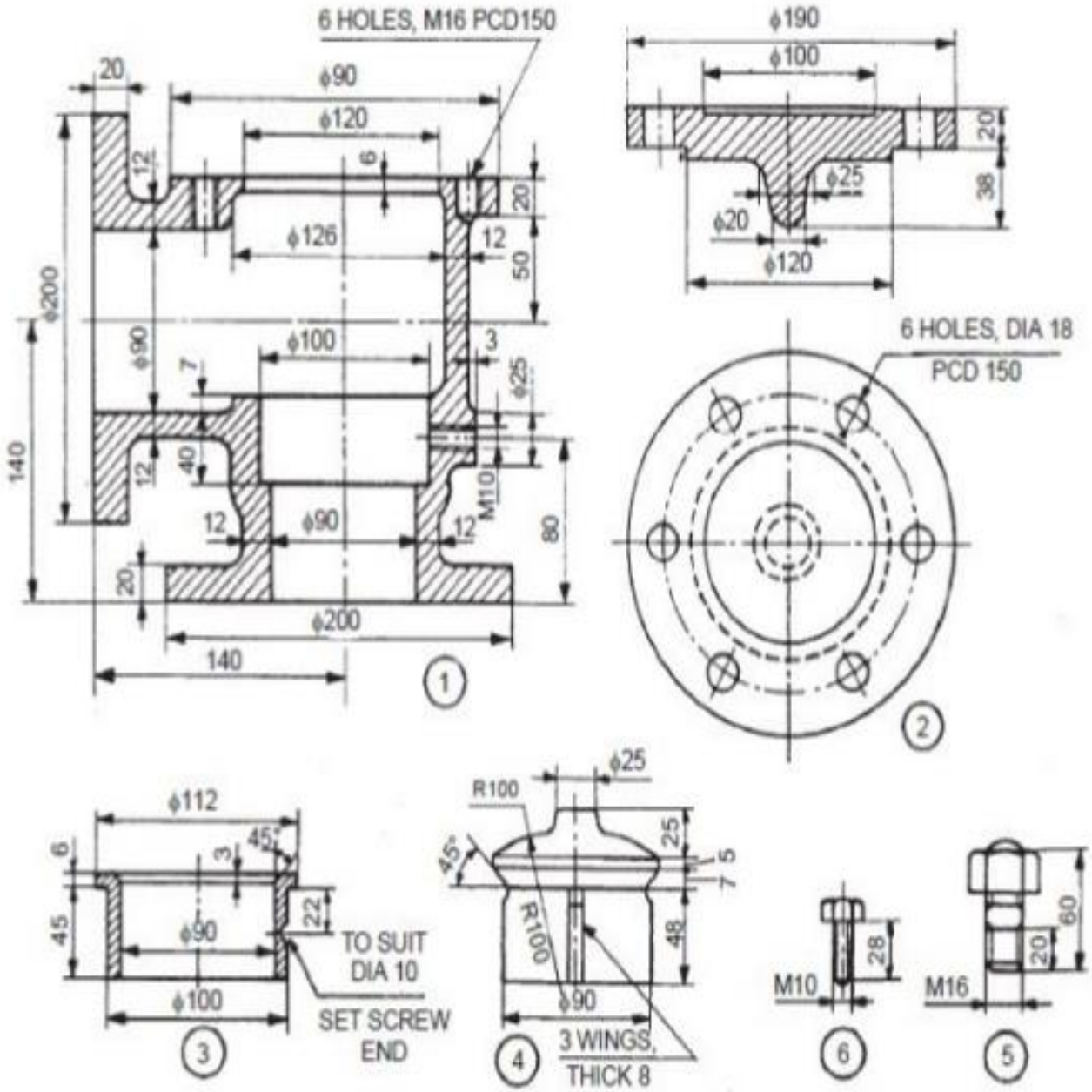
9. For constructing holes and cutout, used hole command and cutout command.
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.



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14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the machine vice has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. What is universal coupling?
A universal joint, universal coupling, U -joint, Cardan joint, Hardy-Spicer joint, or Hooke's joint is a joint or coupling in a rigid rod that allows the rod to 'bend' in any direction, and is commonly used in shafts that transmit rotary motion.

2. What are the parts of universal coupling?
It consists of a pair of hinges located close together, oriented at 90° to each other, connected by a cross shaft.

3. What is coupling?
A coupling is a device used to connect two shafts together at their ends for the purpose of transmitting power. Couplings do not normally allow disconnection of shafts during operation, however there are torque limiting couplings which can slip or disconnect when some torque limit is exceeded.

4. What are the types of couplings?
1. Rigid Couplings
2. Flexible or Compensating Couplings

5. What is knuckle joint?
A knuckle joint is used to connect the two rods which are under the tensile load, when there is requirement of small amount of flexibility or angular moment is necessary. There is always axial or linear line of action of load

6. What are the applications of knuckle joint?
Knuckle joint has it applications in the rods for roof, chain link, steam engine valve rod, eccentric rods etc.

CONNECTING ROD

Ex.No: Date:

AIM

To create the machine vice assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
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7. Construct the full cross section for portion and construct the half of the cross section and an axis line for revolution.
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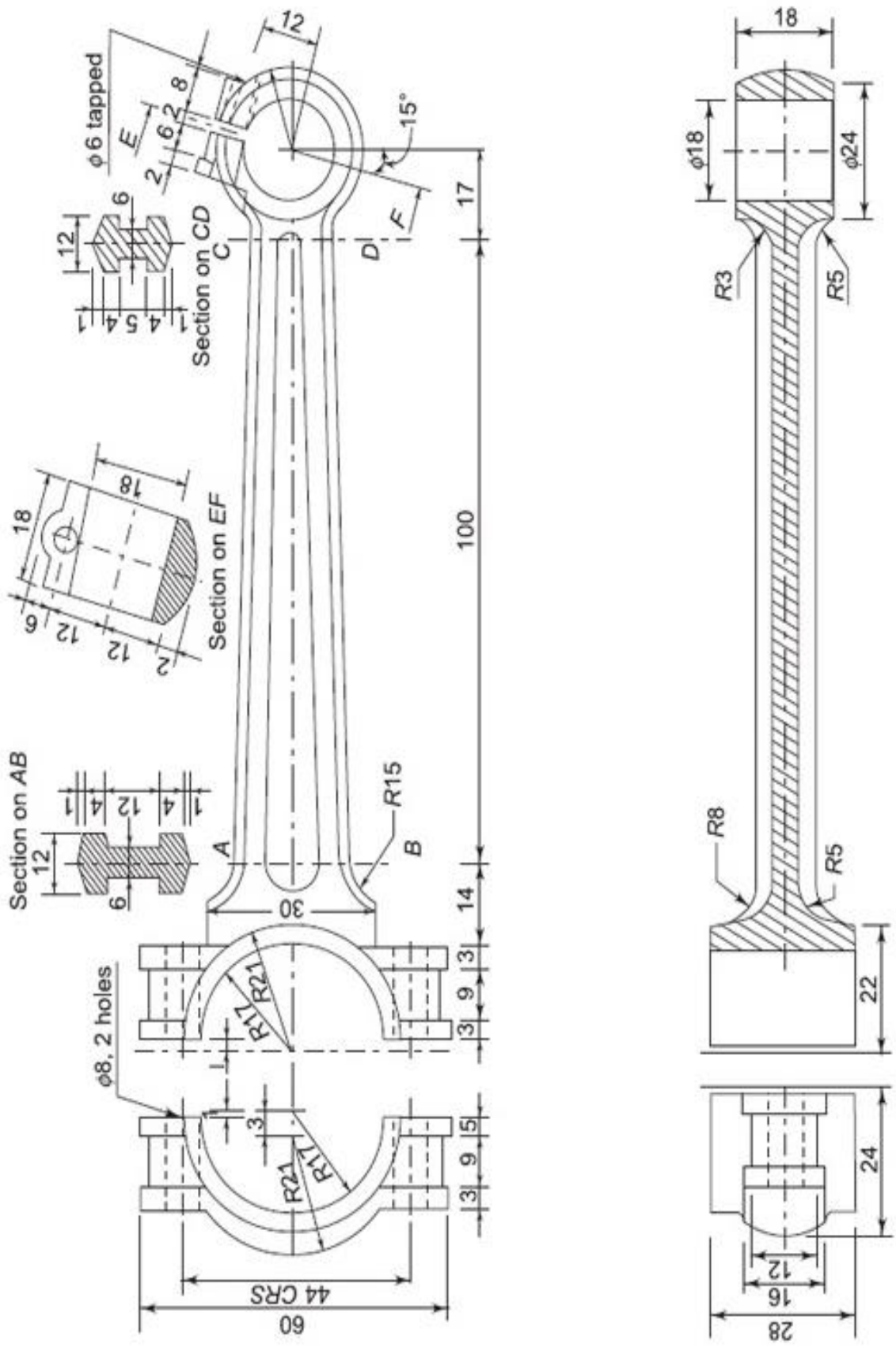

11. Use revolved cutout command whenever needed.

12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.

13. After constructing each part save it as a separate part file with extrusion* par.

14. Enter into assembly environment.

15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).

16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.

17. Save the assembly.

RESULT

Thus the 3D assembly of the crosshead has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

5. A typical set of mechanical working drawings includes Exploded assembly, part details and parts list

6. The text used on a typical detail sheet should be _____. placed horizontally

7. Which primary unit of measurement is used for engineering drawings and design in the mechanical industries
Millimeter

8. What are the two main types of projection
Perspective and Parallel

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This is a standard form of coupling. It consists of two cast iron flanges keyed to the end of shafts. The flanges are tightened together by means of a number of bolts

6. What is use of protected type flange coupling?
In this coupling, each flange is provided with a projection. This projection covers the bolt heads and nuts so that they do not catch the fingers or the clothes of workmen.

9. List out some of the modeling software currently available? Solid works, CATIA, Pro-E, IDEAS

10. What is universal coupling?
A universal joint, universal coupling, U-joint, Cardan joint, Hardy-Spicer joint, or Hooke's joint is a joint or coupling in a rigid rod that allows the rod to 'bend' in any direction, and is commonly used in shafts that transmit rotary motion.

9. What are the parts of universal coupling?
It consists of a pair of hinges located close together, oriented at 90° to each other, connected by a cross shaft.

CRANKSHAFT

Ex.No: Date:

AIM

To create the machine vice assembly as a 3D solid model.

SOFTWARE REQUIRED

1. Windows XP operating system
2. PRO-E Wildfire Version – 4.0

PROCEDURE

1. Identify various parts to be created.
2. First enter into part environment and create the main part and create the main part of the assembly.
3. First identify whether the main part or the first to be created by protrusion or by revolution.
4. Select the sketch tool and then select the coincidental plane option and select any one of the standard 3 planes (i.e. front, right &top).
5. Create the cross-section profile as a closed one using the 2D commands available after completing the sketch, click open or return button and then click finish button.
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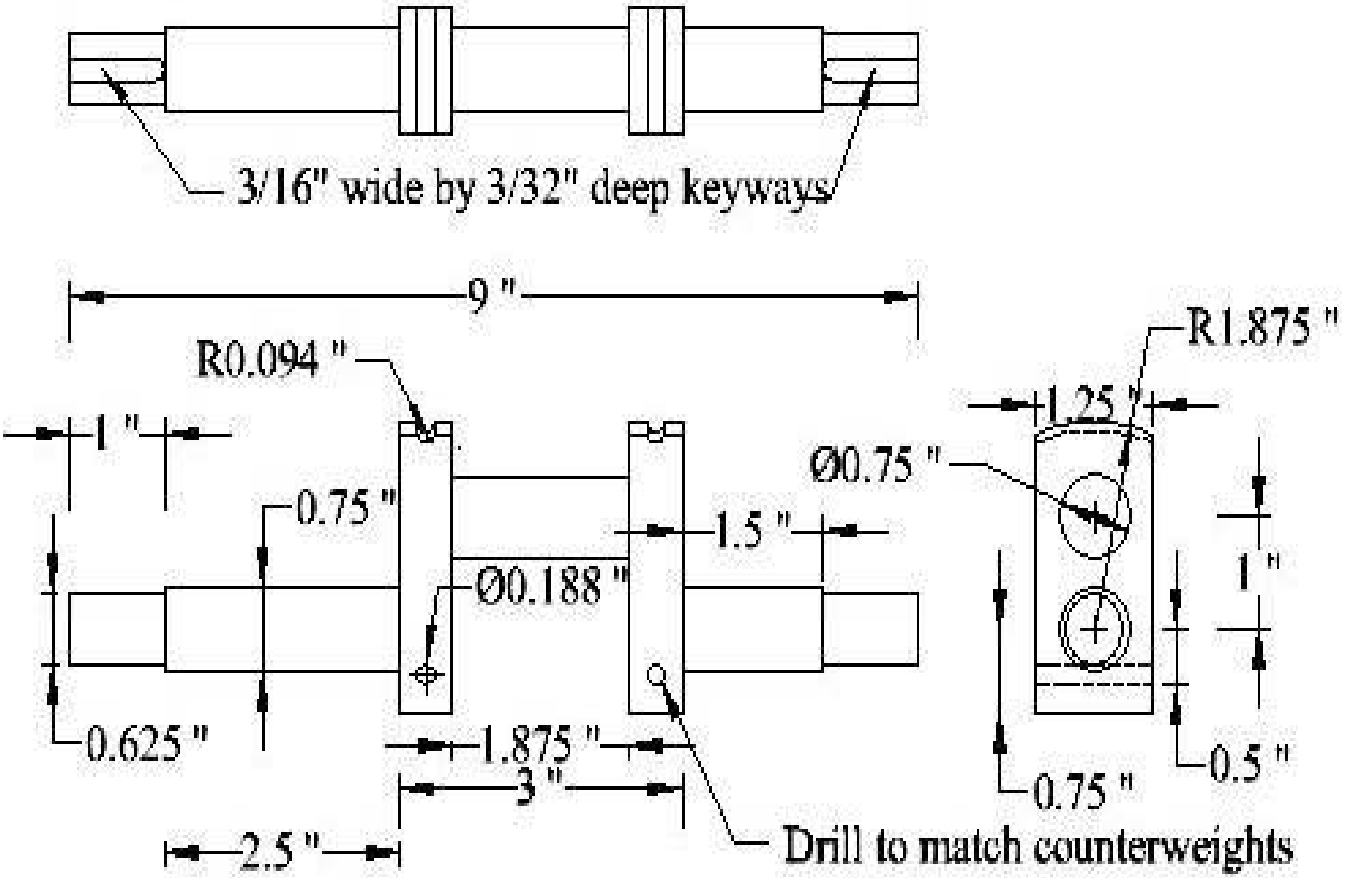
10. If we use hole command, change the diameter of the hole by using modify menu, resize hole option.



Crankshaft - HM100

11. Use revolved cutout command whenever needed.
12. Use the distance between option to maintain accurate distance between one edge and other edge or between one edge and to center the hole.
13. After constructing each part save it as a separate part file with extrusion* par.
14. Enter into assembly environment.
15. Assembly the various parts construct parts construct using the various assembly constrains available (planer, design, mate, axial align, connect etc).
16. After finishing assembly, check whether the various parts have been connected properly or not by rotating the view.
17. Save the assembly.

RESULT

Thus the 3D assembly of the machine vice has been created on the software PRO-E with accurate dimension and withal respects.

VIVA-VOCE QUESTIONS

1. What is universal coupling?
A universal joint, universal coupling, U -joint, Cardan joint, Hardy-Spicer joint, or Hooke's joint is a joint or coupling in a rigid rod that allows the rod to 'bend' in any direction, and is commonly used in shafts that transmit rotary motion.

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6. What are the applications of knuckle joint?
Knuckle joint has it applications in the rods for roof, chain link, steam engine valve rod, eccentric rods etc.

SIMPLE TURING OPERATION USING G01 BILLET SIZE ø25.4 L=70

Ex.No: Date:

AIM

To write the part programming and simulation them to the given lathe job.

TOOLS AND EQUIPMENTS

1. CNC simulation software FANUC
2. CNC trainer software
3. Software Pentium IV

PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

PROGRAM

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1500
G00 X26 Z1
G01 X25 F50
G01 Z-30 F50
G01 X26 F50
G01 Z1 F50
G01 X24 F50
G01 Z-30 F50
G01 X26 F50
G01 Z1 F50
G01 X23 F50
G01 Z-30 F50
G01 X26 F50
G01 Z1 F50
G01 X22 F50
G01 Z-30 F50
G01 X26 F50
G01 Z1 F50
G01 X18 Z0 F50
G03 X22 Z-2 R2 F40
```

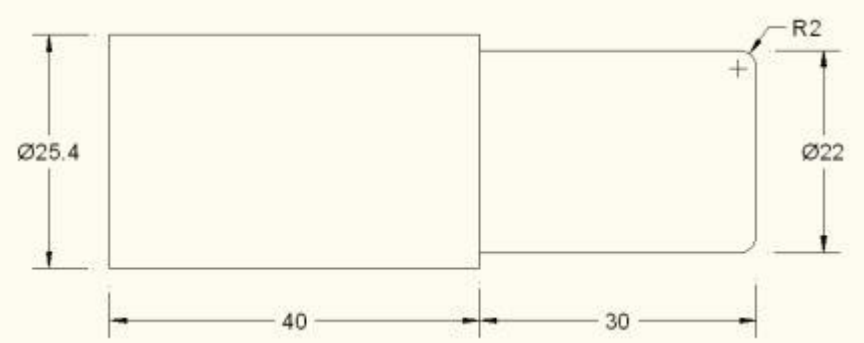
M-CODES

M06 – Tool Change
M03 – Spindle Forward Clockwise
M05 – Spindle Stop
M30 – Program End

G-CODES

G21 – Metric
G98 – Feed/Min
G28 U0 W0 – Reference Point Return
G00 X Y – Positioning (Rapid Traverse)
G01 X Y F – Linear Interpolation (Feed)
G03 – Circular Interpolation (CCW)
G90 – Cutting Cycle Turning

```
G28 U0 W0
M05
M30
```



RESULT

Thus the part program was written and simulated for given job.

STEP TURNING USING CYCLE G90 BILLET SIZE ø25.4 L=70

Ex.No: Date:

AIM

To write the part programming and simulation them to the given lathe job.

TOOLS AND EQUIPMENTS

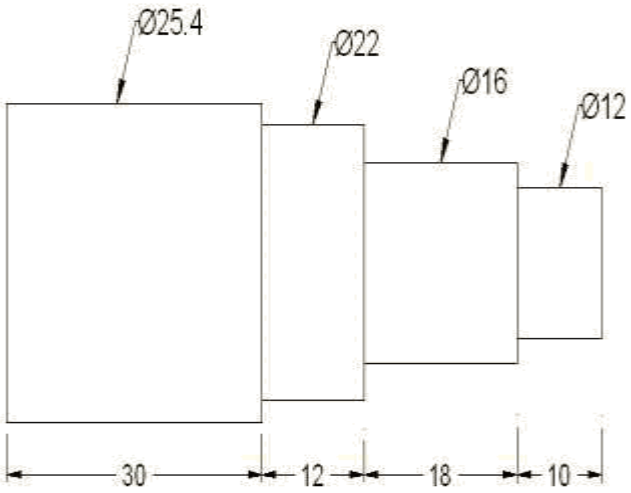
1. CNC simulation software FANUC
2. CNC trainer software
3. Software Pentium IV

PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

PROGRAM

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1500
G00 X26 Z1
G90 X25 Z-40 F50
    X24
    X23
    X22
G90 X21 Z-28 F50
    X20
    X19
    X18
    X17
    X16
G90 X15 Z-10 F50
    X14
    X13
    X12
G28 U0 W0
M05
M30
```



RESULT

Thus the part program was written and simulated for given job.

PROFILE TURNING USING MULTIPLE TURNING CYCLE (G71)
BILLET SIZE ø25.4 L=70

Ex.No: Date:

AIM

To write the part programming and simulation them to the given lathe job.

TOOLS AND EQUIPMENTS

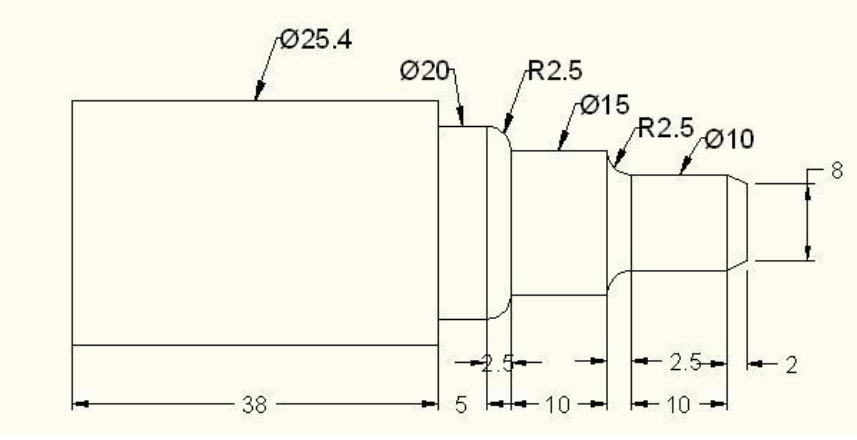
1. CNC simulation software FANUC
2. CNC trainer software
3. Software Pentium IV

PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

PROGRAM

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1200
G00 X26 Z1
G71 U0.5 R1.0
G71 P01 Q02 U0.2 W0.2 F50
N01 G01 X8
G01 Z0
G01 X10 Z-2
G01 X10 Z-12
G02 X15 Z-14.5 R2.5
G01 X15 Z-24.5
G03 X20 Z-27 R2.5
G01 X20 Z-32
N02 G01 X25.4 Z-32
G70 P01 Q02 F40
G28 U0 W0
M05
M30
```



G71 – Multiple Turing cycle (stock remover)
G 70 – Finishing cycle

G71 U R
G71 P Q U W F
G70 P Q

G71 – Multiple Turning Cycle
U – Depth of Cut
R – Retract Allowance

G71 – Multiple Turing Cycle
P – Starting Block (N01)
Q – Ending Block (N02)
U – Finishing Allowance in X-Axis
W – Finishing Allowance in Z-Axis
F – Feed Rate

G70 – Finishing Cycle
P – Starting Block
Q – Ending Block

RESULT

Thus the part program was written and simulated for given job.

TAPER TURNING (R- & R+) USING BOX TURNING CYCLE (G90) BILLET SIZE ø25.4 L=70

Ex.No: Date:

AIM

To write the part programming and simulation them to the given lathe job

TOOLS AND EQUIPMENTS

1. CNC simulation software FANUC
2. CNC trainer software
3. Software Pentium IV

PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

PROGRAM

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1500
G00 X26 Z1
G90 X25 Z-35 F50
G90 X24 Z-5 F50
    X23
    X22
    X21
    X20
G00 X26 Z-5
G90 X25 Z-15 R0 F50
    X25 Z-15 R-0.5 F50
    X25 Z-15 R-1.0 F50
    X25 Z-15 R-1.5 F50
    X25 Z-15 R-2.0 F50
    X25 Z-15 R-2.5 F50
G00 X26 Z-20
G90 X25 Z-30 R0 F50
    X24 Z-30 R0.5 F50
    X23 Z-30 R1.0 F50
    X22 Z-30 R1.5 F50
    X21 Z-30 R2.0 F50
    X20 Z-30 R2.5 F50
G00 X26 Z-30
G90 X24 Z-35 F50
X23
X22
X21
```

R^+

REVERSE TAPER $R^+ = (25 – 20)/2 = +2.5$

FORWARD TAPER $R^- = (20 – 25)/2 = -2.5$

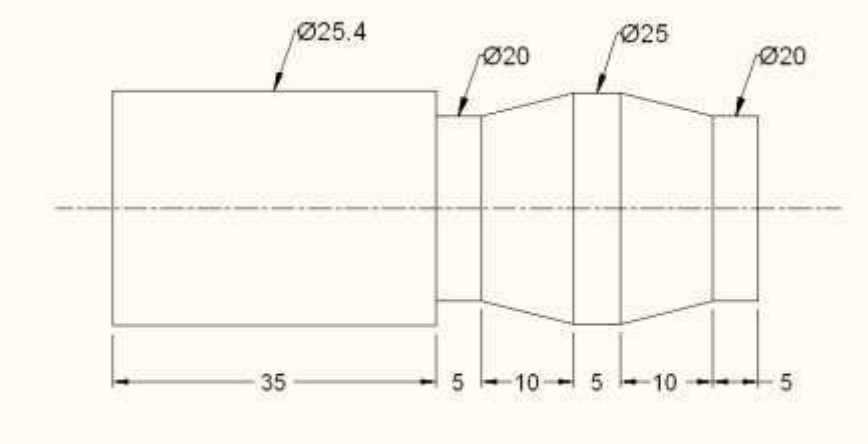
Taper Turning

G90 X Z R F

R – Taper Value

F – Feed Rate

```
X20
G28 U0 W0
M05
M30
```



RESULT

Thus the part program was written and simulated for given job.

THREAD CUTTING USING BOX CYCLE (G92) BILLET SIZE ø25.4 L=70

Ex.No: Date:

AIM

To write the part programming and simulation them to the given lathe job.

TOOLS AND EQUIPMENTS

1. CNC simulation software FANUC
2. CNC trainer software
3. Software Pentium IV

PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

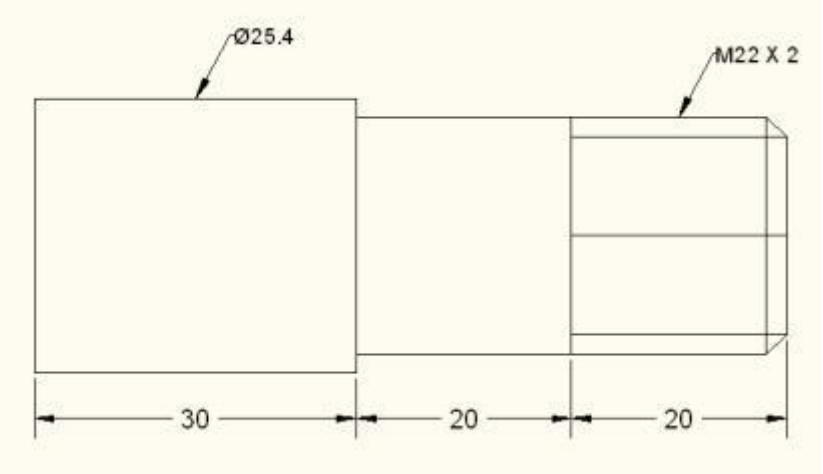
PROGRAM

```
G21 G98
G28 U0 W0
M06 T0101
M03 S1500
G00 X26 Z1
G90 X25 Z-40 F50
X24
X23
X22
G28 U0 W0
M06 T0202
M03 S300
G00 X26 Z1
G92 X22 Z-20 F2
    X21.95
    X21.90
    X21.85
    X21.80
    X21.75
    X21.70
    X21.65
    X21.60
    X21.55
    X21.50
```

G92 Thread Cutting Cycle
Syntax G92 X_ Z_ F_

Feed = Pitch = 2 mm
Calculation of Mirror Diameter (d) d=D-2h
=D - 2 X (0.615 X P)
=22 – 2 X (0.615 X 2)

```
X21.45
X21.40
X21.35
X21.30
X21.25
X21.20
X21.15
X21.10
X21.05
X21
X20.95
X20.90
X20.85
X20.80
X20.75
X20.70
X20.65
X20.60
X20.55
X20.50
X20.45
X20.40
X20.35
X20.30
X20.25
X20.20
X20.15
X20.10
X20.05
X20
X19.95
X19.90
X19.85
X19.80
X19.75
X19.70
X19.65
X19.60
X19.54
G28 U0 W0
M05
M30
```



RESULT

Thus the part program was written and simulated for given job.

LINEAR AND CIRCULAR INTERPOLATION
BILLET SIZE (100x100x10 Z=-10)

Ex.No: Date:

AIM

To write the part programming and simulation them to the given milling job.

TOOLS AND EQUIPMENTS

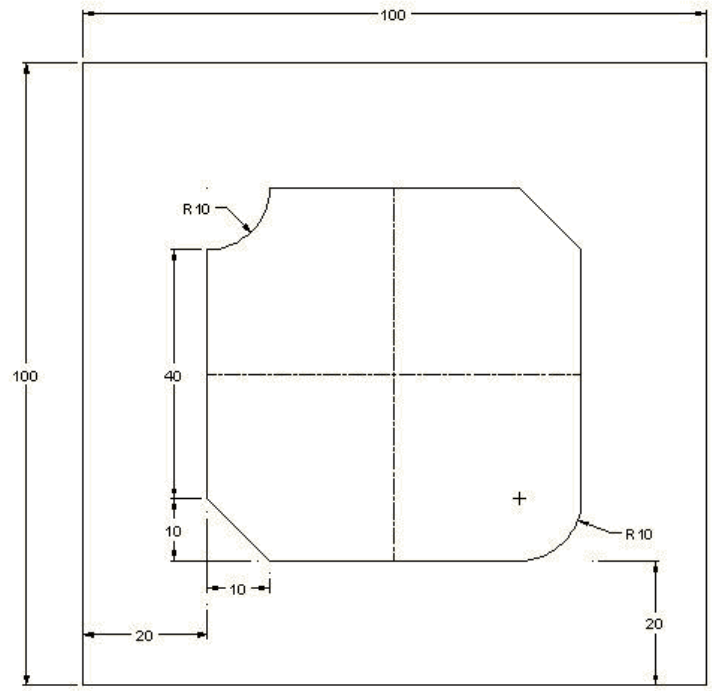
1. CNC simulation software
2. CNC milling software
3. Software Pentium IV

PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

PROGRAM

```
G21 G94
G91
G28 Z0
G28 X0 Y0
M06 T1
M03 S1500
G90
G00 X30 Y20
G00 Z5
G01 Z-0.5 F30
G01 X70 Y20 F50
G03 X80 Y30 R10 F50
G01 X80 Y70 F50
G01 X70 Y80 F50
G01 X30 Y80 F50
G02 X20 Y70 R10
G01 X20 Y30 F50
G01 X30 Y20 F50
G01 Z5 F50
G91
G28 Z0
G28 X0 Y0
M05
M30
```



RESULT

Thus the part program was written and simulated for given job.

CIRCULAR INTERPOLATION CCW

Ex.No: Date:

AIM

To write the part programming and simulation them to the given milling job.

TOOLS AND EQUIPMENTS

1. CNC simulation software
2. CNC milling software
3. Software Pentium IV

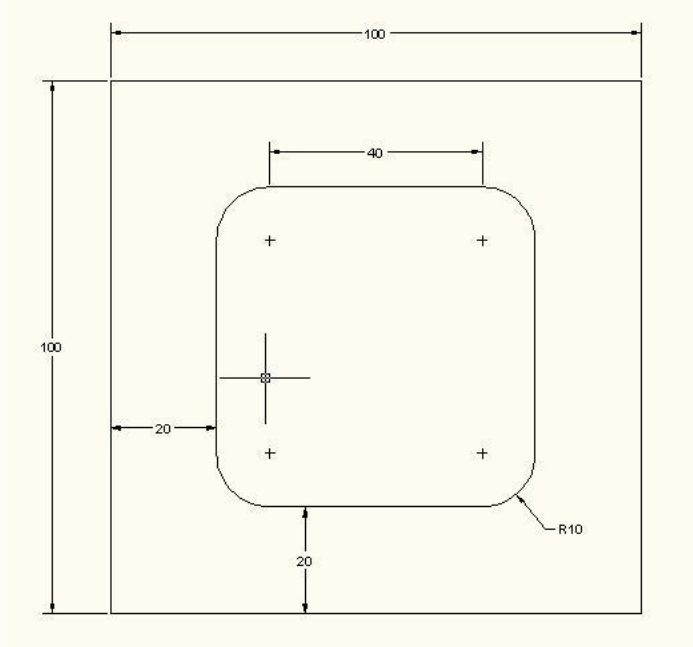
PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

PROGRAM

```
G21 G94
G91
G28 Z0
G28 X0 Y0
M06 T1
M03 S1500
G90
G00 X30 Y20
G00 Z5
G01 Z-0.5 F30
G01 X70 Y20 F50
G03 X80 Y30 R10 F50
G01 X80 Y70 F50
G03 X70 Y80 R10 F50
G01 X30 Y80 F50
G03 X20 Y70 R10 F50
G01 X20 Y30 F50
G03 X30 Y20 R10 F50
G91
G28 Z0
```

```
G28 X0 Y0
M05
M30
```



RESULT

Thus the part program was written and simulated for given job.

CIRCULAR INTERPOLATION-CW

Ex.No: Date:

AIM

To write the part programming and simulation them to the given milling job.

TOOLS AND EQUIPMENTS

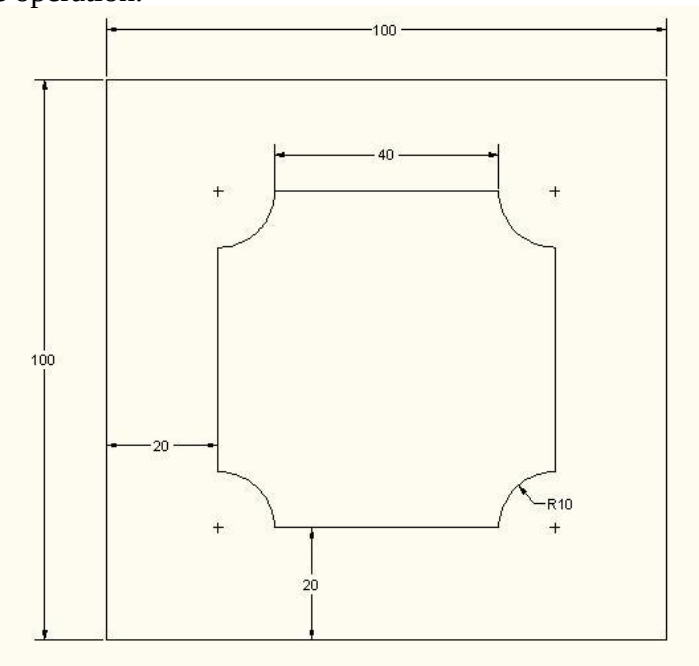
1. CNC simulation software
2. CNC milling software
3. Software Pentium IV

PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

PROGRAM

```
G21 G94
G91
G28 Z0
G28 X0 Y0
M06 T1
M03 S1500
G90
G00 X30 Y20
G00 Z5
G01 Z-0.5 F30
G01 X70 Y20 F50
G02 X80 Y30 R10 F50
G01 X80 Y70 F50
G02 X70 Y80 R10 F50
G01 X30 Y80 F50
G02 X20 Y70 R10 F50
G01 X20 Y30 F50
G02 X30 Y20 R10 F50
```



```
G91
G28 Z0
G28 X0 Y0
M05
M30
```

RESULT

Thus the part program was written and simulated for given job.

LINEAR INTERPOLATION BILLET SIZE (100x100x10 Z=-10)

Ex.No: Date:

AIM

To write the part programming and simulation them to the given milling job.

TOOLS AND EQUIPMENTS

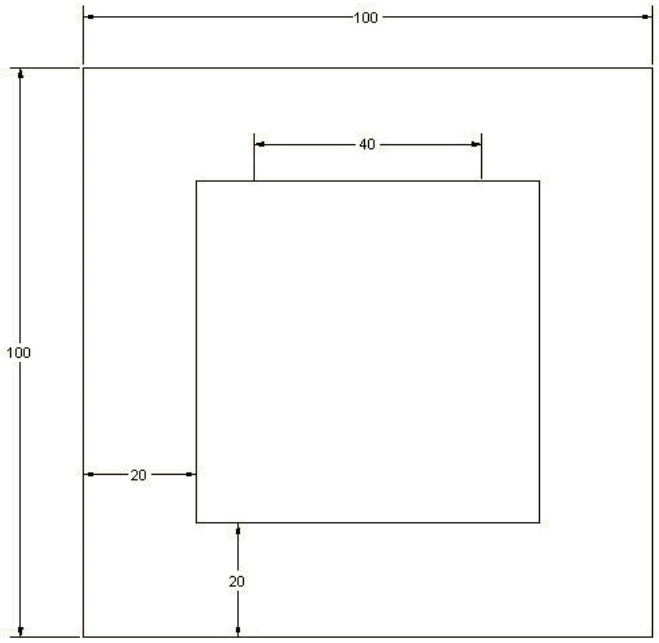
1. CNC simulation software
2. CNC milling software
3. Software Pentium IV

PROCEDURE

1. To write the program for given job.
2. To type G and M CODES.
3. To give the tool size and stock dimensions.
4. Finally to run the machine to the operation.

PROGRAM

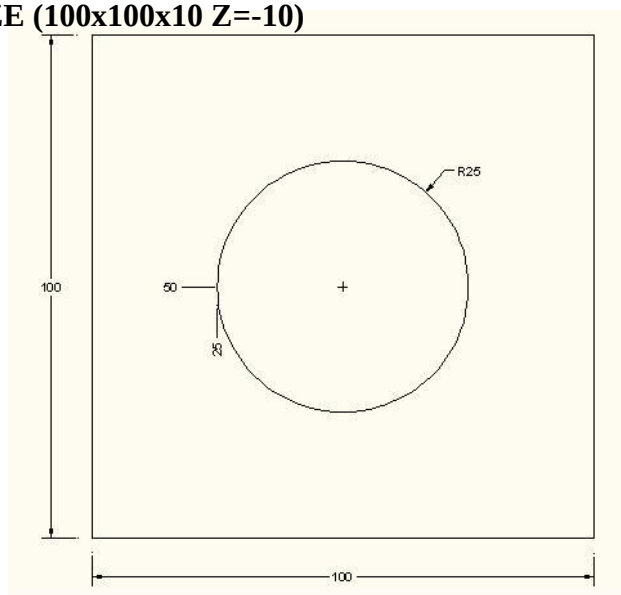
```
G21 G94
G91
G28 Z0
G28 X0 Y0
M06 T1
M03 S1500
G90
G00 X20 Y20
G00 Z5
G01 Z-0.5 F30
G01 X80 Y20 F50
G01 X80 Y80 F50
G01 X20 Y80 F50
G01 X20 Y20 F50
G91
G28 Z0
G28 X0 Y0
M05
M30
```



RESULT

Thus the part program was written and simulated for given job.

MILLING CIRCLE
BILLET SIZE (100x100x10 Z=-10)




```
G21 G94
G91
G28 Z0
G28 Y0  X0
M06 T1
M03 S1500
G90
G00 X25  Y50 Z5
G01 Z-1 F100
G02 X25  I25
G00 Z5
G91
G28 Z0  Y0 X0
M05
M30
```

G-CODES

G21 – Input In mm
G94 – Feed/Min
G91 – Incremental Mode
G28 X Y Z – Return To Reference Point
G90 – Absolute Mode
G00 X Y – Positioning Rapid Traverse
G01 – Linear Interpolation
G03 – Circular Interpolation CCW
G02 – Circular Interpolation CW

M-CODES

M05 – Spindle Stop
M30 – Program End

PREPARATORY FUNCTION

(G -CODES)

G00- Fast transverse

G01- Linear interpolation

G02- Circular interpolation (c.w)

G03- Circular interpolation (c.c.w)

G04-Dwell

G20-Imporial (input in inches)

G21- Metric (input in mm)

G28- Go to reference

G40- Cutter compensation cancel

G41- Cutter compensation right

G42-Cutter compensation left

G50- Co-ordinate setting

G70-Finishing cycle

G71- Stock removal in turning

G72- Multiple facing

G73-Pattern repeating

G74- drilling

G76- Multiple thread

G81- Drilling cycle

G90-Turning cycle

G94- Facing cycle

G96- Constant surface

G97- Variable surface

G98- Feed per minute

G99- Feed per revolution

MISCELLANEOUS FUNCTION

(M - CODES)

M00- Program stop

M02- Optional stop

M03- Program end

M04- Spindle forward

M05- Spindle stop

M06- Tool change

M08- Coolant on

M09- Coolant off

M10- Vice open

M11- Vice close

M62- Output 1ON

M63- Output 2ON

M64- Output1OFF

M65- Output 2OFF

M60- Wait input 1ON

M67- Wait input 10FF

M76- Wait input 2OFF

M77-Sub program call

M98-Sub program exit

M99- Sub program exit

M30- Program and rewind

CNC VIVA QUESTIONS AND ANSWERS

1. Describe how you go about calculating feeds and speeds and how you determine cut depths and cut widths for a particular operation.

Everyone has their own ideas on this one (what, everyone doesn't use G-Wizard Calculator?), so your goal is to see how compatible the applicant's approach is with what your shop needs. Don't be afraid to drill down and ask about subjects like High Speed Machining or Chip Thinning if it looks like a productivity way to explore your applicant's deeper skills set.

2. Do you know manual machining? Walk me through an example of a part or operation you recently had to do on a manual machine.

This is one of those deals where they have to convince you they know a topic cold, at least if you need them to know it. Don't be afraid to grab a piece of bar stock and a micrometer and head out to the shop to have the applicant turn the stock to a particular OD on the lathe. You'll learn a lot watching how quickly they get it done and seeing how they go about it.

3.How would you machine a square block from round stock?

Another one aimed at a basic skill.

3 .Describe the types of routine maintenance you've regularly performed on CNC machines.

Every shop has routine maintenance that has to get done. Lubrication, coolant maintenance, and other tasks. You need to know if this applicant will help get that work done. Don't be afraid to drill down deeper and ask them about more sophisticated maintenance they may have been involved with. You can even ask whether they were involved the last time a tech was brought in to fix a machine and get the story to help understand how well they followed what the tech did.

4 .Share an experience where you identified a problem with a machine

If the machines stop, the work often stops until they're running again. Can your applicant diagnose and fix a problem without having to wait for the techs every time?

5 .Describe the most interesting fixture you've made and what made it great.

Fixtures are a huge productivity opportunity. You'll want to understand whether the applicant has skills in this area and understands the productivity issues.

7.Walk me through a problem you recently solved using trigonometry or other shop math.

A decent grasp of Shop Math is pretty important for many CNC positions, and something you'll likely find hard to teach if they don't already need it.

8.Tell us what fixture or tooling you've encountered in your career that saved your shop the most money

Even if they don't make fixtures, they still need to understand and use them.

9.Can you use a calipers and read a micrometer?

Measurement is a constant issue around the shop. Get into it early.

10 .Hand them some artifacts, a calipers, and a micrometer and ask them to measure various features on the artifacts

Give them some of the parts your shop is making and inspecting and ask them to measure features you've already measured. Don't be afraid to go out to a machine with a DTI and have them sweep some things too, that's another important skill.

11 .Share an experience in which you measured finished workpieces to ensure conformance to specifications

This is your chance to hear about the inspection experience elsewhere. If it seems worthwhile, drill down into more detail and see what you can learn.

12 .Have you ever worked with a CMM? Tell us about your experiences with one.

This is not a skill everyone will have, but CMM's are turning up on shop floors more and more. It's worth knowing whether your applicant can handle one even if that isn't in the cards for the initial job.

13 .Can you communicate?

The question is short and somewhat nebulous for a reason–a good communicator can overcome the communication shortcomings of whomever they're talking to.

14 .Who were the 3 best colleagues you ever worked with and why?

This is your chance to go to school in so many ways. You'll learn how your applicant judges others, which is always useful. You should take down the names of and where these 3 folks are working as part of the process. Now you're building a database of people who at least your applicant thinks are great catches. Sort of like doing the references before you even know the guys and before anyone realizes that's what you're doing. I've gotten a lot of good hires this way.

15 .Describe an experience on the job that made you very happy
What does your applicant like? How do you make him love your workplace?

16 .Describe an experience where you analyzed data in order to suggest new approaches that made a difference
Can the applicant analyze data in order to formulate a solution?

17 .Describe an experience where you anticipated a problem with a new process and helped prevent the problem from occurring in advance
Process is a huge part of manufacturing. How comfortable is your applicant in thinking about it? So comfortable they can visualize problems with a process that hasn't even gone into production yet? A guy like that might be pretty handy to have around.

18 .Describe an experience where you had to offer an unpopular opinion and convince others to follow it in order to succeed
Is your applicant strictly a "Yes" man, or can he speak up if he sees the train is about to come off the track? Can he speak up with an unpopular opinion in a way that helps others to get on board, or is he just a complainer?

19 .Describe an experience where you went to a colleague or peer to get help that made a substantial improvement in your work
If I had a nickel for every time an employee could have gotten around some problem or challenge sooner just by asking for help sooner.

20 .Describe an experience where you were able to help your employer achieve significant cost savings
Does your applicant even care about helping achieve cost savings? Are they good at it?

21 .Describe how you organize, plan, and prioritize your work
Process extends to how an individual manages their own work too.

22. Describe the best manager you ever worked for. What made them special?
This is another one where you get to learn about a potential resource for a future hiring cycle (that stellar manager your applicant loves) as well as how your applicant evaluates their management.

23 .Describe the worst manager you ever worked for. What made them so difficult?
Ditto to #22.

24 .Describe things you've done to reduce stress on the job

All jobs carry some stress, some more than others. A key skill is being able to deal successfully with stress, perhaps even helping others reduce their stress.

Also, if your applicant can't make a convincing argument they have ever felt stress, you have to wonder whether they care much about helping the team to succeed if the going gets tough.

25 .Describe your most successful experience helping, teaching, or mentoring another individual in your shop

Do you have a real team player? Prove it.

26 .Share an experience in which you successfully improved the quality of a product or process

Quality is another big deal for Manufacturing. Drill down on this area with your applicant.

27 .Share an experience where such inspection enabled you to identify a problem and the cause of that problem

OK, so you measured some parts and scrapped the ones that weren't within tolerance. That's table stakes. Can you actually prevent or reduce scrappage?

Now you're talking!

28 .Share an experience where you proposed an improvement to a process to management and got them to adopt

Can you bring great suggestions to the table and help me to understand why they're great so that we can get them going? Many have good ideas but never share them. Many through them out on a take it or leave it basis. It's just never that easy. Who'll go the extra mile and sell their idea until it can make a difference?

29 .Tell us about the last time you had to negotiate with someone in a work setting

Negotiation is a part of working life. May as well see how someone handles it.

30. Tell us about the most stressful job you ever worked on

What does your guy really get bothered by? Also, this is your chance to hear about it from the employee's perspective. Are you doing some of these things without even realizing you're stressing people out in the process?

31.Tell us about the worst mistake you ever made on a job

We all make mistakes. There are really only two interesting things to discuss– how to avoid making the same mistake again and how to recover once a mistake is made.

32 .Tell us about your proudest achievement in your work career

Always good to know what an applicant things they've done well. You'll have to decide whether you'd value that kind of contribution or even make it possible.

33 .What are the top 3 key abilities and skills for this position?

Do they understand the job the same way you do? Having heard their opinion, do they have some good ideas you want to adopt?

34 .What are three positive character traits you wish you had but don't

Most people are not very self-aware. Those that do understand their weaknesses and want to get better are usually people with great attitudes. Beware the bogus interview face answers, "I always work too darned hard and get tired." Throw those out until you get something real.

35 .What do you see as your career path going forward from this position?

Can you provide this path, or are you setting this person up to start looking for another job not long after you've hired them?

36 .What one personal trait has helped you the most in your career?

Do you value what they have to offer? It's tough on an employee when you can't use what they see as their best abilities.

37 .What's been your most effective source of learning for your machining career?

The best employees never stop learning. Does this person quote any learning opportunities that happened recently? Do they have some good ideas for you or your employees to learn going forward?

38. Which personal trait has been the most challenging for you in your career?

Eventually people get told what their worst warts are. May as well have them tell you too if they're willing. It's back to that self-awareness thing.

39. Would you rather write a report or deliver it verbally?

Communication of both kinds is valuable. Most of the time you'd love to have both. Another one to ask about is whether they prefer phone, instant messages, or email?

40. What was the worst shop accident you've seen and how could it have been avoided?

Shop Safety is critically important. Find out how aware your applicants are, how skilled they are, and whether they have got "religion" about shop safety.

41. Describe the most difficult setup task you've ever encountered

Exacting setups really test a machinist's skills. OTOH, they may tell you something that sounds easy to you and that's a red flag worth learning sooner than later.

42. Describe the most difficult skill to learn that you have mastered

Will they work hard to obtain new skills? Can they learn even the most difficult skills? Good to know those things.

43. Can they CAM program? If so, which programs and versions

Not everyone can CAM, but those that can are valuable.

44. Can you hand program g-code? (Very important for finding CAM problems)

Even if they don't CAM, can they deal with problems down on the Shop Floor without sending the g-code back through the CAM cycle again?

45. Can you read prints?

This is another terse one that invites them to give a free-form response. Don't settle for a simple yes or no, make them dig into it.

46. Explain the difference between Cartesian and Polar coordinate systems and examples of what each is good for.

Half shop math and half programming. Polar coordinates are super handy for a lot of problems.

47. Do you understand Geometric dimensioning and tolerancing?
This is a fairly complex subject that's crucial for a lot of jobs. Be sure to drill down and not just take a simple yes or no answer–make them prove it.

48. Give them a blueprint and ask them to describe how to make the part.
This one is the essence of being able to synthesize so many critical skills for machinists.

49. Have they taken any courses in Statistical Process Control?
SPC is another valuable tool we see more and more often in Manufacturing.

50. Share an experience where you modified a g-code program based on problems encountered during operation
Ask for lots of details. Consider taking a simple g-code program, introducing some errors, and asking them to help fix the errors. You might even walk them through "air cutting" a bad program, being careful to make sure they don't screw up