

DRONACHARYA

GROUP OF INSTITUTIONS

LABORATORY MANUAL

COMPUTER AIDED MACHINE DRAWING LAB

SUBJECT CODE: KME-453

B.TECH. (ME) SEMESTER -IV

Academic Session: 2022-23, Even Semester

Student Name:	
Roll. No.:	
Branch/Section:	

Dronacharya Group of Institutions
Plot No. 27, Knowledge Park-3, Greater Noida, Uttar Pradesh 201308

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Vision and Mission of the Institute

Vision:

“Dronacharya Group of Institutions, Greater Noida aims to become an Institution of excellence in imparting quality Outcome Based Education that empowers the young generation with Knowledge, Skills, Research, Aptitude and Ethical values to solve Contemporary Challenging Problems”

Mission:

We, at Dronacharya Group of Institutions, are absolutely committed to serve the society and improve the mode of life by imparting high quality education in the field of Engineering and Management catering to the explicit needs of the students, society, humanity, and industry. ‘Shiksha evam Sahayata’ i.e. Education and help are the two words etched on our banner soaring higher year after year.

Vision and Mission of the Department

Vision:

“To become a Centre of Excellence in teaching and research in Mechanical Engineering for producing skilled professionals having a zeal to serve society”

Mission:

M1: To create an environment where students can be equipped with strong fundamental concepts.

M2: To provide an exposure to emerging technologies by providing hands on experience for generating competent professionals.

M3: To promote Research and Development in the frontier areas of Mechanical Engineering and encourage students for pursuing higher education

M4: To inculcate in students ethics, professional values, team work and leadership skills.

Program Educational Objectives (PEOs)

- PEO 1.** Engineers will practice the profession of engineering using a systems perspective and analyze, design, develop, optimize & implement engineering solutions and work productively as engineers, including supportive and leadership roles on multidisciplinary teams.
- PEO 2.** Continue their education in leading graduate programs in engineering & interdisciplinary areas to emerge as researchers, experts, educators & entrepreneurs and recognize the need for, and an ability to engage in continuing professional development and life-long learning.
- PEO 3.** Engineers, guided by the principles of sustainable development and global interconnectedness, will understand how engineering projects affect society and the environment.
- PEO 4.** Promote Design, Research, and implementation of products and services in the field of Engineering through Strong Communication and Entrepreneurial Skills.
- PEO 5.** Re-learn and innovate in ever-changing global economic and technological environments of the 21st century.

Program Outcomes (POs)

- PO1: Engineering knowledge:** Apply knowledge of mathematics, science, and engineering in Mechanical Engineering.
- PO2: Problem analysis:** Design and conduct experiments, as well as to analyze and interpret data.
- PO3: Design/development of solutions:** To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5: Modern tool usage:** Apply principles of engineering, basic science, and mathematics to design and realize physical systems, components, or processes.
Use the techniques, skills, and modern engineering tools necessary for engineering practice like AUTOCAD.
- PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
- PO9: Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

- PSO 1:** Graduates of the program will achieve excellence in product design, thermal engineering and manufacturing system by acquiring knowledge in mathematics, science and designing principles.
- PSO 2:** Graduate will be able to analyze, interpret and provide solutions to the real life mechanical engineering problems.
- PSO 3:** Graduate will develop an approach to solve multidisciplinary problems of manufacturing and allied industries.
- PSO 4:** Graduates will learn managerial skills to work effectively in a team and in a society by following ethical and environmental practices.

University Syllabus

- 1. Introduction:** Conventional representation of machine components and materials, Conventional representation of surface finish, Roughness number symbol, Symbols of Machine elements and welded joints. Classification of Drawings: Machine drawings, Production drawing, part drawing and assembly drawing. Introduction to detail drawing and bill of materials (BOM).
- 2. Limits, Fits and Tolerances:** General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts. List of Standard Abbreviation used.
- 3. Part Modelling:** Introduction to part modelling of simple machine components using any 3D software (like CATIA, PRO E, UGNX, Autodesk Inventor or SOLIDWORKS) covering all commands/ features to develop a part model (Minimum 24 machine components need to be developed).
- 4. Part Modelling & Assemblies of:** Plummer Block Bearing, Machine Vice, Screw Jack, Engine Stuffing box, Lathe Tailstock, Feed Check Valve and Rams Bottom Safety Valve.

Course Outcomes

CO 1	Upon completion of this course, the students can use computer and CAD software for modelling mechanical components.
CO 2	Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, riveted joints, welded joints.
CO 3	Knowledge of limits, tolerance and fits and indicate them on machine drawings
CO 4	Interpretation of drawings of machine components leading to preparation of Assembly drawings manually and using CAD packages.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1		1		3			2	3	1	3	1
CO 2	1		3		3			2	3	1	3	1
CO 3	1		3		3			2	3	1	3	1
CO 4	1		1		1			2		1	1	2

CO-PSO Mapping

	PSO1	PSO2	PSO3	PSO4
CO 1	2		2	
CO 2	1		2	
CO 3	1		2	
CO 3	2		1	

Course Co-relation Mapping: 3-High, 2-Medium, 1-Low

Course Overview

1. To familiarize with the standard conventions for different materials and machine parts in working drawings.
2. To gain knowledge of conventional representation of various machining and mechanical details as per IS.
3. To gain knowledge of threads, bolts, nuts, stud bolts, tap bolts, set screws, keys, cotter joints and knuckle joint.
4. To make part drawings including sectional views for various machine elements.
5. To prepare assembly drawings given the details of part drawings.

List of Experiments mapped with COs

S. No.	Aim of the Experiment	COs
1.	Study and exercises on machine drawing conventions.	
	a. Conventional representation of materials.	CO2
	b. Conventional representation of machine components.	CO2
	c. Conventional representation sectional views.	CO2
	d. Conventional representation of limits, Fits and tolerances-form and positional tolerances and machining symbols.	CO3
	e. Surface roughness and its Indications	CO2
2.	Assembly of bolt and nut	CO4
3.	Riveted joints for plates	CO2
4.	3d modeling - flange coupling	CO2
5.	3d modeling universal coupling	CO2
6.	Assembly of sleeve and cotter joint	CO4
7.	Assembly of knuckle joint	CO4
8.	Assembly of screw jack	CO4
9.	Assembly of connecting rod	CO4

DOs and DON'Ts

DOs

1. Student must carry record and observation.
2. Take signature of lab in charge after completion of observation and record.
3. If any equipment fails in the experiment report it to the supervisor immediately.
4. Students should come to the lab with thorough theoretical knowledge.
5. Put your bags in the designated area.

DON'Ts

1. Don't touch the equipment without instructions from lab supervisor.
2. Don't crowd around the experiment and behave in-disciplinary.
3. Using the mobile phone in the laboratory is strictly prohibited.

General Safety Precautions

Precautions (In case of Injury or Electric Shock)

1. To break the victim with live electric source, use an insulator such as firewood or plastic to break the contact. Do not touch the victim with bare hands to avoid the risk of electrifying yourself.
2. Unplug the risk of faulty equipment. If the main circuit breaker is accessible, turn the circuit off.
3. If the victim is unconscious, start resuscitation immediately, use your hands to press the chest in and out to continue breathing function. Use mouth-to-mouth resuscitation if necessary.

Precautions (In case of Fire)

1. Turn the equipment off. If the power switch is not immediately accessible, take plug off.
2. If fire continues, try to curb the fire if possible, by using the fire extinguisher or by covering it with a heavy cloth if possible isolate the burning equipment from the other surrounding equipment.
3. Sound the fire alarm by activating the nearest alarm switch located in the hallway.

Guidelines to Students for Report Preparation

All students are required to maintain a record of the experiments conducted by them. Guidelines for its preparation are as follows:-

- 1) All files must contain a title page followed by an index page. *The files will not be signed by the faculty without an entry in the index page.*
- 2) Student's Name, Roll number and date of conduction of experiment must be written on all pages.
- 3) For each experiment, the record must contain the following
 - (i) Aim/Objective of the experiment
 - (ii) Pre-experiment work (as given by the faculty)
 - (iii) Lab assignment questions and their solutions
 - (iv) Test cases (if applicable to the course)
 - (v) Results/ output

Note:

1. Students must bring their lab record along with them whenever they come for the lab.
2. Students must ensure that their lab record is regularly evaluated.

Lab Assessment Criteria

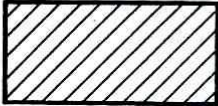
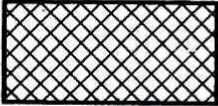
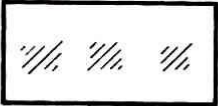
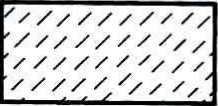
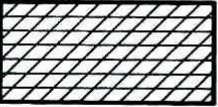
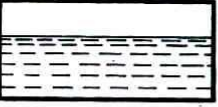
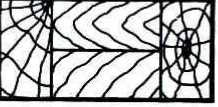
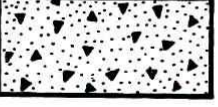
An estimated 10 lab classes are conducted in a semester for each lab course. These lab classes are assessed continuously. Each lab experiment is evaluated based on 5 assessment criteria as shown in following table. Assessed performance in each experiment is used to compute CO attainment as well as internal marks in the lab course.

Grading Criteria	Exemplary (4)	Competent (3)	Needs Improvement (2)	Poor (1)
AC1: Pre-Lab written work (this may be assessed through viva)	Complete procedure with underlined concept is properly written	Underlined concept is written but procedure is incomplete	Not able to write concept and procedure	Underlined concept is not clearly understood
AC2: Program Writing/ Modeling	Assigned problem is properly analyzed, correct solution designed, appropriate language constructs/tools are applied, Program/solution written is readable	Assigned problem is properly analyzed, correct solution designed, appropriate language constructs/tools are applied	Assigned problem is properly analyzed & correct solution designed	Assigned problem is properly analyzed
AC3: Identification & Removal of errors/ bugs	Able to identify errors/ bugs and remove them	Able to identify errors/ bugs and remove them with little bit of guidance	Is dependent totally on someone for identification of errors/ bugs and their removal	Unable to understand the reason for errors/ bugs even after they are explicitly pointed out
AC4: Execution & Demonstration	All variants of input /output are tested, Solution is well demonstrated and implemented concept is clearly explained	All variants of input /output are not tested, However, solution is well demonstrated and implemented concept is clearly explained	Only few variants of input /output are tested, Solution is well demonstrated but implemented concept is not clearly explained	Solution is not well demonstrated and implemented concept is not clearly explained
AC5: Lab Record Assessment	All assigned problems are well recorded with objective, design constructs and solution along with Performance analysis using all variants of input and output	More than 70 % of the assigned problems are well recorded with objective, design contracts and solution along with Performance analysis is done with all variants of input and output	Less than 70 % of the assigned problems are well recorded with objective, design contracts and solution along with Performance analysis is done with all variants of input and output	Less than 40 % of the assigned problems are well recorded with objective, design contracts and solution along with Performance analysis is done with all variants of input and output

LAB EXPERIMENTS

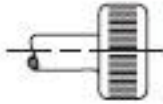
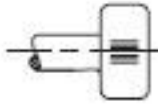
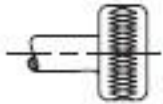
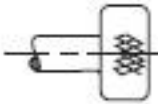

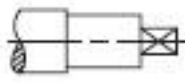


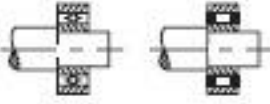
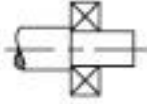
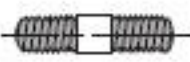


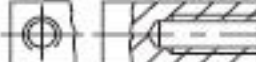


1. CONVENTIONAL REPRESENTATION OF MATERIALS


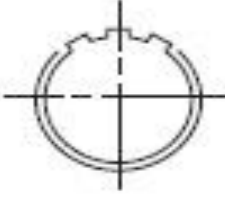
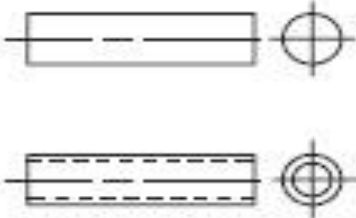
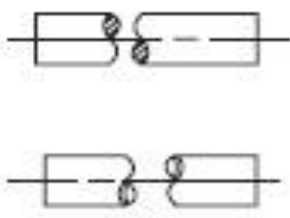

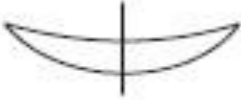

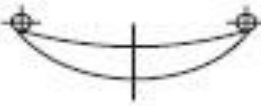






As a variety of materials are used for machine components in engineering applications, it is preferable to have different conventions of section lining to differentiate between various materials. The recommended conventions in use are shown in Fig.

TYPE	CONVENTION	MATERIALS
METALS		STEEL, CAST IRON, COPPER AND ITS ALLOYS, ALUMINIUM AND ITS ALLOYS, ETC
		LEAD, ZINC, TIN, WHITE-METAL, ETC
GLASS		GLASS
PACKING AND INSULATING MATERIALS		PORCELAIN, STONEWARE, MARBLE, SLATE, ETC
		ASBESTOS, FIBRE, FELT, SYNTHETIC RESIN PRODUCTS, PAPER, CORK, LINOLEUM, RUBBER, LEATHER, WAX, INSULATING & FILLING MATERIALS
LIQUIDS		WATER, OIL, PETROL, KEROSENE, ETC
WOOD		WOOD, PLYWOOD, ETC
CONCRETE		


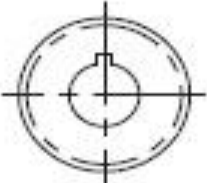
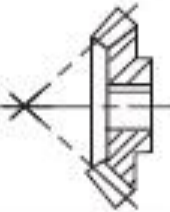
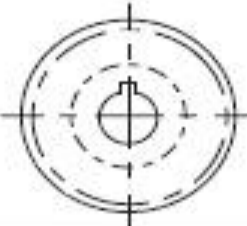
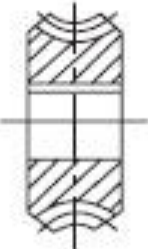
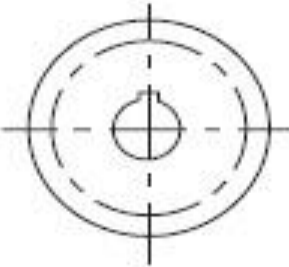
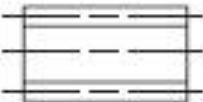

2. CONVENTIONAL REPRESENTATION OF MACHINE COMPONENTS

When the drawing of a component in its true projection involves a lot of time, its convention may be used to represent the actual component. Images shows typical examples of conventional representation of various machine components used in engineering drawing.

Title	Subject	Convention
Straight knurling		
Diamond knurling		
Square on shaft		
Holes on circular pitch		
Bearings		
External screw threads (Detail)		
Internal screw threads (Detail)		
Screw threads (Assembly)		

Title	Subject		Convention
Splined shafts			
Interrupted views			
Semi-elliptic leaf spring			
Semi-elliptic leaf spring with eyes			
	Subject	Convention	Diagrammatic Representation
Cylindrical compression spring			
Cylindrical tension spring			

(b)

Title	Convention	
Spur gear		
Bevel gear		
Worm wheel		
Worm		

3. CONVENTIONAL REPRESENTATION SECTIONAL VIEWS

When an object becomes more complex, as in the case of an automobile engine block, a clearer presentation of the interior can be made by sketching the object as it would look if it were cut apart. In that way, the many hidden lines on the sketch are eliminated.

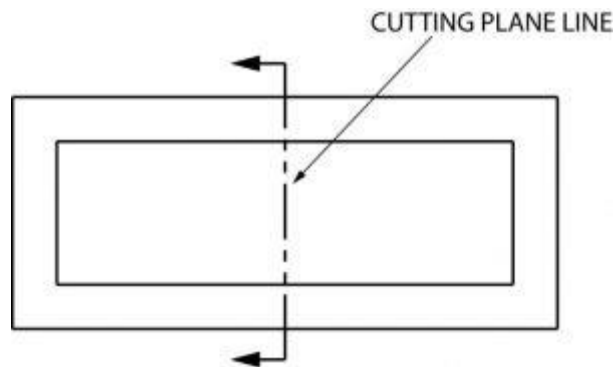
The process of sketching the internal configuration of an object by showing it cut apart is known as sectioning. Sectioning is used frequently on a wide variety of Industrial drawings. The following are the representation of sectional views.

Cutting Plane

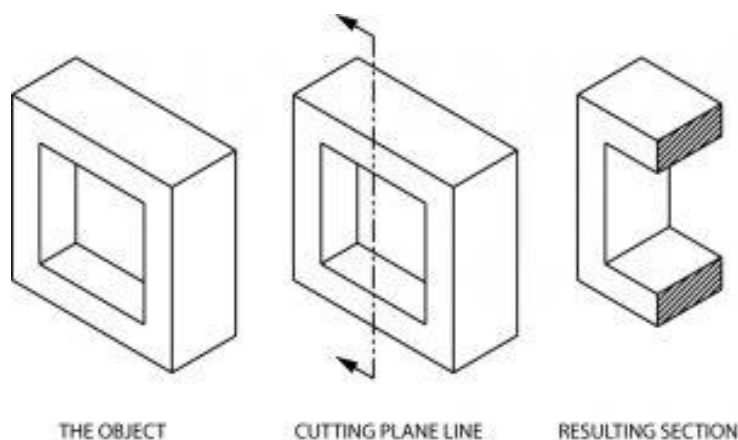
A surface cut by the saw in the drawing above is a cutting plane. Actually, it is an imaginary cutting plane taken through the object, since the object is imagined as being cut through at a desired location.

Cutting Plane Line

A cutting plane is represented on a drawing by a cutting plane line. This is a heavy long-short-short-long kind of line terminated with arrows. The arrows in show the direction of view.



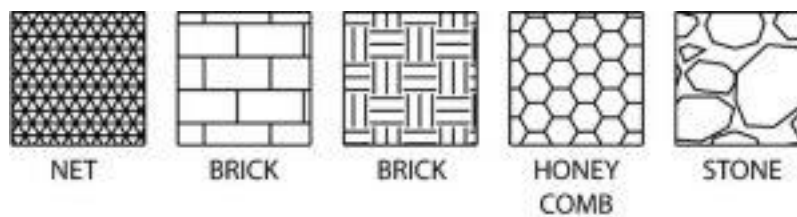
Once again, here is a graphic example of a cutting plane line and the section that develops from it.



Section Lining

The lines in the figure above, which look like saw marks, are called section lining. They are found on most sectional views, and indicate the surface which has been exposed by the cutting plane. Notice that the square hole in the object has no section lining, since it was not changed by sectioning.

Different kinds of section lining is used to identify different materials. When an object is made of a combination of materials, a variety of section lining symbols makes materials identification easier. Here are a few examples:

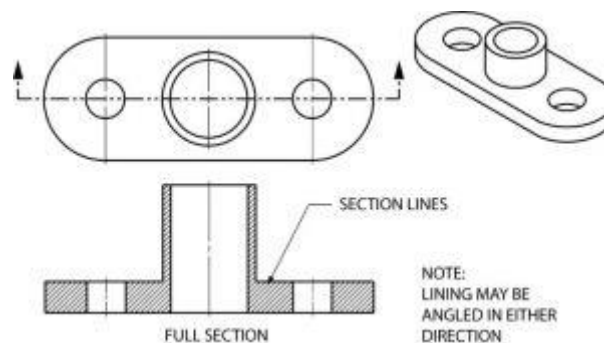


Section lines are very light. When sketching an object or part that requires a sectional view, they are drawn by eye at an angle of approximately 45 degrees, and are spaced about 1/8" apart. Since they are used to set off a section, they must be drawn with care.

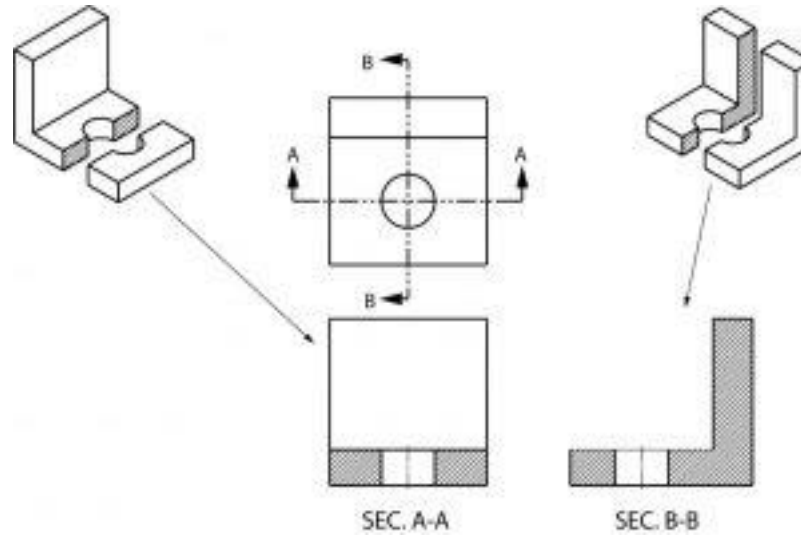
It is best to use the symbol for the material being shown as a section on a sketch. If that symbol is not known, you may use the general purpose symbol, which is also the symbol for cast iron.

Full Sections

When a cutting plane line passes entirely through an object, the resulting section is called a full section Fig. 7 illustrates a full section.



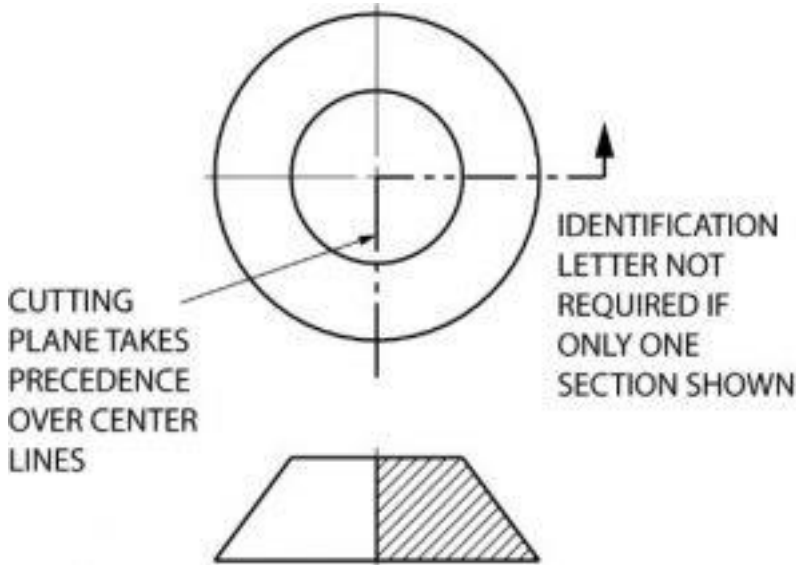
It is possible to section an object whenever a closer look intentionally is desired. Here is an object sectioned from two different directions.



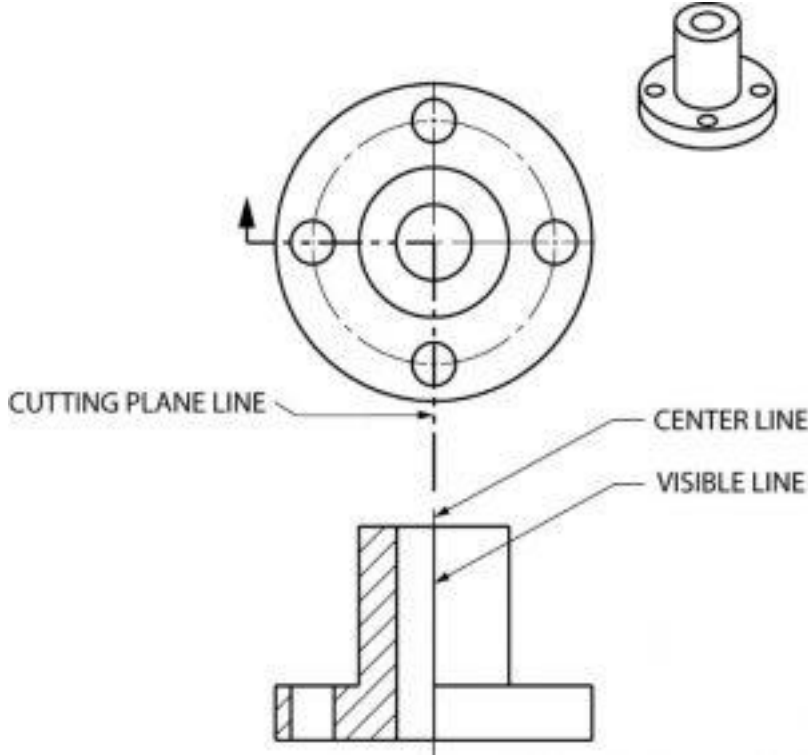
Half Sections

If the cutting plane is passed halfway through an object, and one-quarter of the object is removed, the resulting section is a half section. A half section has the advantage of showing both inside and outside configurations.

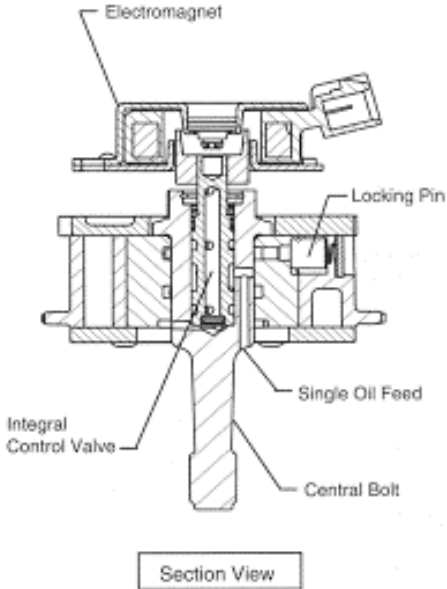
It is frequently used for symmetrical objects. Hidden lines are usually not shown on the unsectioned half unless they are needed for clearness or for dimensioning purposes. As in all sectional drawings, the cutting plane take precedence over the center line.



Here is another example of a half section. Remember that only one fourth of the object is removed with a half section, whereas half of the object is generally removed with a full section.

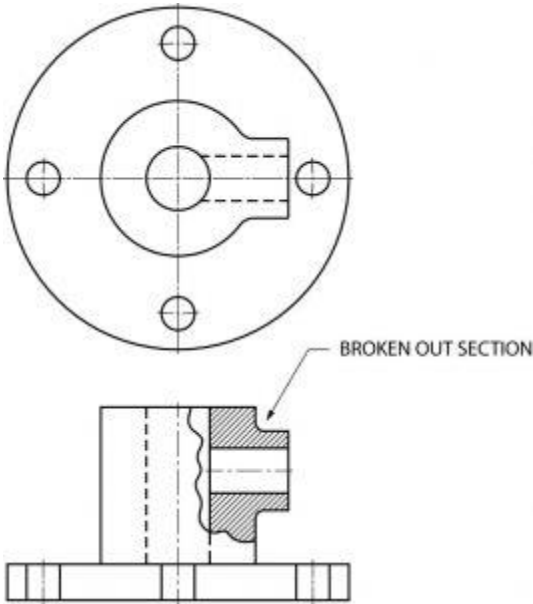


This manufacturer’s drawing, using both full and half section, illustrates the advantages of sectional views. The different line directions indicate different parts and materials used in the assembly of this valve.



Broken Out Sections

In many cases only a small part of a view needs to be sectioned in order to show some internal detail. In the figure below, the broken out section is removed by a freehand break line. A cutting plane line does not need to be shown, since the location of the cut is obvious.



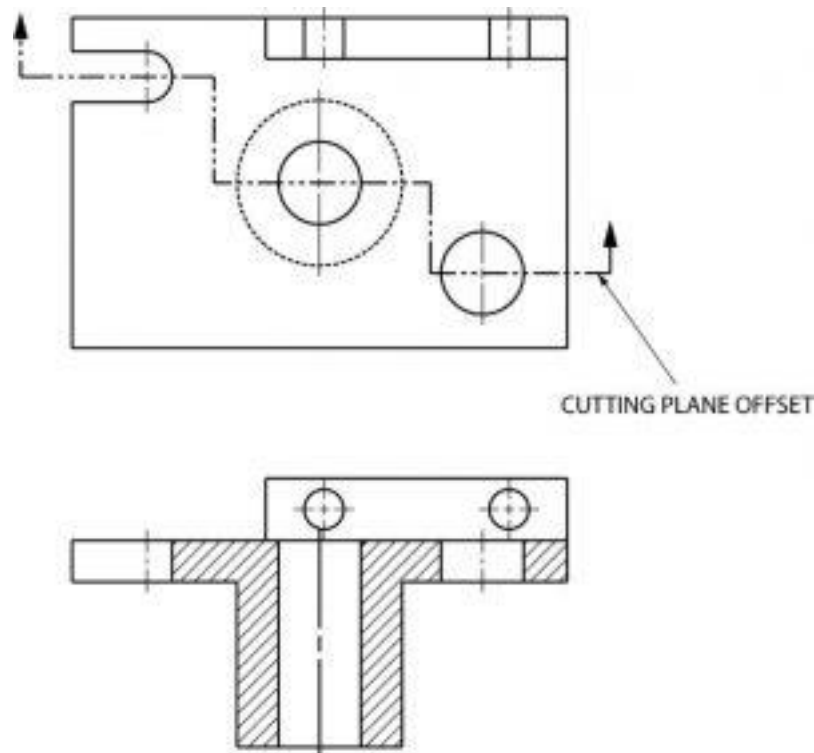
Revolved Sections

A revolved section shows the shape of an object by rotating a section 90 degrees to face the viewer. The three revolved sections illustrated in the spear-like object of figure 12 show the changes that take place in its shape.



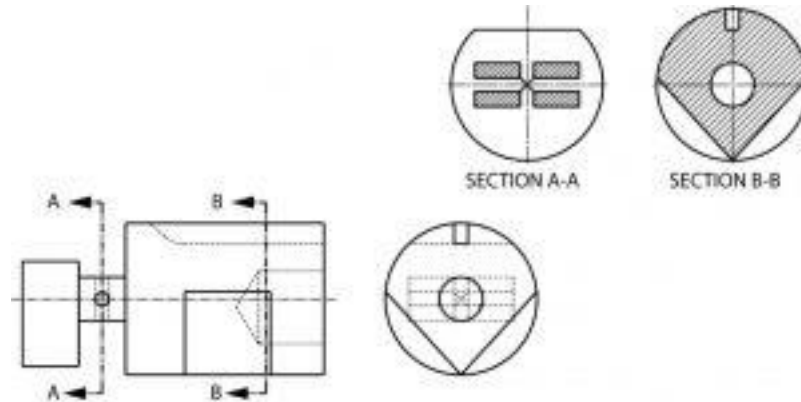
Offset Sections

An offset section is a means of including in a single section several features of an object that are not in a straight line. To do this, the cutting plane line is bent, or “OFFSET” to pass through the features of the part.



Removed Sections

A section removed from its normal projected position in the standard arrangement of views is called a “removed” section. Such sections are labeled SECTION A-A, SECTION B-B, etc., corresponding to the letter designation at the ends of the cutting plane line. Removed sections may be partial sections and are often drawn to a different scale.



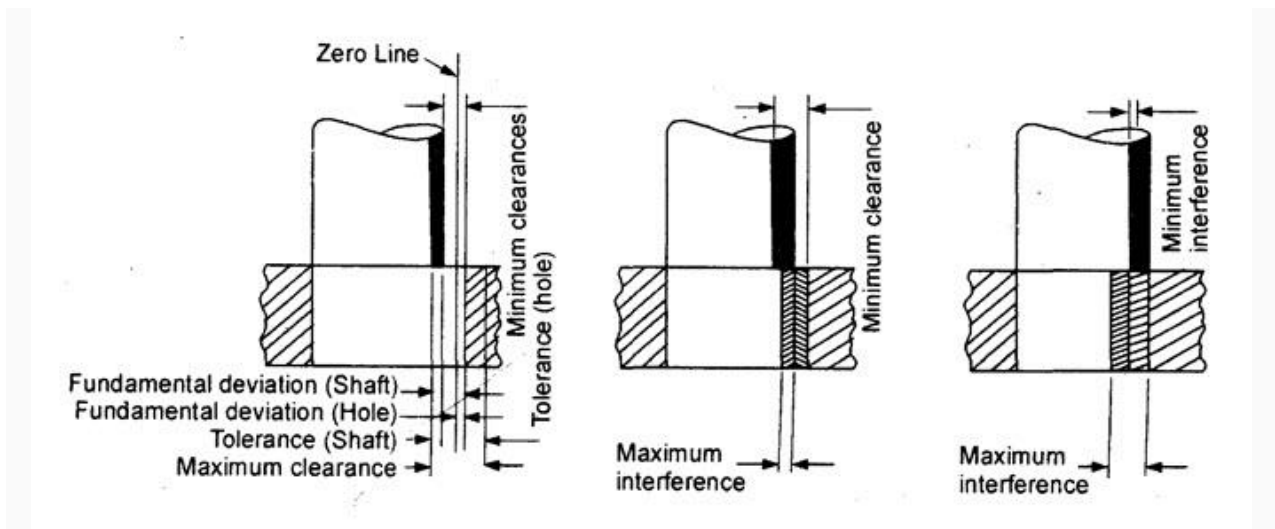
4. CONVENTIONAL REPRESENTATION OF LIMITS, FITS AND TOLERANCES- FORM AND POSITIONAL TOLERANCES AND MACHINING SYMBOLS.

Fits

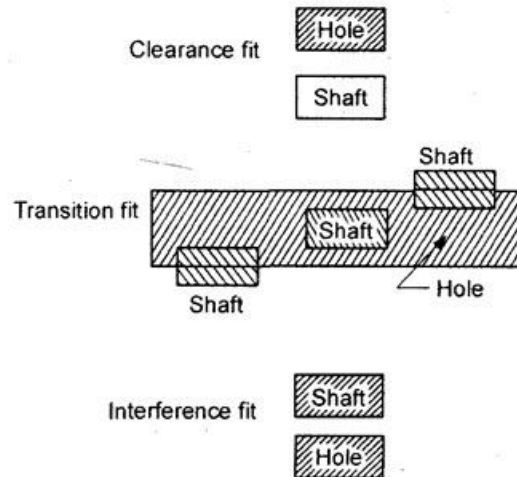
When two parts are to be assembled the relation resulting from the difference between their sizes before assembly is called a fit. The fit signifies the range of tightness or looseness which may result from the application of a specific combination of allowances and tolerances in the design of mating parts.

Types of Fits

The three types of fits are shown below. The disposition of tolerance zones for the three classes of fit are shown in next figure.



Types of fits



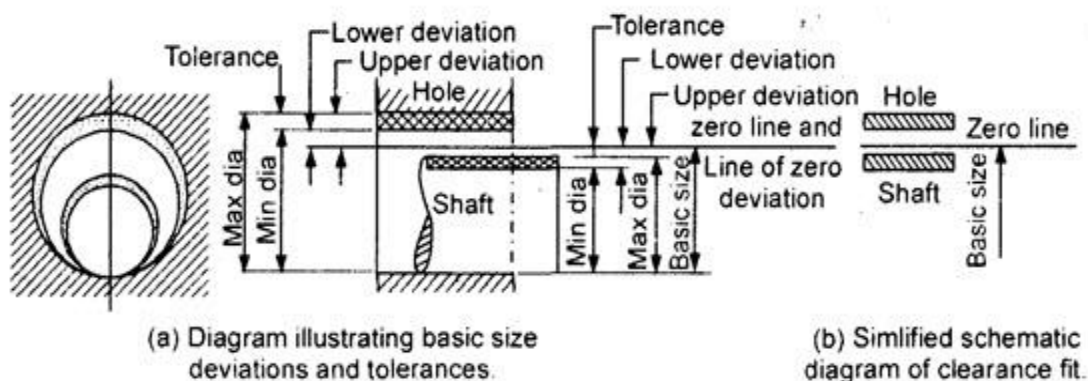
Disposition of tolerance zones for the three classes of fit

There are three general types of fit between the mating parts

1. **Clearance fit:** A clearance fit is one having limits of size so prescribed that a clearance always results when mating parts are assembled.
2. **Interference fit:** An interference fit is one having limits of size so prescribed that an interference always results when mating parts are assembled.
3. **Transition fit:** A transition fit is one having limits of size so prescribed that either a clearance or interference may always result when mating parts are assembled.

Terminology

The terminology used in fits and tolerances is shown in Fig. The important terms are



Terminology for fits and tolerances

Basic size: It is the exact theoretical size arrived at by design. It is also called nominal size.

Actual size: The size of a part as may be found by measurement.

Maximum limit of size: The greater of the two limits of size.

Minimum limit of size: The smaller of the two limits of size.

Allowance: It is an intentional difference between maximum material limits of mating parts. It is a minimum clearance or maximum interference between mating parts.

Deviation: The algebraic difference between a size (actual, maximum, etc.) and the corresponding basic size.

Actual deviation: The algebraic difference between the actual size and the corresponding basic size.

Upper deviation: The algebraic difference between the maximum limit of size and the corresponding basic size.

Upper deviation of hole = ES (& art Superior)

Upper deviation of shaft es

Lower deviation: The algebraic difference between the minimum limit of size and the corresponding basic size.

Lower deviation of hole = EI (Ecart Inferior)

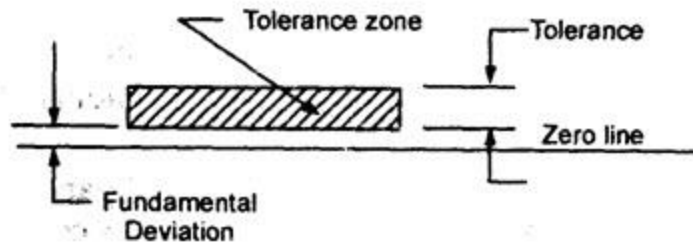
Lower deviation of shaft = ei

Upper deviation Lower deviation + Tolerance

Zero line: It is the line of zero deviation and represents the basic size.

Tolerance zone: It is the zone bounded by the two limits of size of the parts and defined by its magnitude, i.e. tolerance and by its position in relation to the zero line.

Fundamental deviation: That one of the two deviations which is conveniently chosen to define the position of the tolerance zone in relation to zero line, as shown below.



Disposition of fundamental deviation and tolerance zone with respect to the zero line

Basic shaft: A shaft whose upper deviation is zero.

Basic hole: A hole whose, lower deviation of zero.

Clearance: It is the positive difference between the hole size and the shaft size.

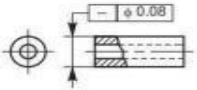
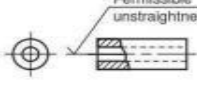
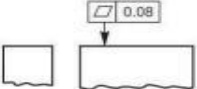
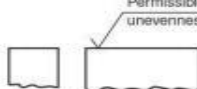
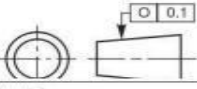

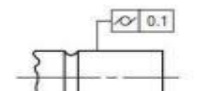
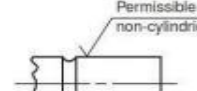
Maximum clearance: The positive difference between the maximum size of a hole and the minimum size of a shaft.

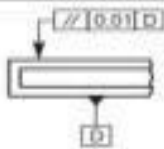

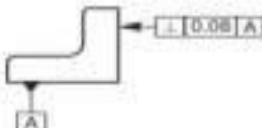
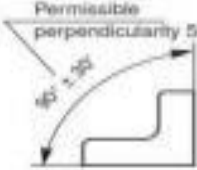
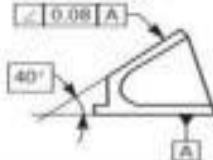
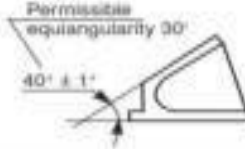

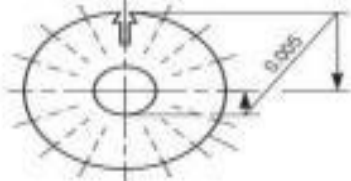
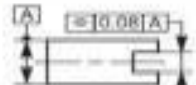

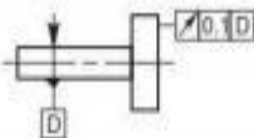
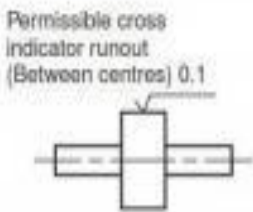
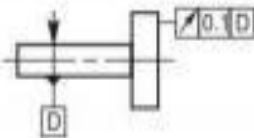
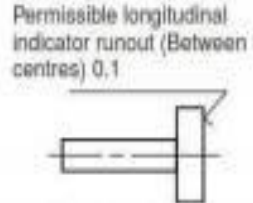
Minimum clearance: The positive difference between the minimum size of a hole and the maximum size of a shaft.

Symbols for Geometric Tolerancing

Feature	Type of Tolerance	Characteristic	Symbol
For individual features	Form	Straightness	—
		Flatness	▭
		Circularity (roundness)	○
		Cylindricity	∕
For individual or related features	Profile	Profile of a line	⤿
		Profile of a surface	⤿
For related features	Orientation	Angularity	∠
		Perpendicularity	⊥
		Parallelism	∥
	Location	Position	⊕
		Concentricity	⊙
	Runout	Circular runout	↗
		Total runout	↗↘

FORM AND POSITIONAL TOLERANCES

<i>As per the standard</i>	<i>As prevalent in industry</i>
<p>1. Straightness tolerance</p> 	<p>Permissible unstraightness 0.08</p> 
<p>2. Flatness tolerance</p> 	<p>Permissible unevenness 0.08</p> 
<p>3. Circularity tolerance</p> 	<p>Permissible ovality 0.2</p> 
<p>4. Cylindricity tolerance</p> 	<p>Permissible non-cylindricity 0.2</p> 

5. Parallelism tolerance	
	
6. Perpendicularity tolerance	
	
7. Angularity tolerance	
	
8. Concentricity and coaxiality tolerance	
	
9. Symmetry tolerance	
	
10. Radial run-out	
	
11. Axial run-out	
	

Systems of indication of tolerances of form and of position

5. SURFACE ROUGHNESS AND ITS INDICATIONS

Surface Roughness: The properties and performance of machine components are affected by the degree of roughness of the various surfaces. The higher the smoothness of the surface, the better is the fatigue strength and corrosion resistance. Friction between mating parts is also reduced due to better surface finish.

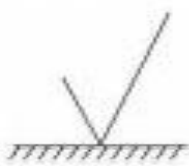
Surface Roughness Number: The surface roughness number represents the average departure of the surface from perfection over a prescribed sampling length and is expressed in microns.

$$R_a = \frac{h_1 + h_2 + h_3 + \dots + h_n}{n}$$

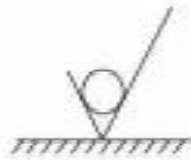
The surface roughness may be measured, using any one of the following:

1. Straight edge
2. Surface gauge
3. Optical flat
4. Tool makers Microscopes
5. Profilometer
6. Profilograph
7. Talysurf

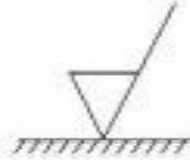
Machine Symbols: The basic symbol consists of two legs of unequal length, inclined at approximately 60° to the line, representing the surface considered. This symbol may be used where it is necessary to indicate that the surface is machined, without indicating the grade of roughness or the process to be used.



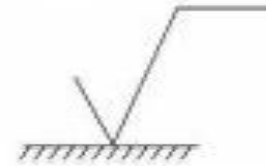
(a)



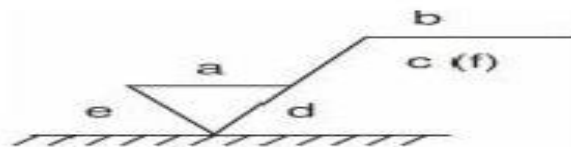
(b)



(c)



- (d)
- a) Basic symbol.
 - b) Material Removal is Not Allowed
 - c) removal Of Material is Allowed.
 - d) special surface characteristics



Surface Roughness, Values, Grades and Symbols

Roughness Value Ra μm	Roughness Grade Number	Roughness Symbols
50	N 12	\cong
25	N 11	∇
12.5	N 10	
6.3	N 10	$\nabla\nabla$
3.2	N 9	
1.6	N 8	
0.8	N 6	$\nabla\nabla\nabla$
0.4	N 5	
0.2	N 4	
0.1	N 3	
0.05	N 2	$\nabla\nabla\nabla\nabla$
0.025	N 1	

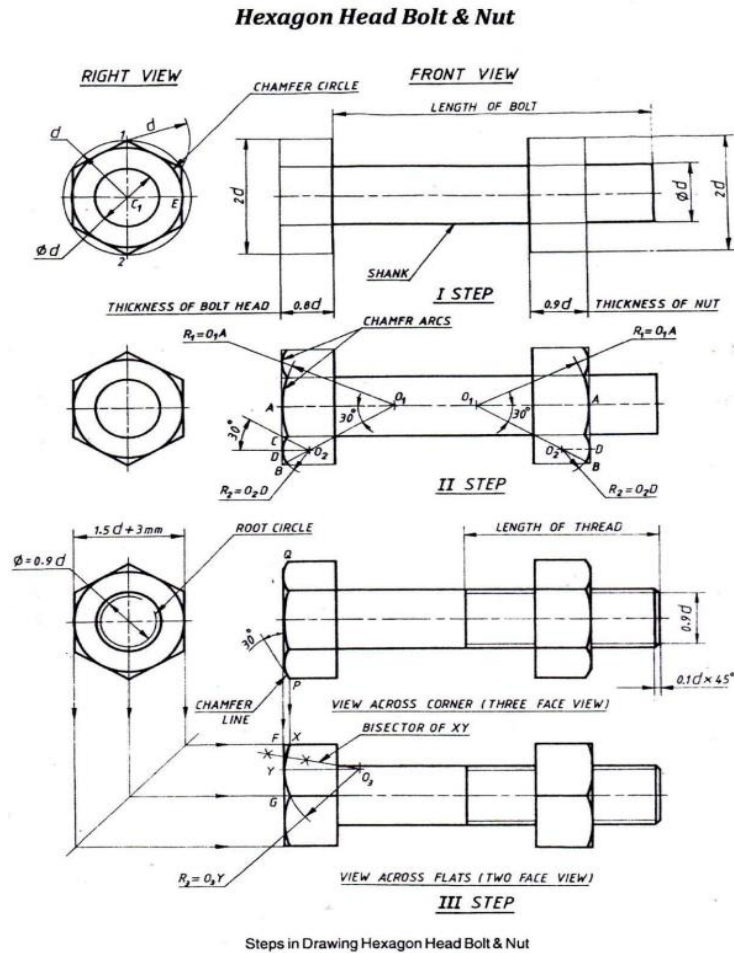
Indication of Special Roughness Characteristics: In certain circumstances, for functional reasons, it may be necessary to specify additional special requirements, concerning surface roughness. If it is required that the final surface texture be produced by one particular production method, this method should be indicated on an extension of the longer arm of the symbol. Also, any indications relating to treatment of coating may be given on the extension of longer arm of the symbol

<i>Symbol</i>	<i>Interpretation</i>	
=	Parallel to the plane of projection of the view in which the symbol is used	
⊥	Perpendicular to the plane of projection of the view in which the symbol is used	
X	Crossed in two slant directions relative to the plane of projection of the view in which the symbol is used	
M	Multi-directional	
C	Approximately circular, relative to the centre of the surface to which the symbol is applied	
R	Approximately radial, relative to the centre of the surface to which the symbol is applied	

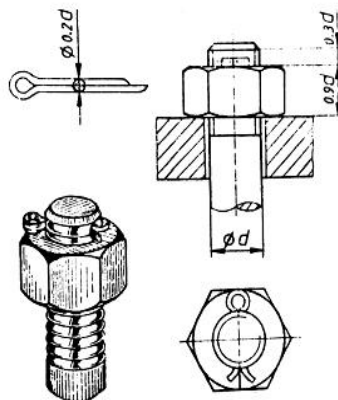
Symbols specifying the directions of lay

EXPERIMENT : 1. ASSEMBLY OF BOLT AND NUT

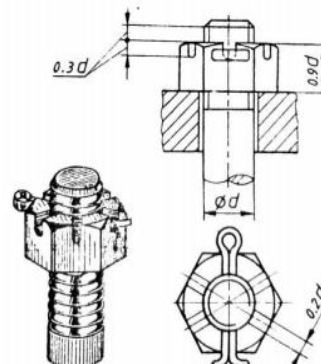
Aim : To model a bolt and nut by creating, modifying assembling and manipulating various features by feature based parametric solid modeling and detailing.



Split pin lock nut assembly



Slotted nut assembly

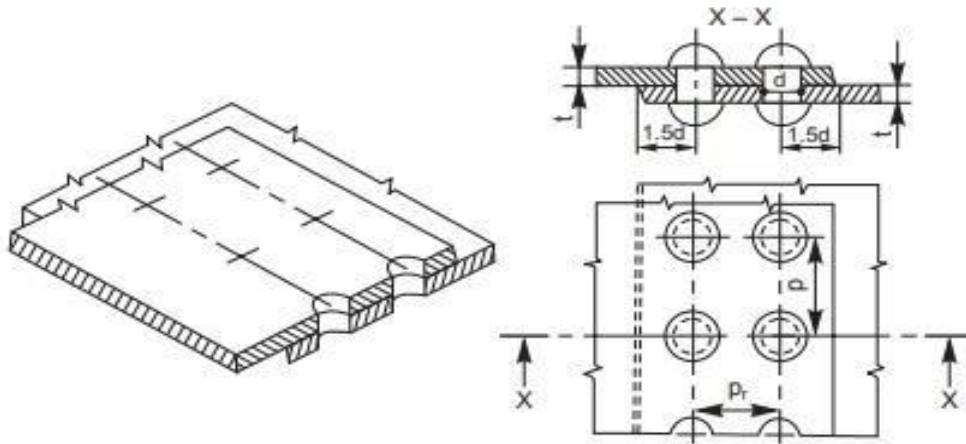


Result: The given Machine Component is modeled is modeled using SOLID WORKS software.

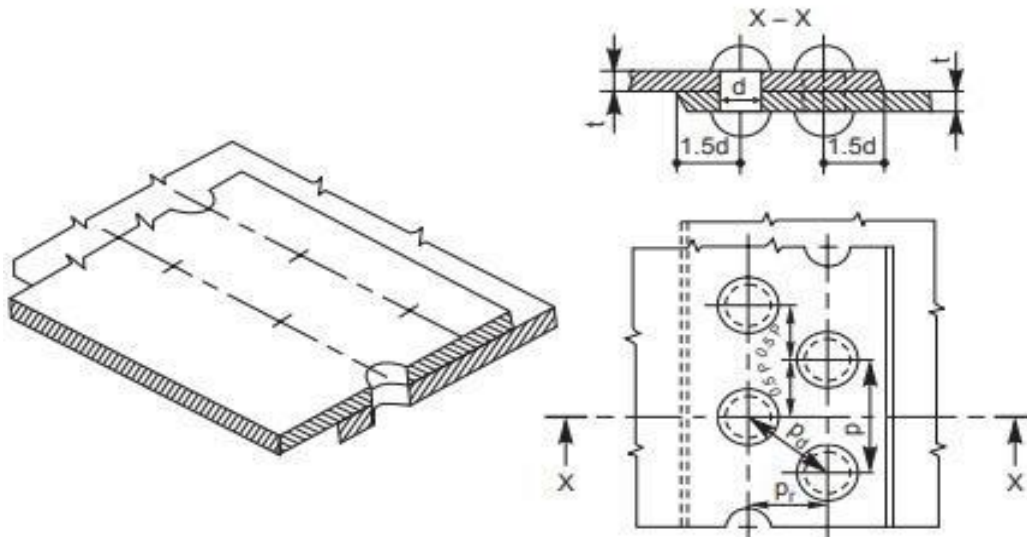
EXPERIMENT 2: RIVETED JOINTS FOR PLATES

Aim: To create the models of the components for rived joint for plates

Description: In a lap joint, the plates to be riveted, overlap each other. The plates to be joined are first bevelled at the edges, to an angle of about 80° Depending upon the number of rows Riveted Joints of rivets used in the joint, lap joints are further classified as single riveted lap joint, double riveted lap joint and so on. were $d=6\sqrt{t}$ mm.



Double riveted chain lap joint



Double riveted zig-zag lap joint

Result: The given Machine Component is modeled is modeled using SOLID WORKS software.

EXPERIMENT 3: 3D MODELING - FLANGE COUPLING

Aim : To create the models of the components for the **FLANGE COUPLING** and assemble these components together, as shown below. Save this assembly model as **Flange Coupling.asm**. By using the SolidWorks software.

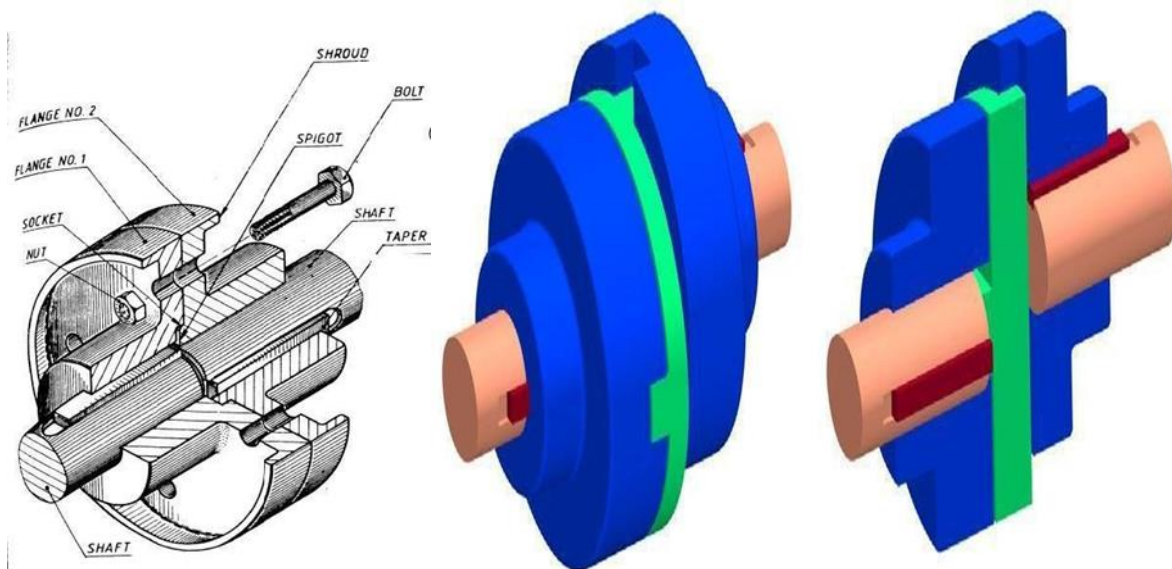
Application :

This type of coupling is a protective type flanged coupling, the bolt heads and nuts are shielded by a peripheral protrusion, called „shroud“, on each flange is shown in fig.5. Alignment of the two shafts is independent of the bolts and is ensured by the provision of a turned projection, called „spigot“, on the flat face of the one of the flanges which fits into a corresponding recess, called „socket“, in the other flange. The length of the spigot projection is kept slightly less than the depth of the socket. The socket and spigot are turned to give a push fit for accurate alignment of the two shafts. The bolt holes are drilled and reamed to give a close running for the bolts in order that the load is taken smoothly without any impact.

Description:

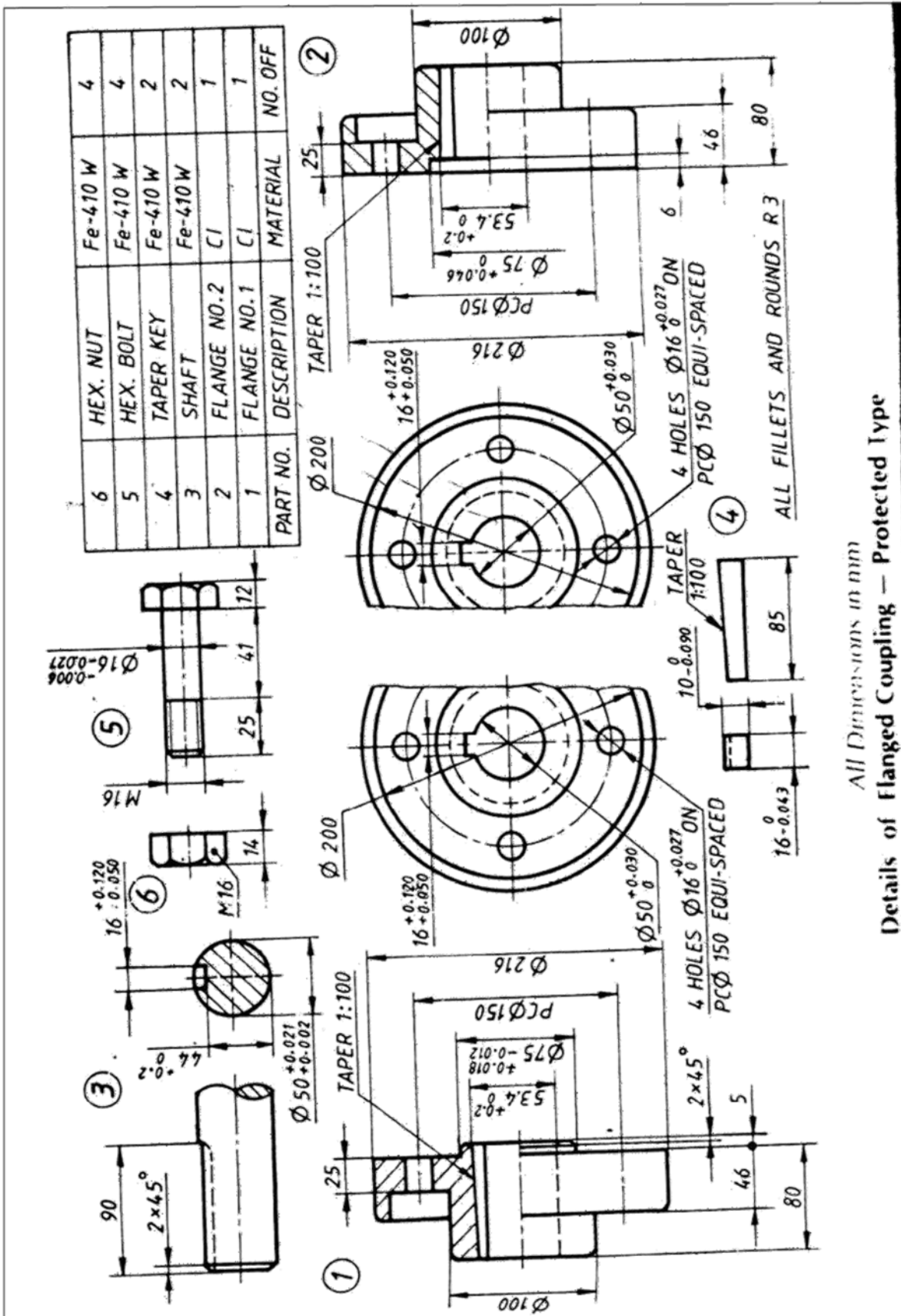
Each of the flanged bosses is securely keyed to the end of each shaft using a tapered key driven from inside. While assembling, generally the two flanges are set such that the keys fitted in them are out of alignment by 90degrees to each other. The two flanges are bolted together by a number of bolts and nuts. Power is transmitted from one

other through bolts.



RESULT:

The given Machine Component is modeled is modeled using SOLID WORKS software.



All Dimensions in mm
Details of Flanged Coupling — Protected Type

EXPERIMENT 4: 3D MODELING UNIVERSAL COUPLING

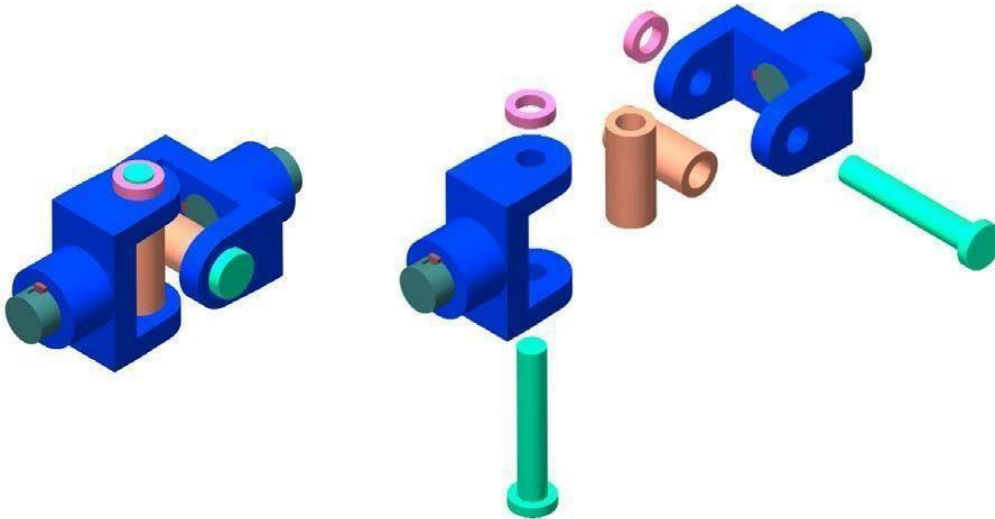
Aim : To create the models of the components for the **UNIVERSAL COUPLING** and assemble these components together, as shown below. Save this assembly model as **UNIVERSAL COUPLING .asm**. By using the SolidWorks software.

Application :

It is a rigid coupling that connects two shafts, whose axes intersect if extended. It consists of two forks which are keyed to the shafts. The two forks are pin joined to a central block, which has two arms at right angle to each other in the form of a cross. The angle between the shafts may be varied even while the shafts are rotating.

Description:

Figure shows the details of universal coupling. The forks 2 are mounted at the ends of two shafts 1, making use of sunk keys 6. The central block 3, having two arms at right angle to each other, is placed between the forks and connected to both of them by using pins 4 and collars 5. A taper pin (not shown) is used to keep the pins 4 in position. During rotation of shafts, the angle between them can be varied. Figure shows the assembly drawing.



Result: The given Machine Component is modeled is modeled using SOLID WORKS software.

EXPERIMENT 5: ASSEMBLY OF SLEEVE AND COTTER JOINT**Aim:**

1. To create 3D models of Sleeve and Cotter Joint parts using Standard Software
2. To Create the Assembly of Sleeve and Cotter Joint using Standard Software
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The modeling concepts – Solid modeling, Surface modeling were trailed in standard Cad Software by creating 3D model of Sleeve and cotter Joint-connecting rod, sleeve, cotter.
2. The options available in each Feature command are tried to understand the capabilities of each command
3. Design Methods: Bottom-up Design, Top down Design are discussed
4. Assembly of Sleeve and Cotter Joint was created using Bottom-up design approach

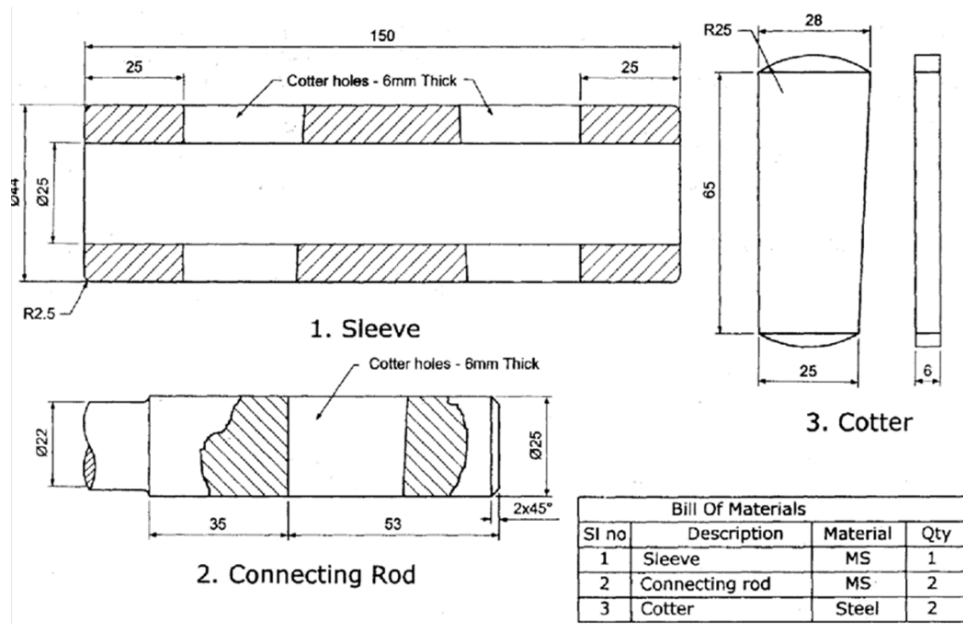
Commands used:

Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View Features
Commands: Extrude (pad) and Cut, Revolve (shaft), Sweep, and Loft, Fillet/Round, Chamfer, and Draft, Hole - Simple and Hole Wizard, Hole Series, Scale, Shell, Rib, Dome, Freeform, Shape, Deform, Indent, Flex, Pattern and Mirror, Curves, Fastening Features

Assembly Commands: Insert, Component, Existing Part/Assembly

Mating Commands: Angle, Coincident, Concentric, Distance, Parallel, Perpendicular, Tangent

Result: The 3D models of Sleeve and Cotter Joint parts are created using Standard Cad software.



EXPERIMENT 6: ASSEMBLY OF KNUCKLE JOINT

Aim:

1. To create 3D models of **Knuckle Joint** parts using Standard Cad Software.
2. To Create the Assembly of Knuckle Joint using Standard Cad Software.

Procedure:

1. The modeling concepts – Solid modeling, Surface modeling were trailed in Standard Cad Software by creating 3D model of Knuckle Joint Parts – Fork, Eye, Pin, Collar, Taper pin
2. The options available in each Feature command are tried to understand the capabilities of each command
3. Design Methods: Bottom-up Design, Top down Design are discussed
4. Assembly of Knuckle Joint was created using Bottom-up design approach

Commands used:

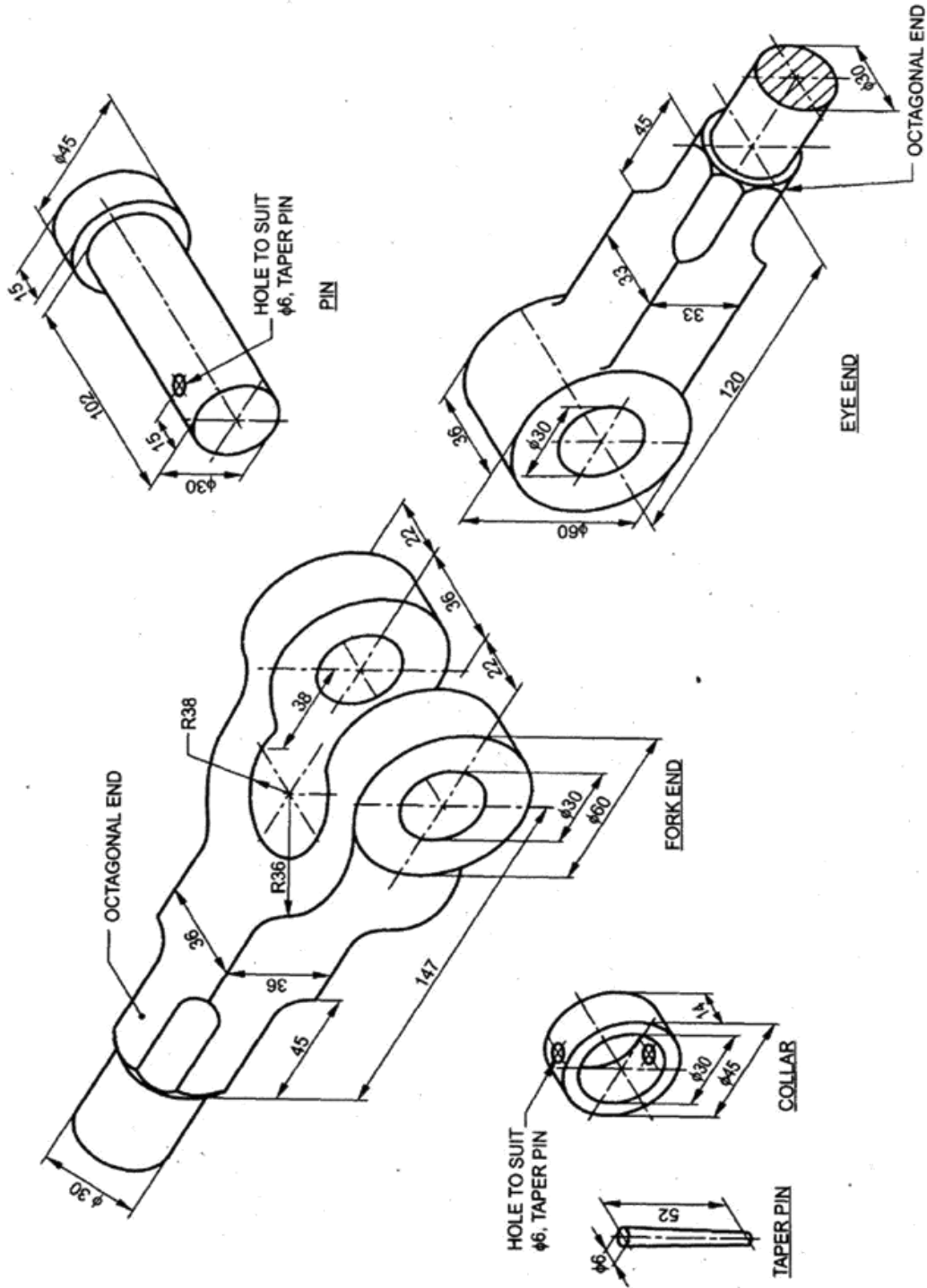
Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Sweep, and Loft, Fillet/Round, Chamfer, and Draft, Hole - Simple and Hole Wizard, Hole Series, Scale, Shell, Rib, Dome, Freeform, Shape, Deform, Indent, Flex, Pattern and Mirror, Curves, Fastening Features

Assembly Commands: Insert, Component, Existing Part/Assembly

Mating Commands: Angle, Coincident, Concentric, Distance, Parallel, Perpendicular, Tangent

Result:

The 3D models of **Knuckle Joint** parts are created using Standard Cad Software.



EXPERIMENT 7: ASSEMBLY OF SCREW JACK

Aim:

1. To create 3D models of **SCREW JACK** parts using Standard Cad Software
2. To Create the Assembly of **Screw Jack** using Standard Cad Software

Procedure:

1. The drawings of Body, Nut, Screw Spindle, Cup, Washer Special, CSK Screw, and Tommy Bar are studied.
2. 3D models of Body, Nut, Screw Spindle, Cup, Washer Special, CSK Screw, and Tommy Bar are created using Standard Cad Software
3. The Assembly of Screw Jack was created as per the drawing specification.

Commands used:

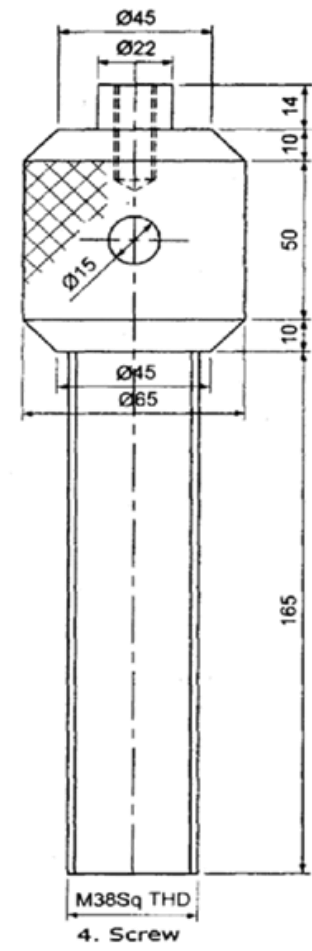
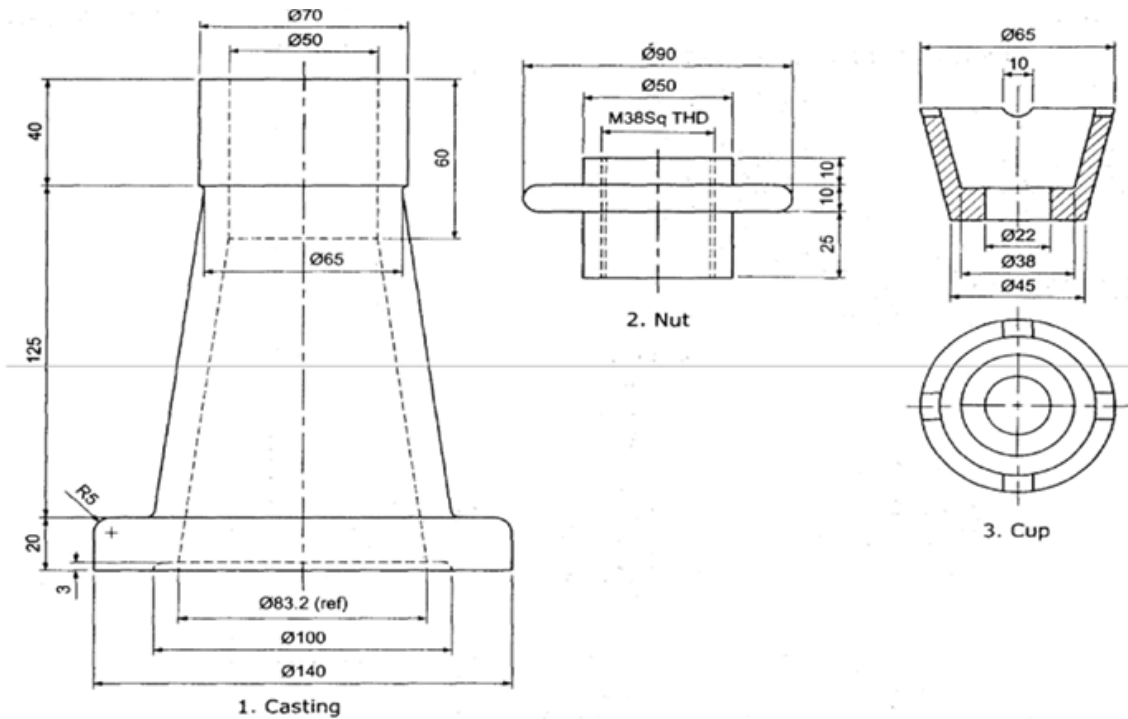
Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View
Features Commands: Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features

Assembly Commands: Insert, Component, Existing Part/Assembly

Mating Commands: Coincident, Concentric, Distance

Result:

The 3D models of **Screw Jack** parts (Casting, Nut, Cup, Tommy bar, Setscrew, Screw, washer) are created using Standard Cad Software.



Bill Of Materials			
Sl no	Description	Material	Qty
1	Casting	CI	1
2	Nut	MS	1
3	Cup	MS	1
4	Screw	MS	1
5	Tommy bar	MS	1
6	Set Screw	MS	1
7	Washer	MS	1

EXPERIMENT 8: ASSEMBLY OF CONNECTING ROD**Aim:**

1. To create 3D models of **Connecting Rod** parts using Standard Cad Software
2. To Create the Assembly of Connecting Rod using Standard Cad Software
3. To understand the type of fits and tolerances used in Assembly.

Procedure:

1. The drawings of Connecting Rod, Bush, Stud, Pin, Bearing Brasses, Distance Piece, Cover, Washer, Nut, and Split pin are studied.
2. 3D models of all the parts are created using Standard Cad Software
3. The Assembly of Connecting Rod was created as per the drawing specification.

Commands used:

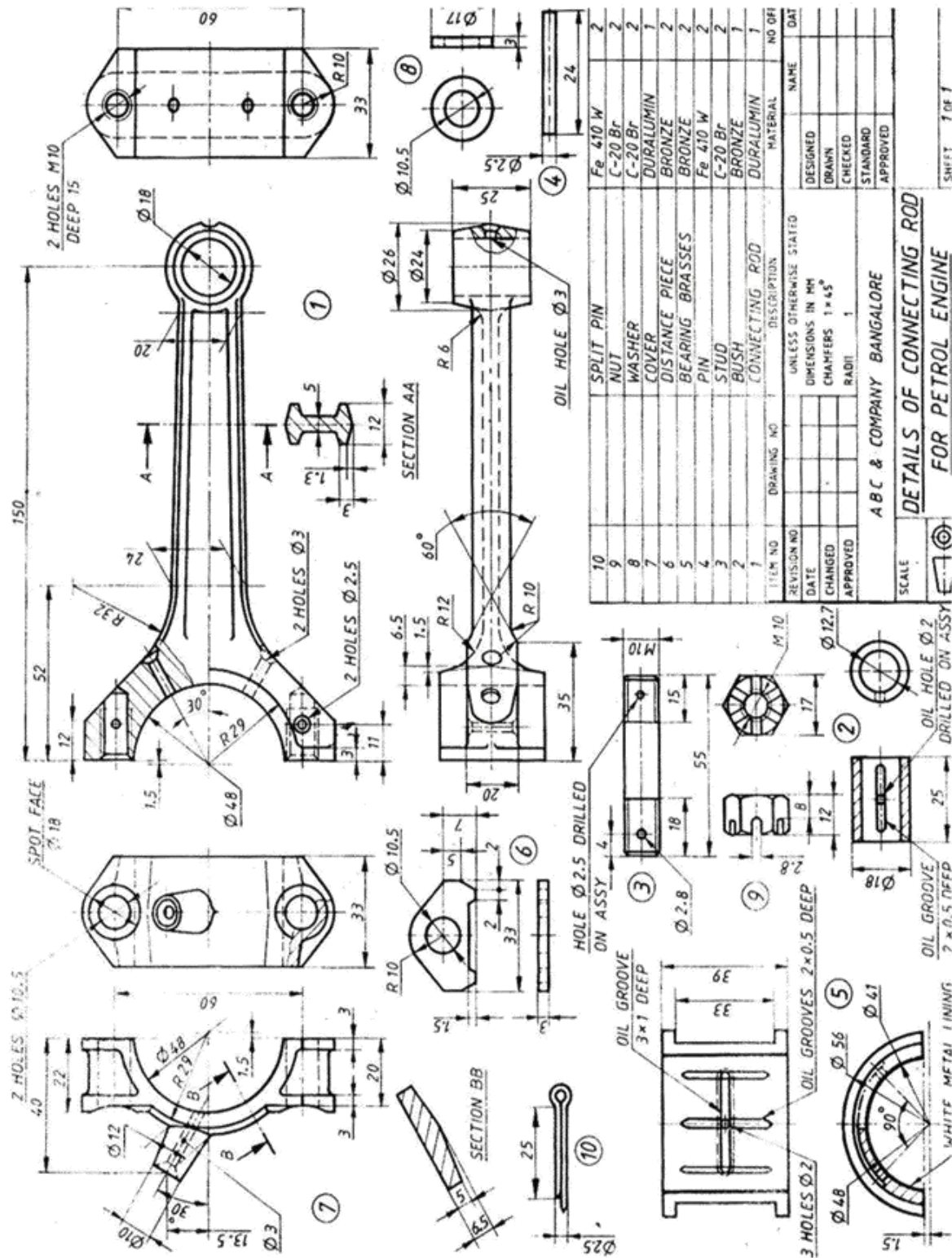
Sketcher Commands: Line, Circle, Arc, Fillet, Trim, Smart Dimension, Relations, Show, and View. **Features Commands:** Extrude (pad) and Cut, Revolve (shaft), Fillet/Round, Chamfer, Hole - Simple, Pattern, Fastening Features.

Assembly Commands: Insert, Component, Existing Part/Assembly.

Mating Commands: Coincident, Concentric, Distance.

Result:

The 3D models of Connecting Rod parts (Connecting Rod, Bush, Stud, Pin, Bearing Brasses, Distance Piece, Cover, Washer, Nut, and Split pin) are created using Standard Cad Software. The type of fits and tolerances used in Assembly are studied.



ITEM NO	DESCRIPTION	MATERIAL	NO OF
10	SPLIT PIN	Fe 410 W	2
9	NUT	C-20 Br	2
8	WASHER	DURALUMIN	2
7	COVER	BRONZE	1
6	DISTANCE PIECE	BRONZE	2
5	BEARING BRASSES	Fe 410 W	2
4	PIN	C-20 Br	2
3	STUD	BRONZE	1
2	BUSH	DURALUMIN	1
1	CONNECTING ROD	DURALUMIN	1

REVISION NO	DATE	UNLESS OTHERWISE STATED	DESIGNED	NAME	NO OF
1		DIMENSIONS IN MM	DRAWN		DATE
2		CHAMFERS 1x45°	CHECKED		
3		RADI	STANDARD		
4			APPROVED		

SCALE	DRAWING NO	DESCRIPTION	MATERIAL	NO OF
1:1		CONNECTING ROD	DURALUMIN	1

SCALE: 1:1
 ABC & COMPANY BANGALORE
 DETAILS OF CONNECTING ROD
 FOR PETROL ENGINE
 SHEET 1 OF 1

Dr. Bishub Choudhury

Lab IN-charge

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