COMPUTER AIDED MODELLING AND ANALYSIS LABORATORY

LAB MANUAL

Course Code : AME114
Regulations : IARE -R16
Class : IV Year I Semester (ME)

Prepared by

Mrs. T Vanaja, Assistant Professor

Department of Mechanical Engineering

INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal – 500 043, Hyderabad

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Program Outcomes	
PO1	**Engineering Knowledge:** Capability to apply knowledge of Mathematics, Science Engineering in the field of Mechanical Engineering
PO2	**Problem Analysis:** An ability to analyze complex engineering problems to arrive at relevant conclusion using knowledge of Mathematics, Science and Engineering.
PO3	**Design/ Development of solution:** Competence to design a system, component or process to meet societal needs within realistic constants.
PO4	**Conduct investigation of complex problems:** To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.
PO5	**Modern Tool usage:** An ability to formulate solve complex engineering problems using modern engineering and information technology tools.
PO6	**The Engineer society:** To utilize the engineering practices, techniques, skills to meet needs of health, safety legal, cultural and societal issues.
PO7	**Environment and Sustainability:** To understand the impact of engineering solution in the societal context and demonstrate the knowledge for sustainable development.
PO8	**Ethics:** An understanding and implementation of professional and Ethical responsibilities.
PO9	**Individual Team work:** To function as an effective individual and as a member or leader in multi-disciplinary environment and adopt in diverse teams.
PO10	**Communication:** An ability to assimilate, comprehends, communicate, give and receive instructions to present effectively with engineering community and society.
PO11	**Project Management and Finance:** An ability to provide leadership in managing complex engineering project at multi-disciplinary environment and to become a professional engineer.
PO12	**Life-Long learning:** Recognition of the need and an ability to engage in lifelong learning to keep abreast with technological changes.
Program Specific Outcomes	
PSO1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical system including allied engineering streams.
PSO2	**Design/ Analysis:** An ability to adapt and integrate current technologies in the design and manufacturing domain to enhance the employability.
PSO3	**Successful Career and Entrepreneurship:** To build the nation by imparting technological inputsand managerial skills to become a Technocrats.

INSTITUTE OF AERONAUTICAL ENGINEERING

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Dundigal, Hyderabad – 500 043

Certificate

This is to certify that Mr. /Ms. _____

*bearingrollno*_____*ofB.Tech*_____*semester*

_____*branch has satisfactorily*

completed_____laboratory during the academic year

_____.

SignatureofHOD **Signature ofFaculty**

Signature ofInternalExaminer **Signature of ExternalExaminer**

INSTRUMENTATION AND CONTROL SYSTEMS LABORATORY

VII Semester: ME

Course Code	Category	Hours / EXPERIMENT			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AME114	Core	-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36				Total Classes: 36		

OBJECTIVES:

The course should enable the students to:

I. Understand the features and specifications of CAD and 3D Modeling tools.
II. Develop the part design and drafting methods.
III. Use the CAE software and analyse the load conditions.
IV. Execute the results of reaction forces and stress and strain diagrams.

LIST OF EXPERIMENTS

EXPERIMENT - 1	**INTRODUCTION TO CATIA**
Familiarization and practicing of drawing and modifying commands, template creation, lettering, object snapping and sectioning.	
EXPERIMENT - 2	**DRAFTING OF SIMPLE 2D DRAWINGS**
Prepare the 2D drawings using draw and modify commands for simple geometric assemblies, sectional views for part drawing and assemblies.	
EXPERIMENT - 3	**SOLID MODELING**
Preparing the 2D and 3D models (wire frame, surface and solid models) by using B-REP, CSG. Introduction of Boolean operations. Generation of 2D, 3D models, through protrusion, revolve, sweep.	
EXPERIMENT - 4	**CREATING ORTHOGRAPHIC VIEWS FROM SOLID MODELS**
Development of orthographic views for assembly drawings and preparation of bill of materials(IC engine components, Machine tool accessories, Jigs and Fixtures).	
EXPERIMENT - 5	**INTRODUCTION TO ANSYS**
Determination of deflection and stresses in bar.	
EXPERIMENT - 6	**TRUSSES AND BEAMS**
Determination of deflection and stresses in 2D and 3D trusses and beams.	
EXPERIMENT - 7	**SHELL STRUCTURES**
Determination of stresses in 3D and shell structures (one example in each case).	

EXPERIMENT - 8	**HARMONIC ANALYSIS**
Estimation of natural frequencies and mode shapes, harmonic responses of 2D beams.	
EXPERIMENT - 9	**HEAT TRANSFER ANALYSIS**
Steady state heat transfer analysis of plane and axi-symmetric components	
EXPERIMENT - 10	**CONVENTIONAL REPRESENTATION OF MATERIALS**
Conventional representation of parts screw joints, welded joints, springs, gears, electrical, hydraulic and pneumatic circuits, methods of indicating notes on drawings.	
EXPERIMENT - 11	**LIMTS FITS AND TOLERANCES**
Limits, Fits and Tolerances: Types of fits, exercises involving selection, interpretation of fits and estimation of limits from tables.	
EXPERIMENT - 12	**FORM AND POSITIONAL TOLERANCES**
Introduction and indication of form and position tolerances on drawings, types of run out, total run out and their indication.	
EXPERIMENT - 13	**SURFACE ROUHNESS AND ITS INTRODUCTION**
Definition, types of surface roughness indication surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components. Heat treatment and surface treatment symbols used on drawings.	
EXPERIMENT - 14	**DETAILED AND PART DRAWINGS**
Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors.	
EXPERIMENT - 15	**DETAILED AND PART DRAWINGS**
Part drawings using computer aided drafting by CAD software.	

Reference Books:

1. K.L. Narayana, P. Kannaiah, ―Production Drawing‖, New Age publishers, 3rd Edition, 2009
2. Goutham Pohit, Goutham Ghosh, ―Machine Drawing with Auto CAD, Pearson, 1st Edition, 2004.

Web References:

1. https://nptel.ac.in/courses/112107240/

ATTAINMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES

Exp. No.	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Familiarization and practicing of drawing and modifying commands, template creation, lettering, object snapping and sectioning.	PO1, PO2, PO3	PSO1, PSO2
2	Prepare the 2D drawings using draw and modify commands for simple geometric assemblies, sectional views for part drawing and assemblies.	PO1, PO2, PO3	PSO1, PSO2
3	Preparing the 2D and 3D models (wire frame, surface and solid models) by using B-REP, CSG. Introduction of Boolean operations. Generation of 2D, 3D models, through protrusion, revolve, sweep.	PO1, PO2, PO3	PSO1, PSO2
4	Development of orthographic views for assembly drawings and preparation of bill of materials(IC engine components, Machine tool accessories, Jigs and Fixtures).	PO1, PO2, PO3	PSO1, PSO2
5	Determination of deflection and stresses in bar.	PO1, PO2, PO3	PSO1, PSO2
6	Determination of deflection and stresses in 2D and 3D trusses and beams.	PO1, PO2, PO3	PSO1, PSO2
7	Determination of stresses in 3D and shell structures (one example in each case).	PO1, PO2, PO3	PSO1, PSO2
8	Estimation of natural frequencies and mode shapes, harmonic responses of 2D beams.	PO1, PO2, PO3	PSO1, PSO2
9	Steady state heat transfer analysis of plane and axi-symmetric components	PO1, PO2, PO3	PSO1, PSO2
10	Conventional representation of parts screw joints, welded joints, springs, gears, electrical, hydraulic and pneumatic circuits, methods of indicating notes on drawings.	PO1, PO2, PO3	PSO1, PSO2
11	Limits, Fits and Tolerances: Types of fits, exercises involving selection, interpretation of fits and estimation of limits from tables.	PO1, PO2, PO3	PSO1, PSO2
12	Introduction and indication of form and position tolerances on drawings, types of run out, total run out and their indication.	PO1, PO2, PO3	PSO1, PSO2
13	Definition, types of surface roughness indication surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components. Heat treatment and surface treatment symbols used on drawings.	PO1, PO2, PO3	PSO1, PSO2
14	Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors.	PO1, PO2, PO3	PSO1, PSO2
15	Part drawings using computer aided drafting by CAD software.	PO1, PO2, PO3	PSO1, PSO2

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S.NO.	NAME OF EXPERIMENT	PAGE NO.	DATE	REMARK	SIGN
1	Familiarization and practicing of drawing and modifying commands, template creation, lettering, object snapping and sectioning.				
2	Prepare the 2D drawings using draw and modify commands for simple geometric assemblies, sectional views for part drawing and assemblies.				
3	Preparing the 2D and 3D models (wire frame, surface and solid models) by using B-REP, CSG. Introduction of Boolean operations. Generation of 2D, 3D models, through protrusion, revolve, sweep.				
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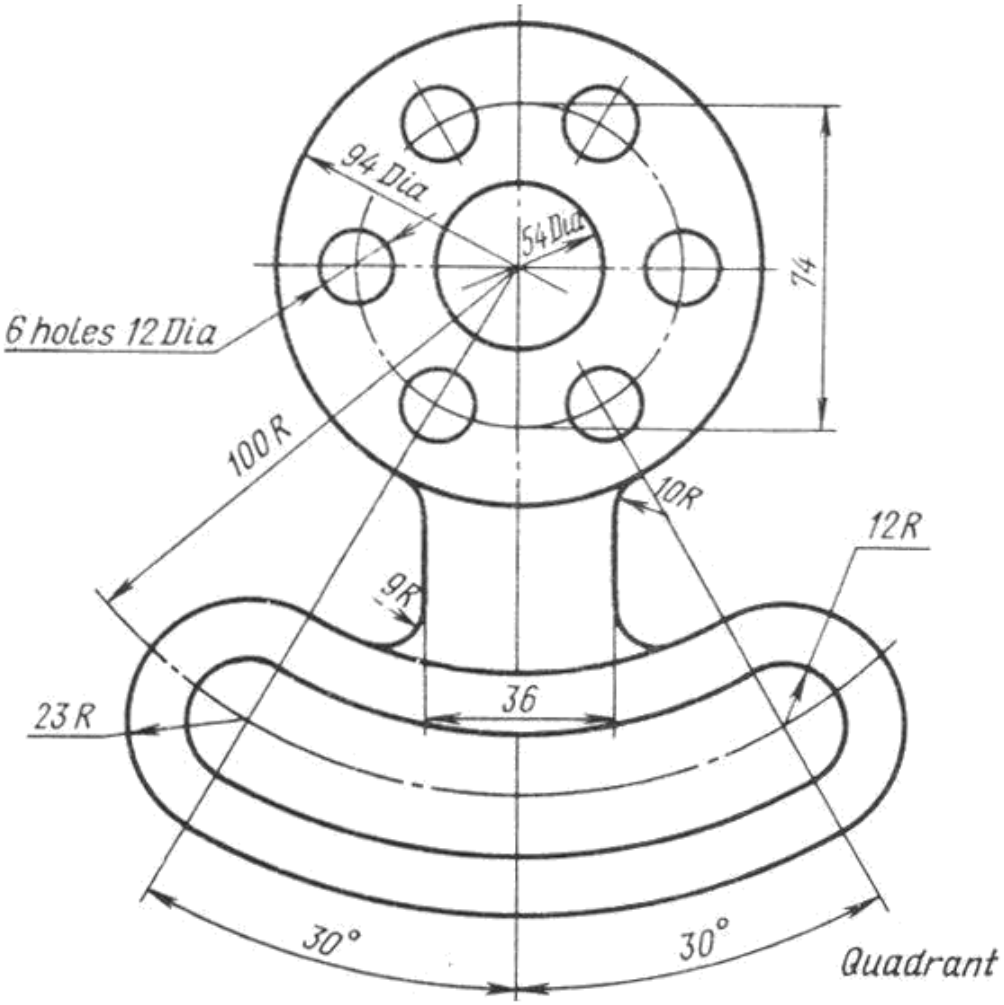
15	Part drawings using computer aided drafting by CAD software.				

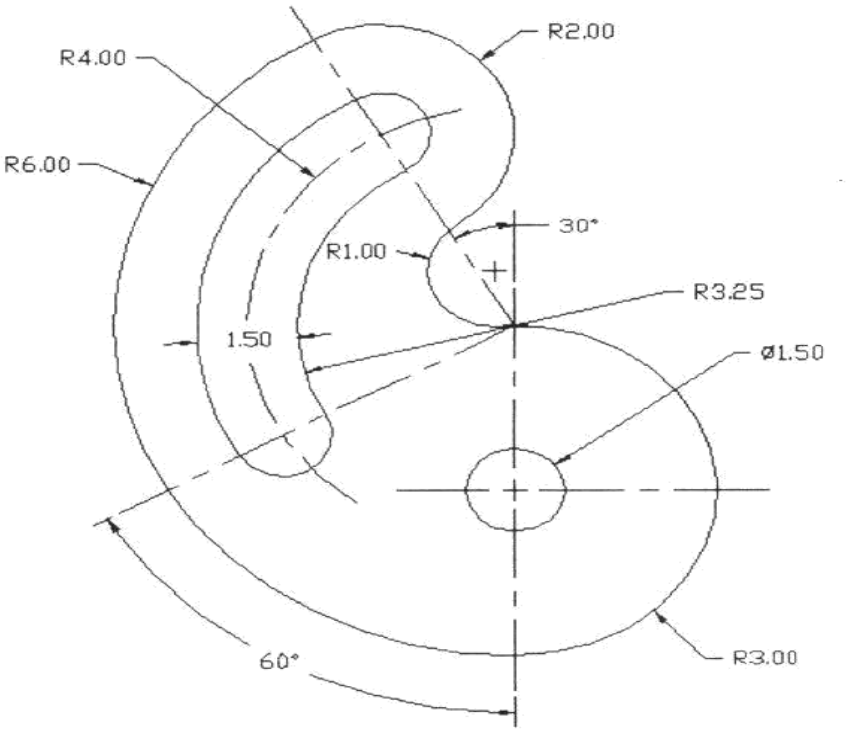
EXPERIMENT -1

INTRODUCTION TO CATIA

EXERCISE-I



EXERCISE -2



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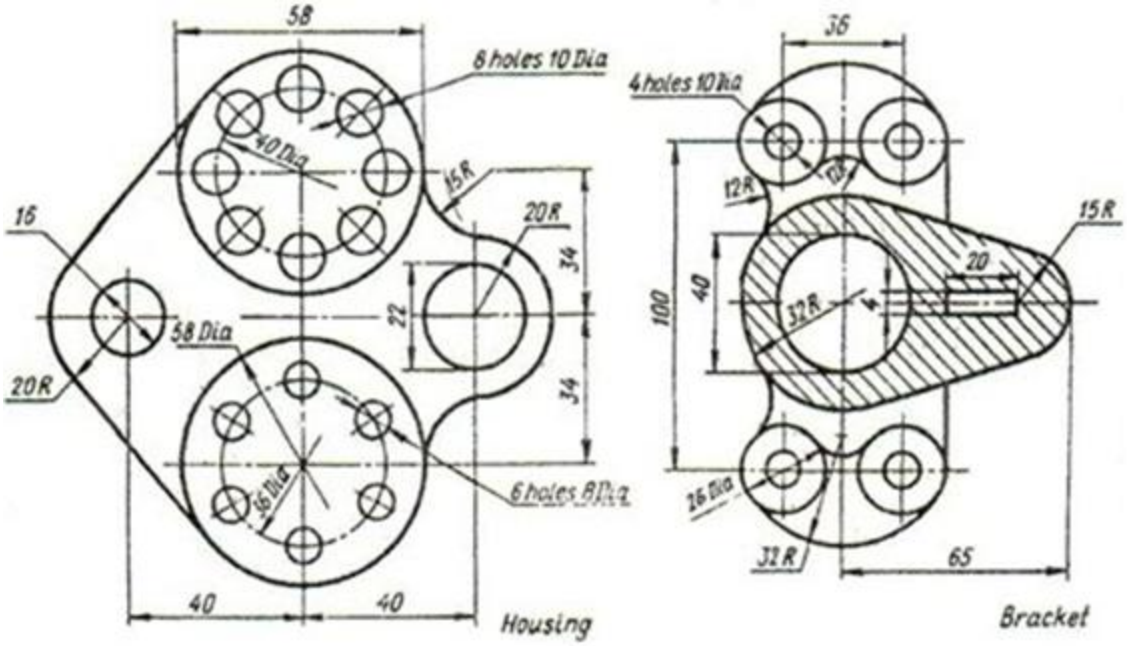
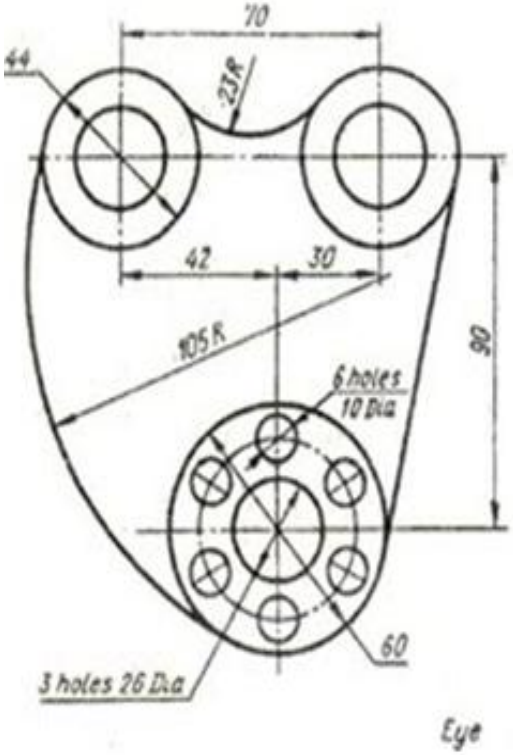
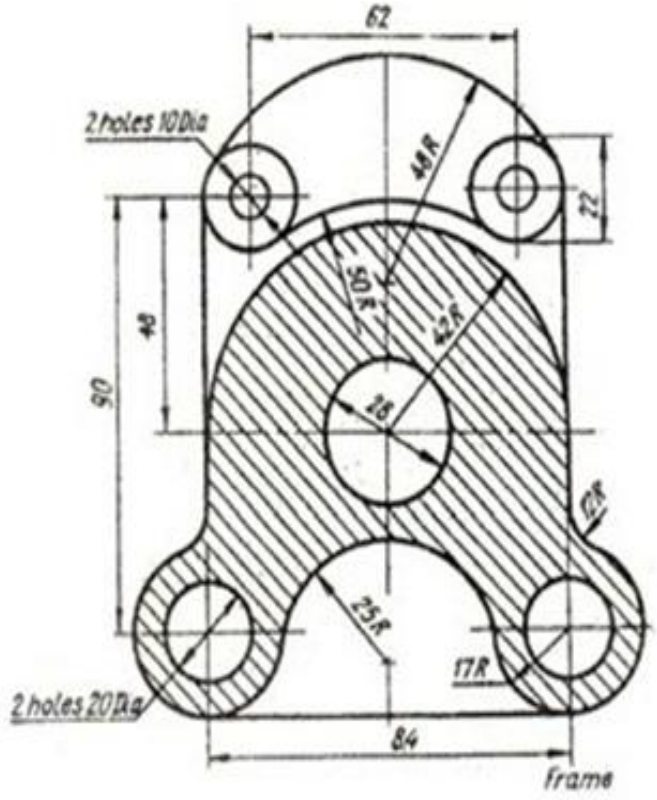

58
6 holes 10 Dia
40 Dia
15R
20R
34
22
15
58 Dia
20R
34
6 holes 8 Dia
36 Dia
40
40
Housing
36
4 holes 10 Dia
12R
15R
20
100
40
32R
26 Dia
31R
65
Bracket

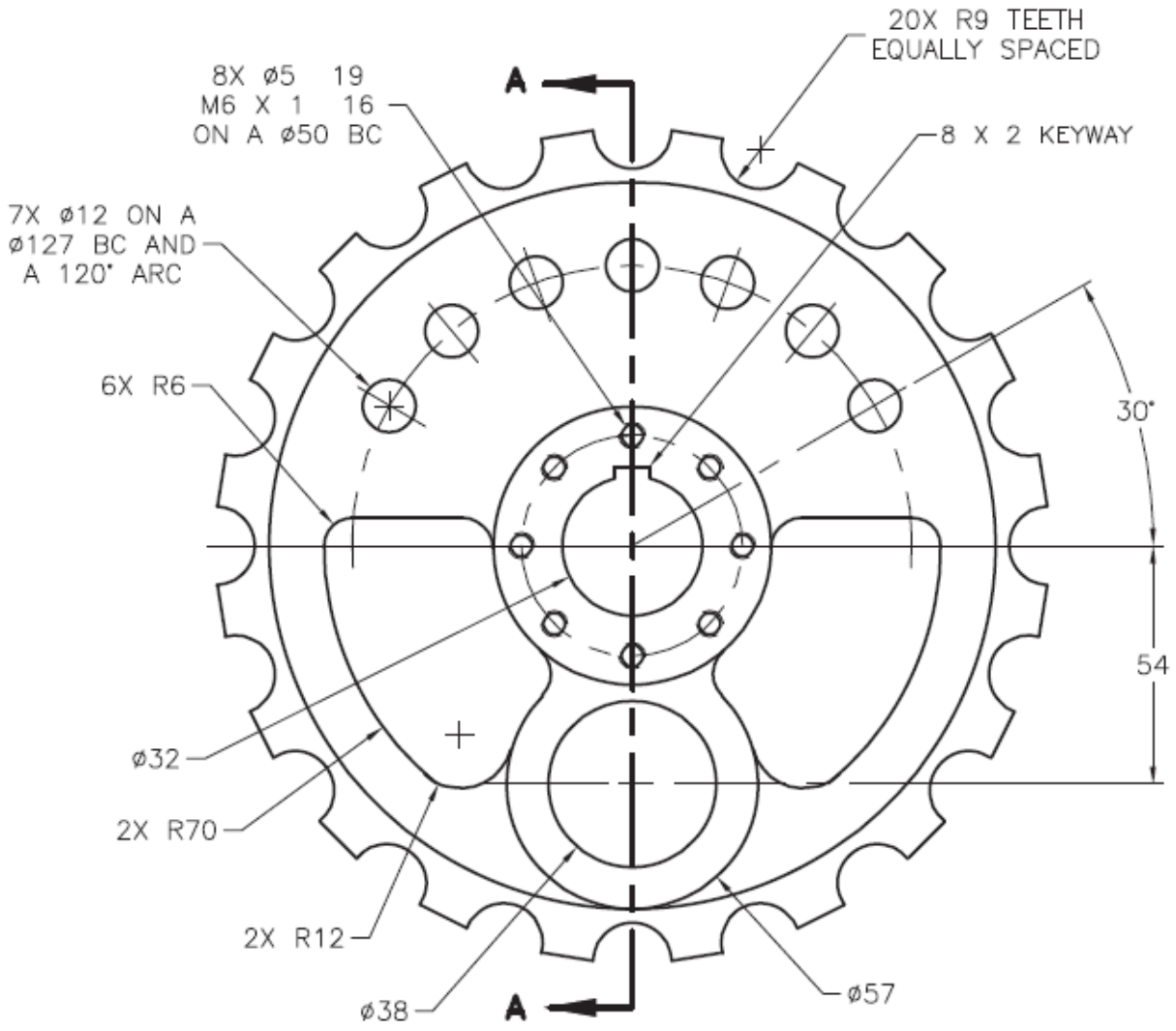
EXPERIMENT -2
DRAFTING OF SIMPLE 2D DRAWINGS



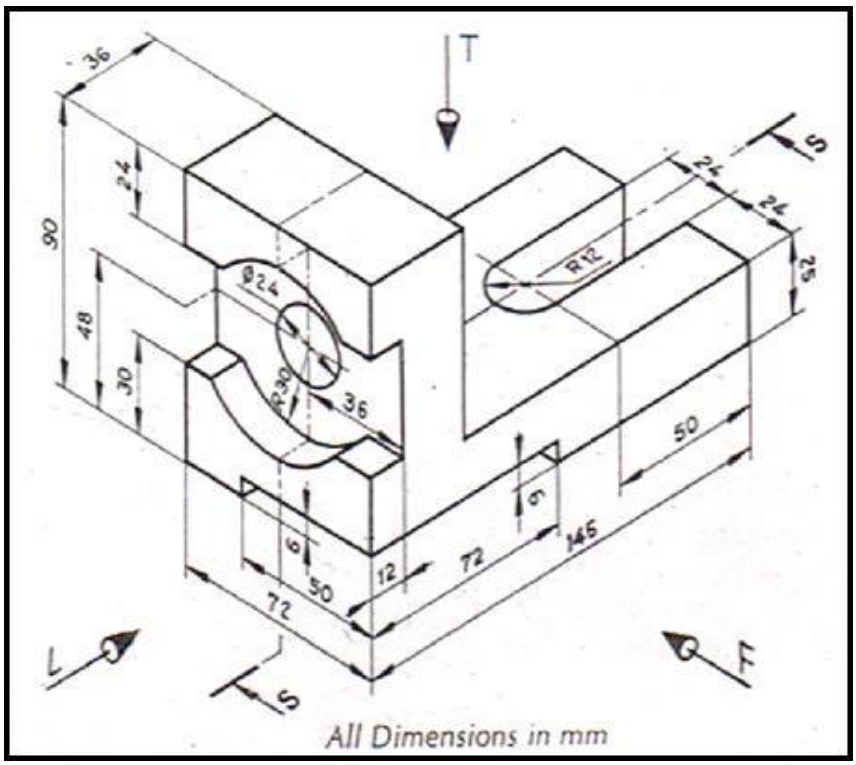
Eye

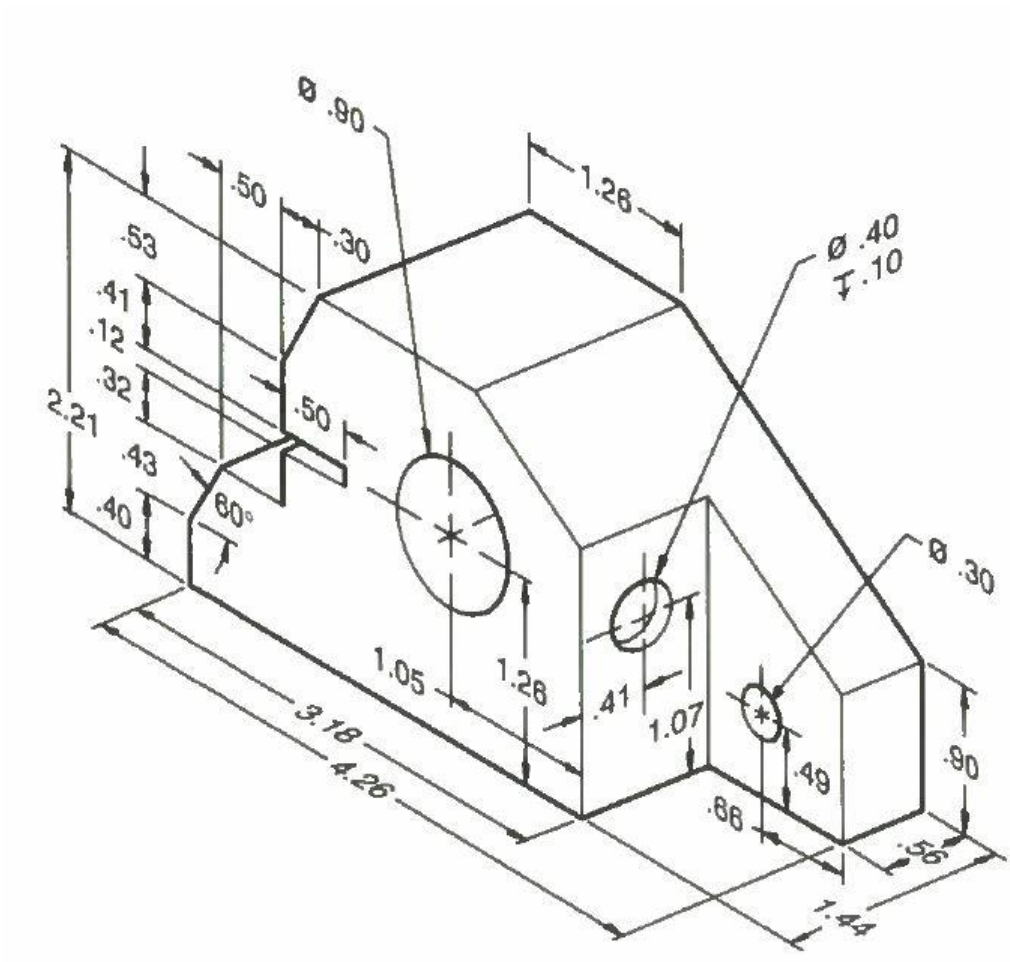


Frame

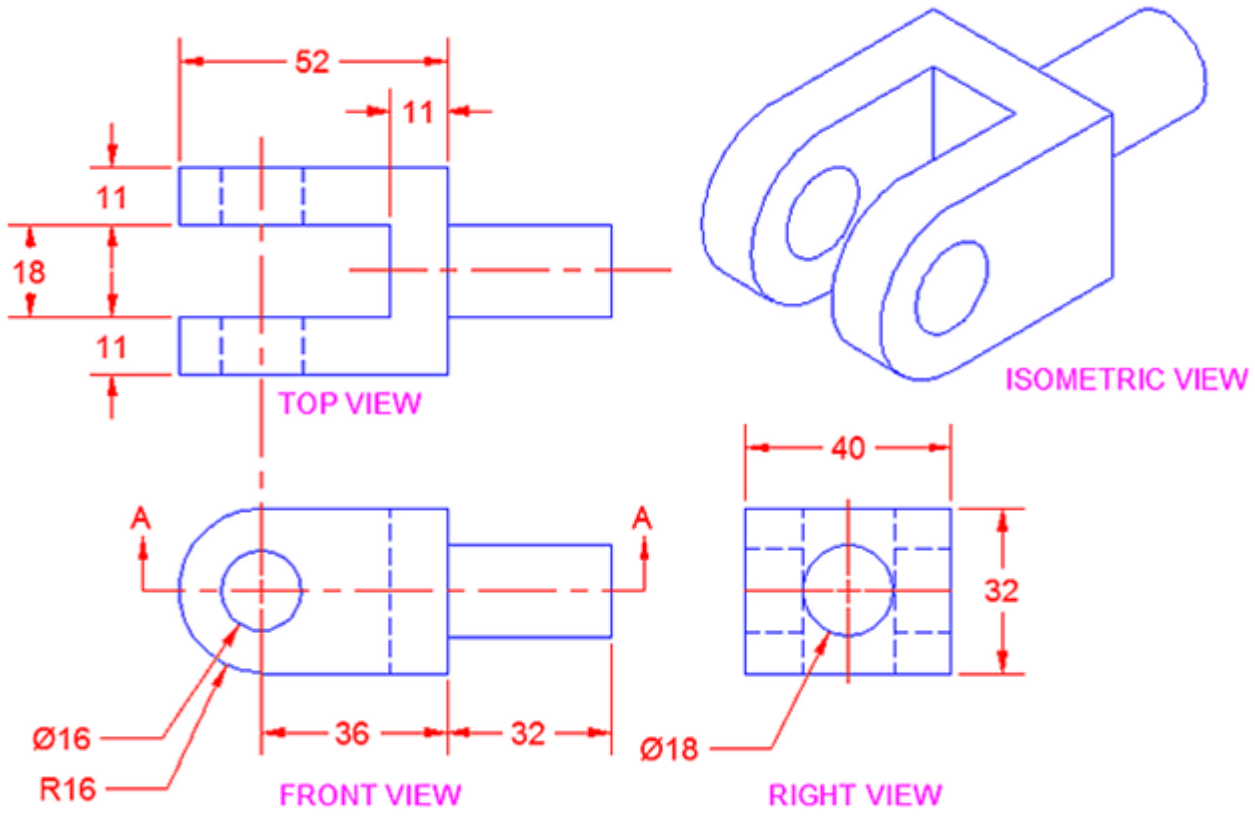

20X R9 TEETH
EQUALLY SPACED
8X ø5 19
M6 X 1 16
ON A ø50 BC
A
8 X 2 KEYWAY
7X ø12 ON A
ø127 BC AND
A 120° ARC
6X R6
30°
54
ø32
2X R70
2X R12
ø38
A
ø57

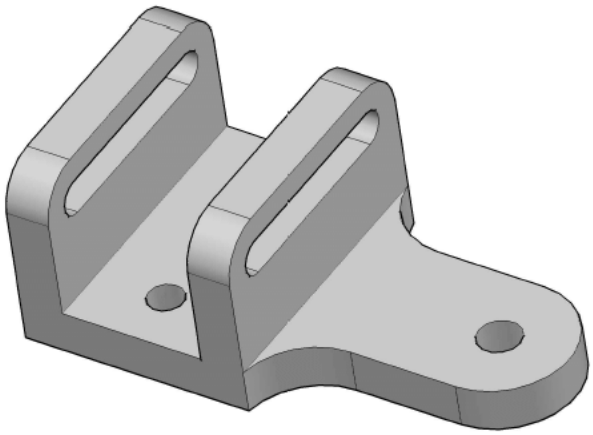
EXPERIMENT -3
SOLID MODELING

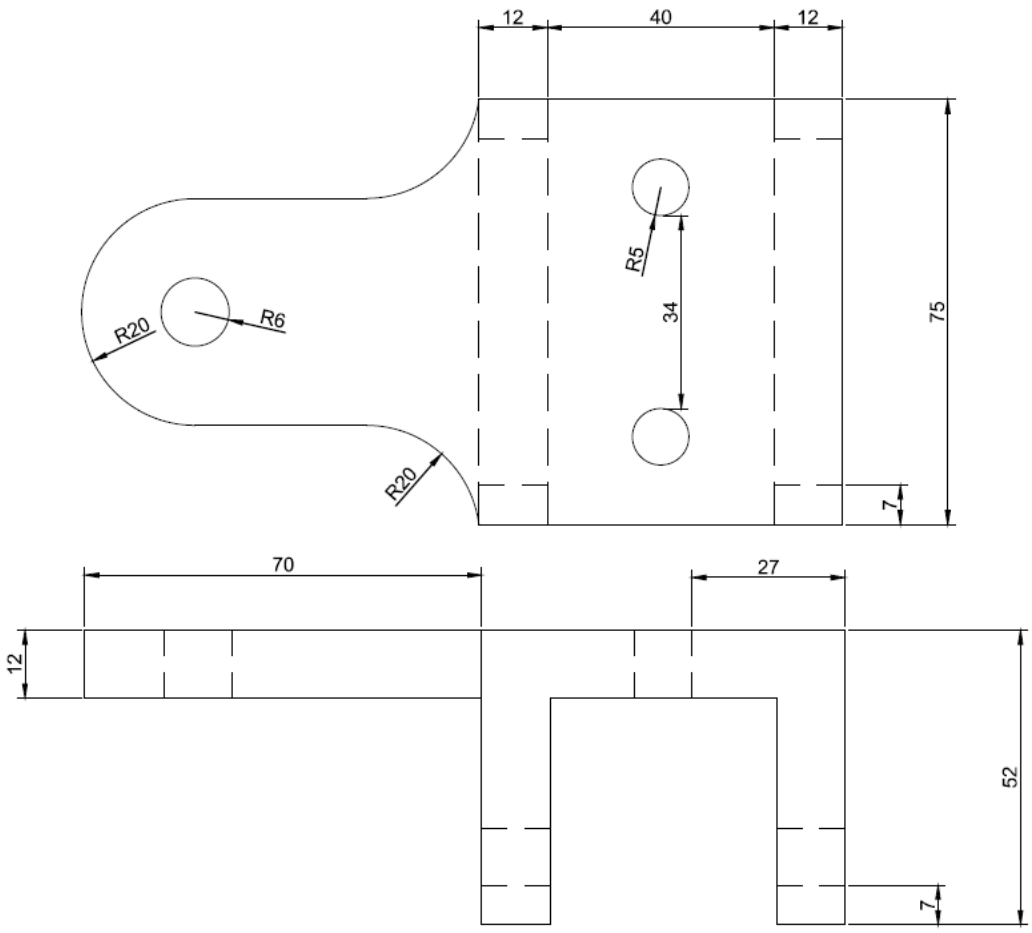




EXPERIMENT -4
CREATING ORTHOGRAPHIC VIEWS FROM SOLID MODELS

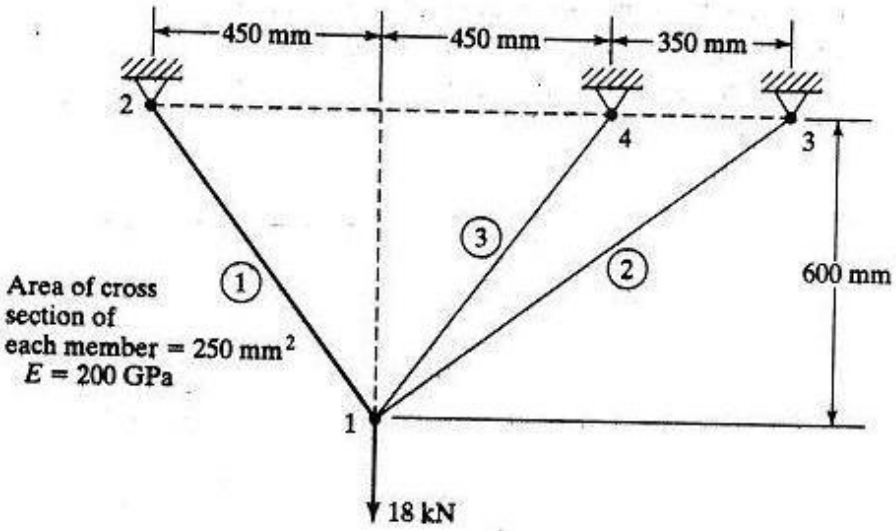


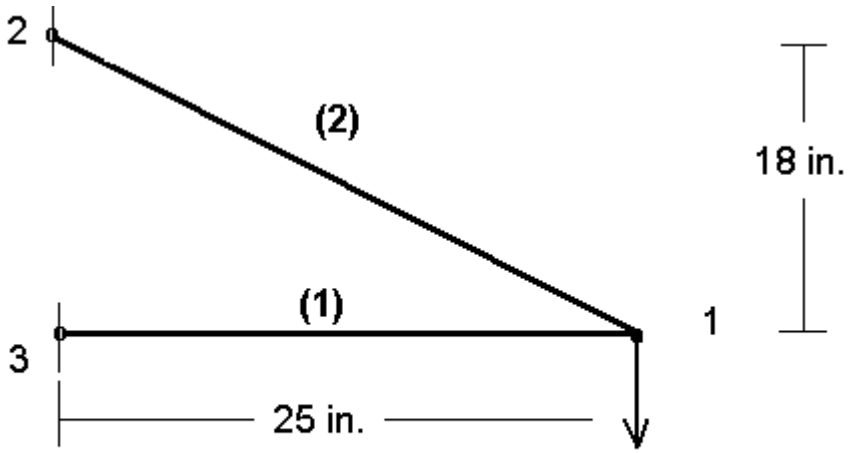



12
40
12
R5
34
75
R20
R6
R20
7
70
27
12
52
7

EXPERIMENT – 5
INTRODUCTION TO ANSYS

For the three-bar truss shown in Fig. determine the displacements of node 1 and the stress in element 3.

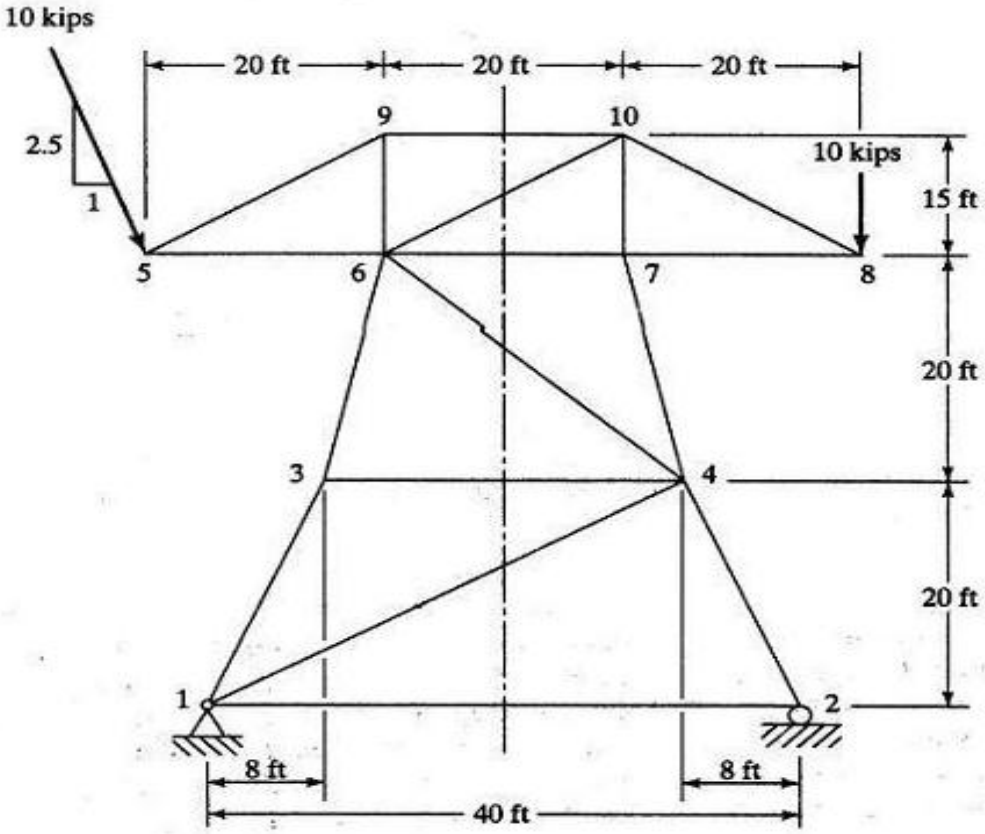




○ A = 0.5 sq in E = 3.e7 psi **1000 lbs.**

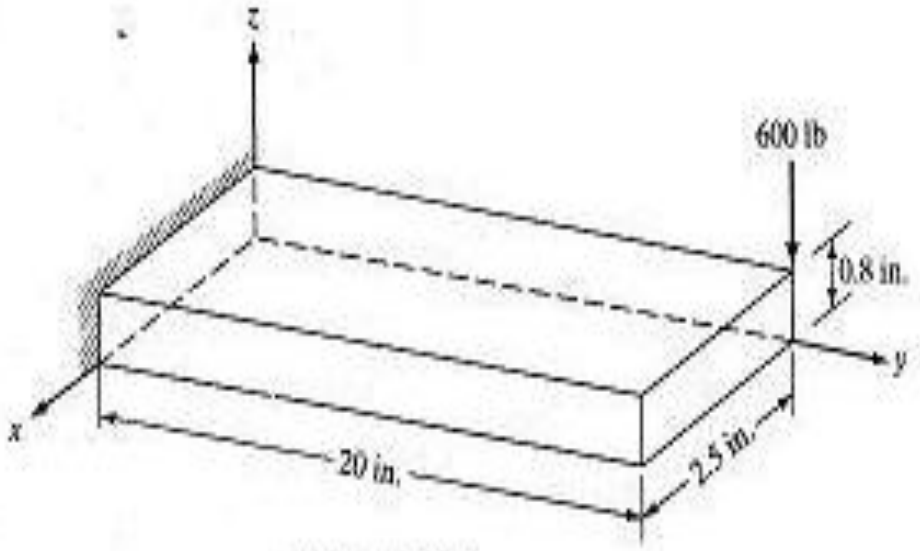
EXPERIMENT- 6
TRUSSES AND BEAMS

Find the deflections at the nodes for the truss configuration shown in Fig. Area = 8 in.^{2} for each member.



EXPERIMENT -7
SHELL STRUCTURES

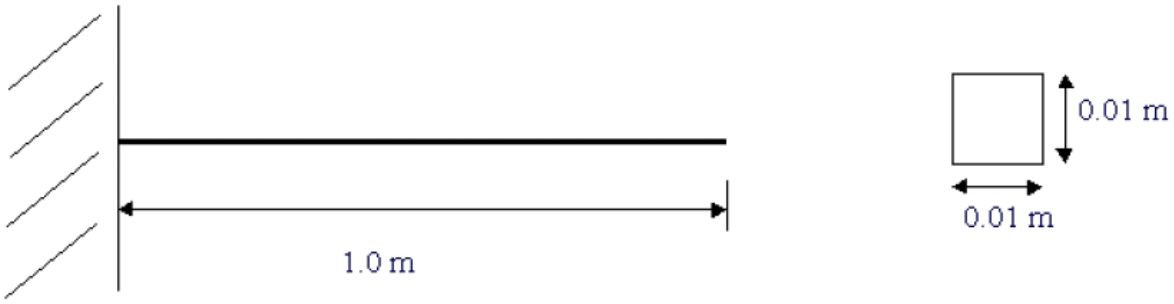
Determine the deflections at the corner points of the steel cantilever beam shown in Fig. P9.1.



$E = 30 \times 10^6$ psi
$\nu = 0.3$

EXPERIMENT – 8
HARMONIC ANALYSIS

This tutorial was created using ANSYS 7.0 The purpose of this tutorial is to explain the steps required to perform Harmonic analysis the cantilever beam shown below.

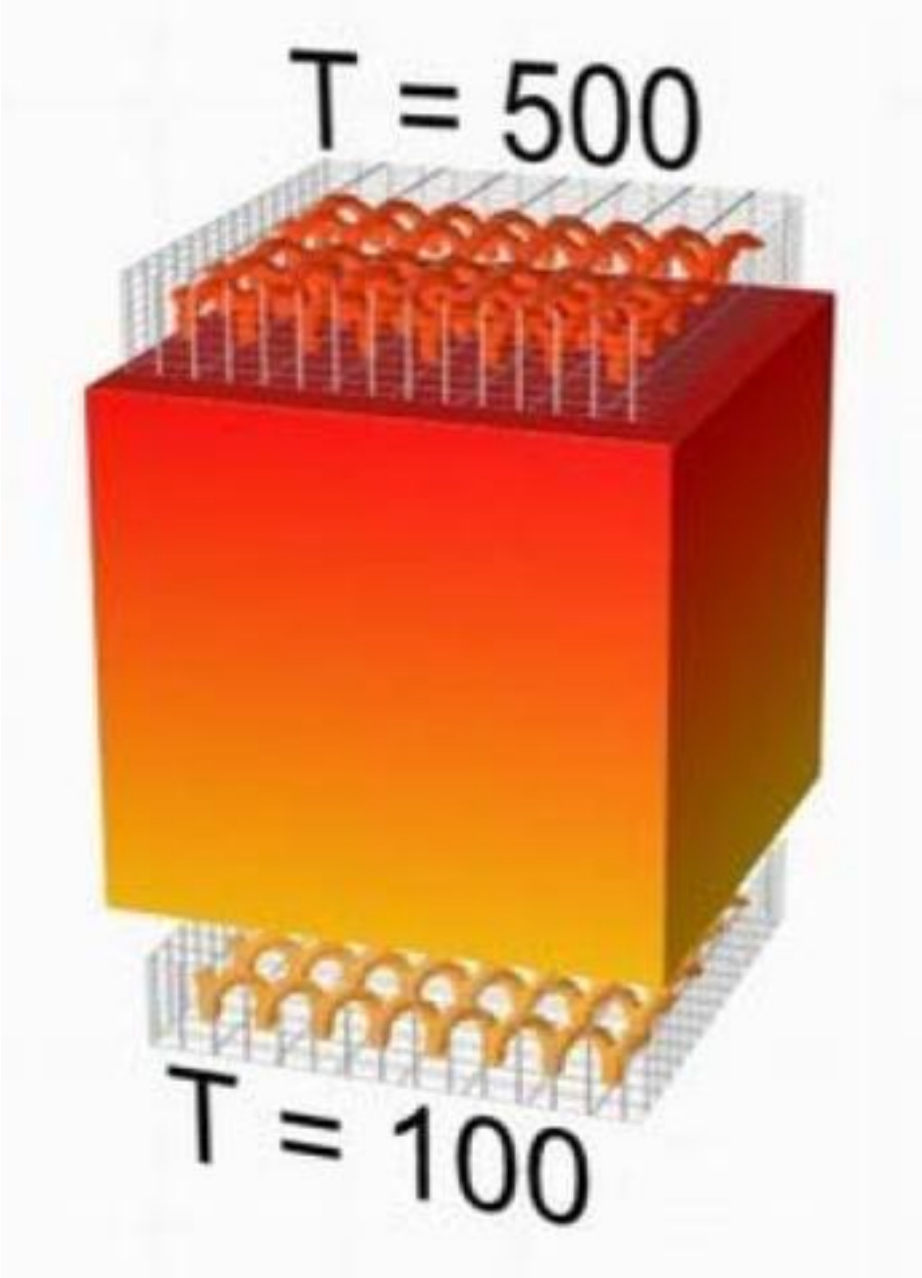


Modulus of Elasticity (E) = 206800(10^6) N/m^2

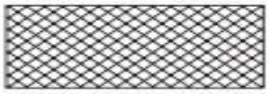
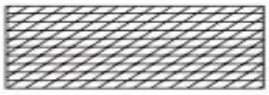
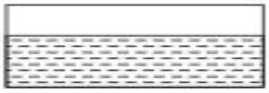
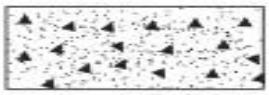
Density = 7830 kg/m^3

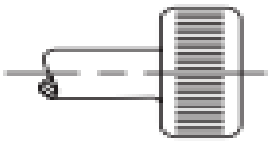
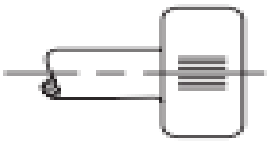
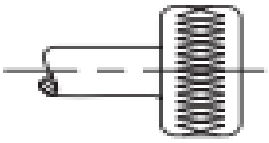
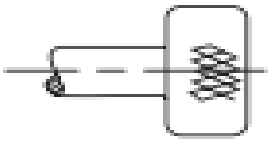
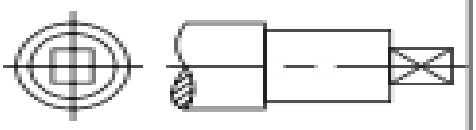
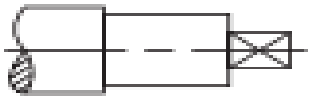
EXPERIMENT- 9
HEAT TRANSFER ANALYSIS

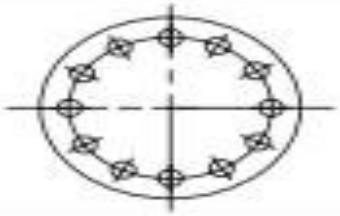
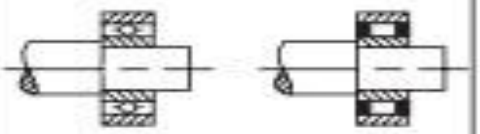
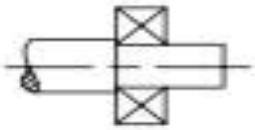
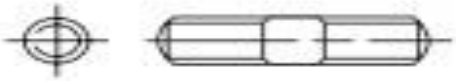
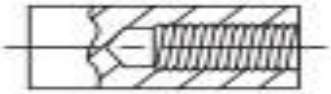
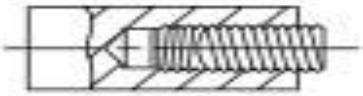
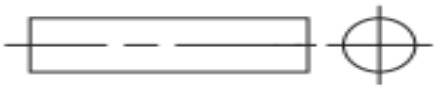
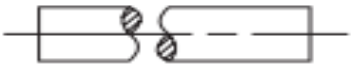
The example is constrained as shown in the following figure. Thermal conductivity (k) of the material is 5 W/m*K and the block is assumed to be infinitely long. Also, the density of the material is 920 kg/m^3 and the specific heat capacity (c) is 2.040 kJ/kg*K.



EXPERIMENT- 10
CONVENTIONAL REPRESENTATION OF MATERIALS

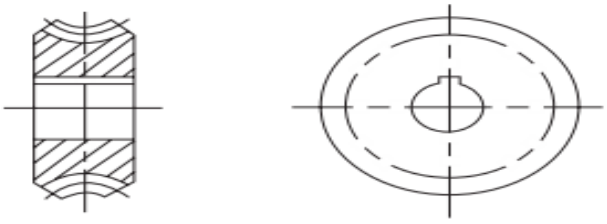
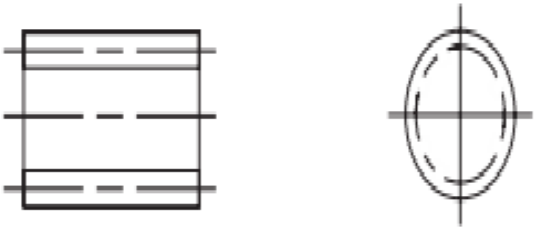
Type	Convention	Material
Metals		Steel, Cast Iron, Copper and its Alloys, Aluminium and its Alloys, etc.
		Lead, Zinc, Tin, White-metal, etc.
Glass		Glass
Packing and Insulating material		Porcelain, Stoneware, Marble, Slate, etc.
		Asbestos, Fibre, Felt, Synthetic resin products, Paper, Cork, Linoleum, Rubber, Leather, Wax, Insulating and Filling materials, etc.
Liquids		Water, Oil, Petrol, Kerosene, etc.
Wood		Wood, Plywood, etc.
Concrete		A mixture of Cement, Sand and Gravel

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)		
Splined shafts		
Interrupted views	 	 
Semi-elliptic leaf spring		

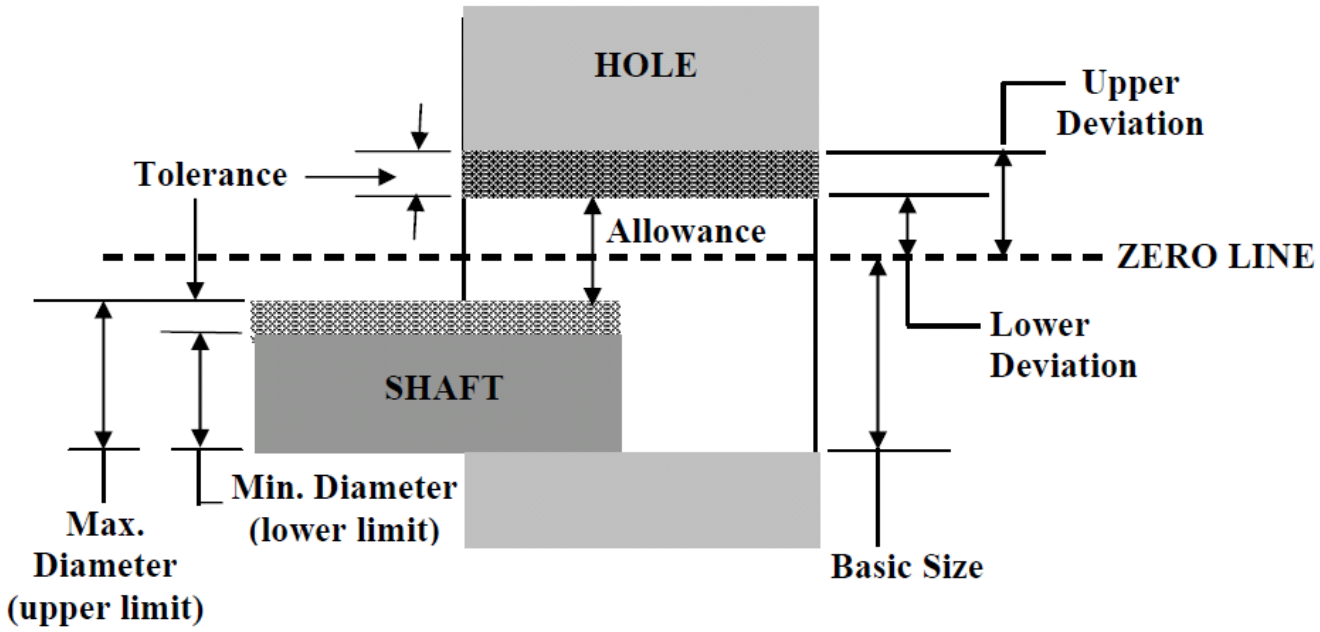
Semi-elliptic leaf spring with eyes			
	Subject	Convention	Diagrammatic Representation
Cylindrical compression spring			
Cylindrical tension spring			

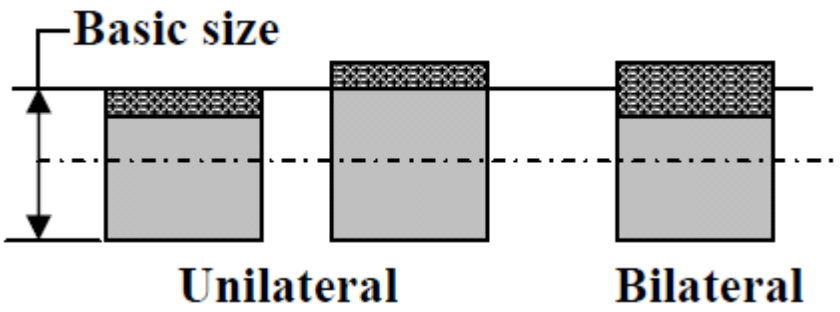
Conventional representation of machine components

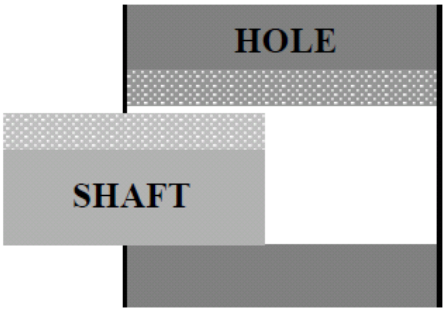
Title	Convention
Spur gear	
Bevel gear	
Worm wheel	
Worm	

EXPERIMENT – 11
LIMTS FITS AND TOLERANCES

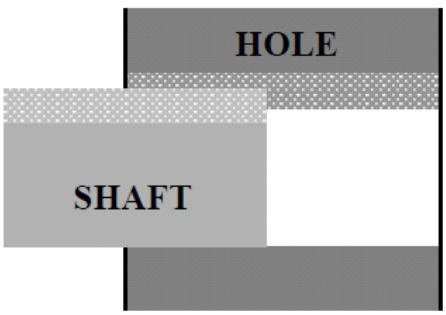
HOLE AND SAHFT BASIS SYSTEM



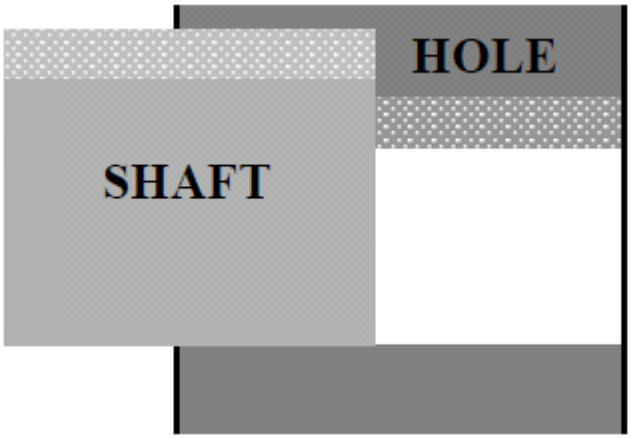




Clearance fit

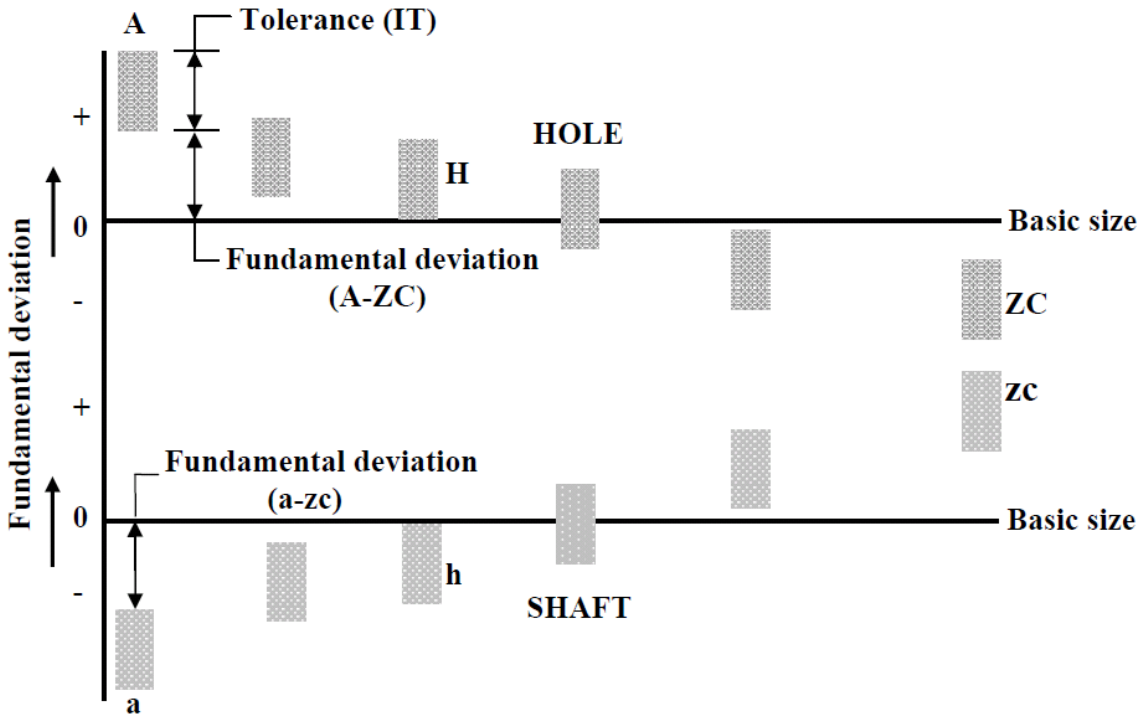


Transition fit



Interference fit

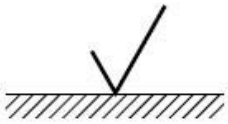
SCHEMATIC DIAGRAM OF LIMITS AND FITS



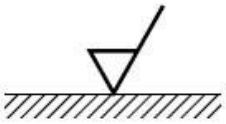
EXPERIMENT – 12
FORM AND POSITIONAL TOLERANCES

Features and tolerances		Toleranced characteristics	Symbols
Single features	Form tolerances	Straightness	
		Flatness	
		Circularity	
		Cylindricity	
Single or related features		Profile of any line	
		Profile of any surface	
Related features	Orientation tolerances	Parallelism	
		Perpendicularity	
		Angularity	
	Location tolerances	Position	
		Concentricity and coaxiality	
		Symmetry	
	Run-out tolerances	Circular run-out	
		Total run-out	

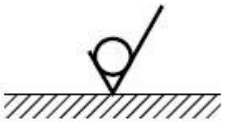
EXPERIMENT – 13
SURFACE ROUHNESS AND ITS INTRODUCTION



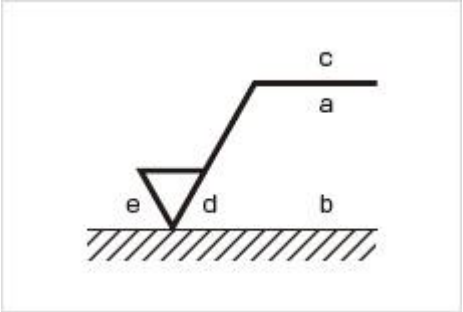
Symbol indicating the surface



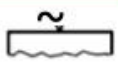
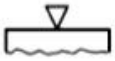
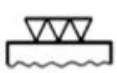
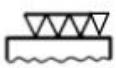
Symbol indicating a surface that requires material removal

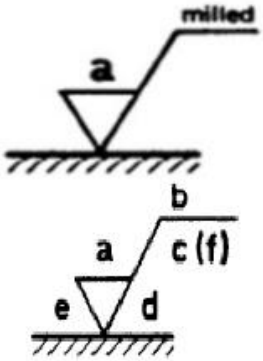


Symbol indicating a surface that does not require material removal



If it is required that the required **surface texture** be produced by one **particular production method**, this method shall be indicated in plain language on an extension of the longer arm of the symbol

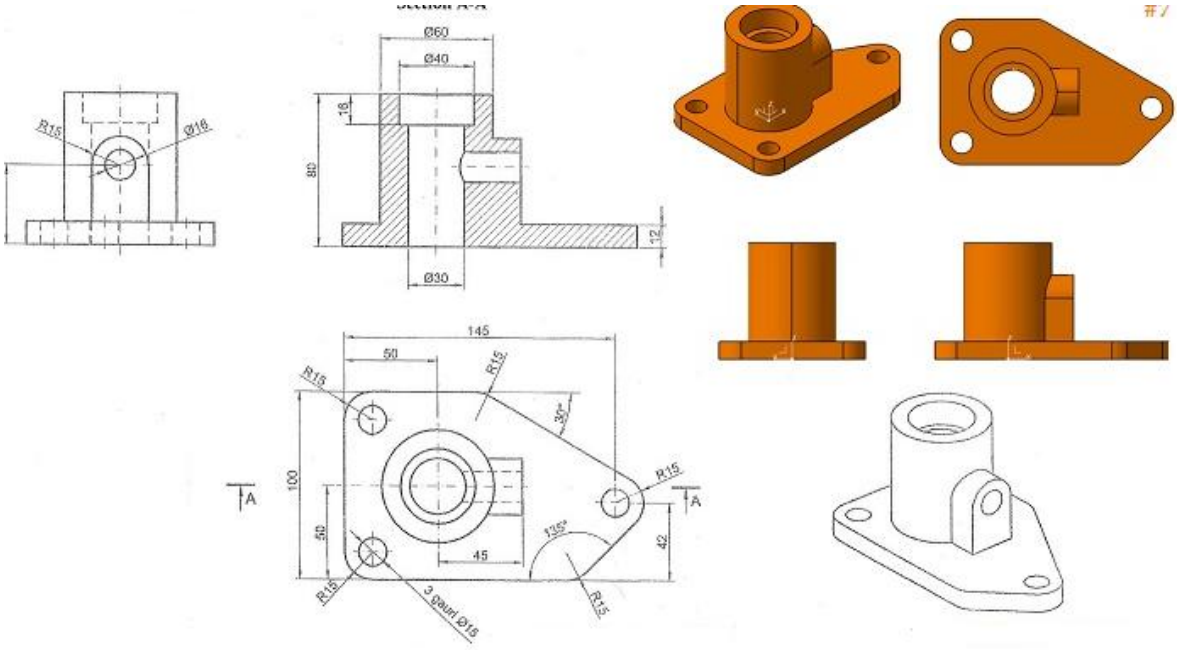
Roughness Value (Microns)	Roughness Grade	Conventional Symbol
50	N12	
25	N11	
12.5	N10	
6.3	N9	
3.2	N8	
1.6	N7	
0.8	N6	
0.4	N5	
0.2	N4	
0.1	N3	



a = Roughness value *Ra* in micrometres
or
= Roughness grade number N1 to N12.

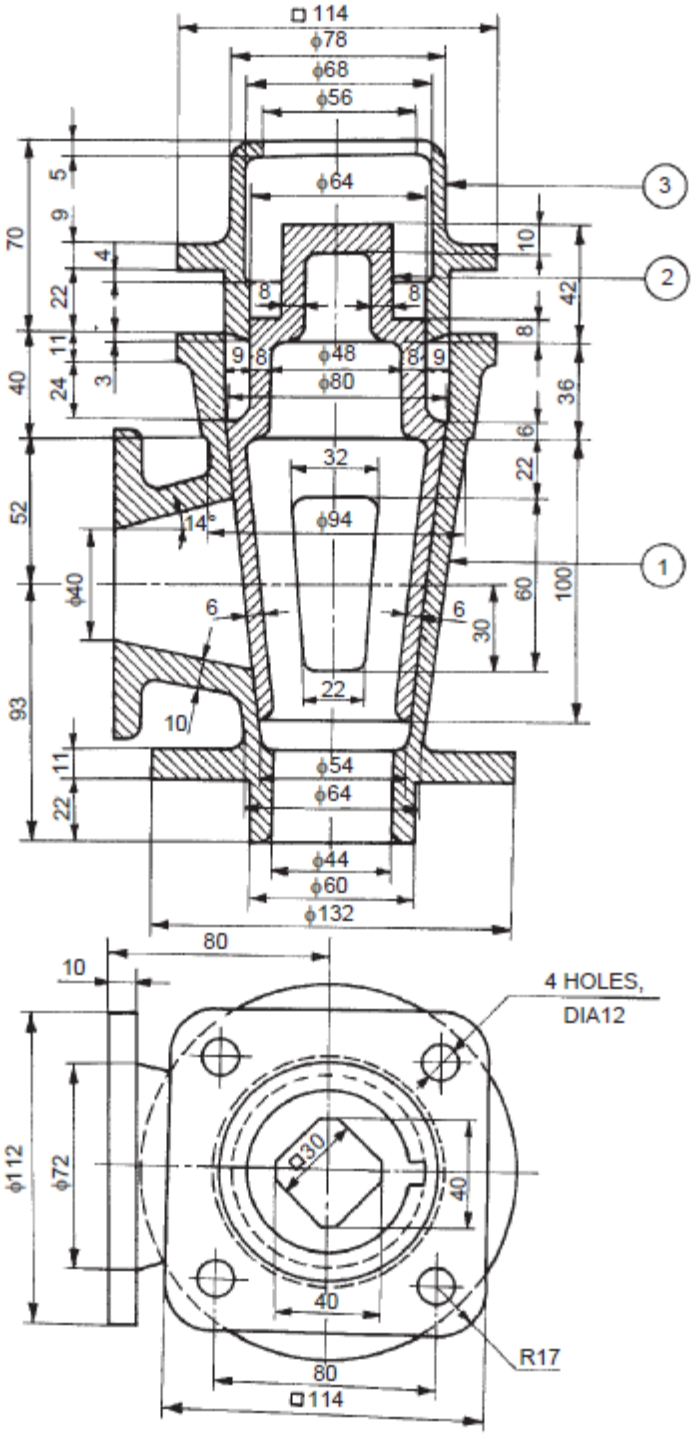
b = Production method, treatment or coating
c = Sampling length
d = Direction of lay
e = Machining allowance
f = Other roughness values (in brackets).

EXPERIMENT – 14
DETAILED AND PART DRAWINGS



EXPERIMENT – 15
PRODUCTION DRAWING PRACTICE

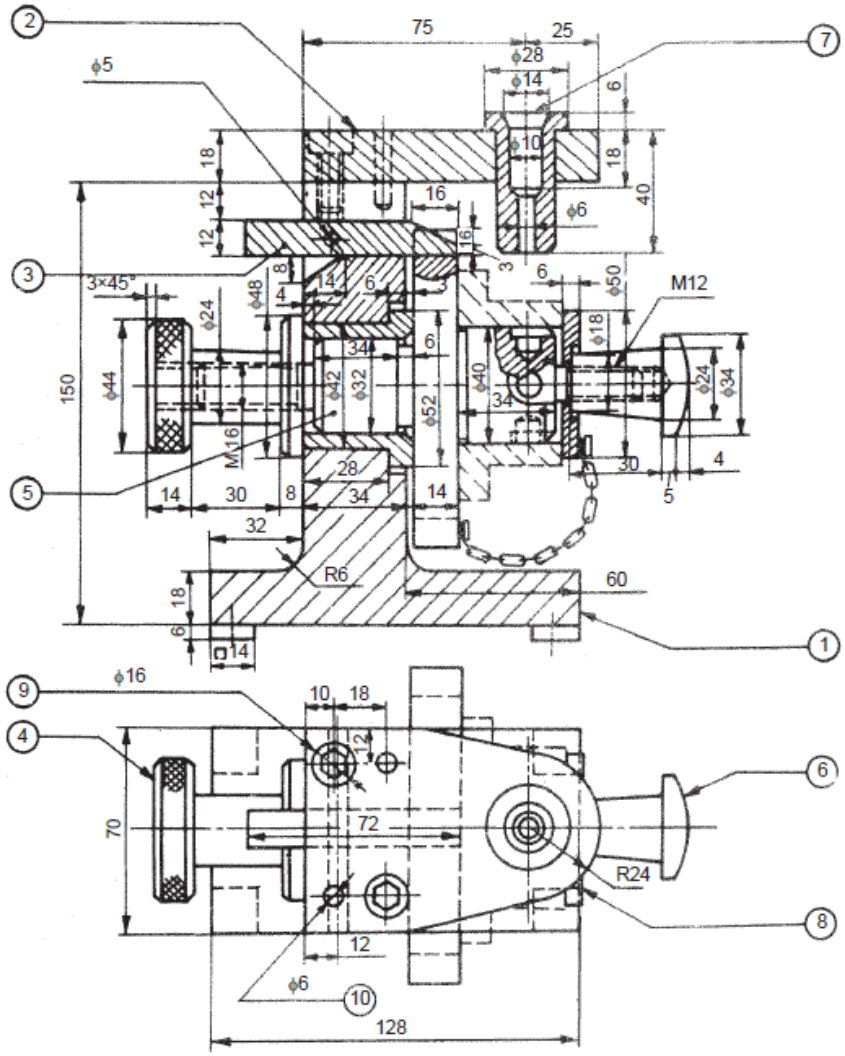
BLOW OFF COCK



Parts list

Part No.	Name	Matl.	Qty.
1	Body	CS	1
2	Cock	GM	1
3	Gland	CS	1

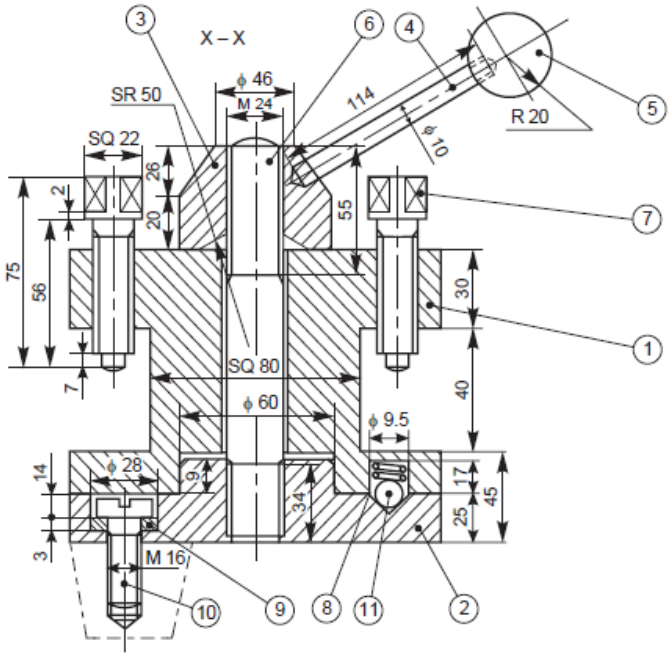
INDEX DRILL JIG

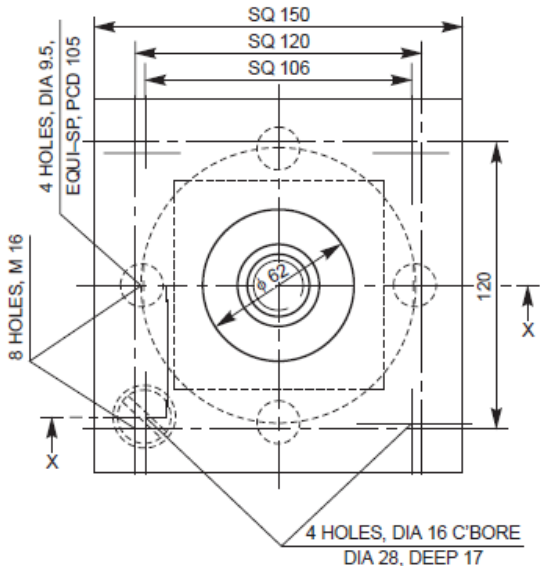


Parts list

Part No.	Name	Matl.	Qty.	Part No.	Name	Matl.	Qty.
1	Jig body	CI	1	6	Clamp	CI	1
2	Bush plate	CI	1	7	Drill bush	HCS	1
3	Indexing lever	MS	1	8	C washer	MS	1
4	Locking screw	MS	1	9	Locating pin	HCS	2
5	Rotating pin	MS	1	10	Dowel pin	HCS	2

SQUARE POST





S. No.	Name	Material	Qty
1	Tool holder	Steel	1
2	Base plate	Steel	1
3	Clamp	Steel	1
4	Handle	Steel	1
5	Knob	Ebonite	1
6	Stud	MS	1
7	Screw	Steel	8
8	Spring	Steel	4
9	Spring washer	Steel	4
10	Machine screw	MS	4
11	Ball	Steel	4