

ENGINEERING GRAPHICS (Code No. 046)
CLASS XI-XII (2021-22)

The subject of 'Engineering Graphics' has become an indispensable tool for Engineers, Technocrats, Architects, Draftsmen, Surveyors, Designers and many other professionals in the recent times. It is used to convey the ideas and information necessary for the construction or analysis of machines, structures and system, graphically. It is expected that the knowledge gained through the study of different topics and the skills acquired through the prescribed practical work will make the learners to meet the challenges of academic, professional courses and daily life situations after studying the subject at Senior Secondary Stage.

Objectives:

The study of the subject of Engineering Graphics at Senior School Level aims at helping the learner to:

- develop clear concept and perception of different objects.
- develop a clear understanding of plane geometry, solid geometry and machine drawing so as to apply the same in relevant practical fields such as technology and industry.
- develop the skill of expressing two-dimensional and three-dimensional objects into professional language and vice versa.
- acquire speed and accuracy in use of drawing instruments.
- acquire the ability to readily draw neat sketches, often needed in "On-job situations".
- use technology (CAD) in developing isometric and orthographic projections of simple objects.

COURSE STRUCTURE
CLASS XI (2021-22)

TERM – 1

S.No.	Unit	Marks	Periods
I	PLANE GEOMETRY 1. Lines, angles and rectilinear figures 2. Circles, inscribing and circumscribing of circles	10	15
II	SOLID GEOMETRY 4. Orthographic projection of points and lines 5. Orthographic projection of regular plane figures 6. Orthographic projection of right regular solids	25	45
Practicals		15	20
Total Marks		50	80

THEORY

I. PLANE GEOMETRY 15 Periods

**Printing English alphabets (capital and small) and numerals in standard proportions.
Unidirectional/aligned system of dimensioning as per SP 46:2003 (Revised)**

Unit 1: Construction of lines, angles and their divisions. Simple questions based on triangles, square, rhombus, regular polygons-pentagon, and hexagon. 8 Periods

Unit 2: Construction of circles, inscribing and circumscribing of circles in equilateral triangle, square, rhombus, regular polygons-pentagon and hexagon. 7 Periods

II. SOLID GEOMETRY 45 Periods

Unit 4: Orthographic projection: dimensioning and conventions strictly as per SP 46:2003 (Revised). Orthographic projection of points and lines. 10 Periods

Unit 5: Orthographic projection of regular plane figures - triangle, square, pentagon, hexagon, circle and semi-circle. 10 Periods

Unit 6: Orthographic projection of right regular solids such as cubes; prisms and pyramids (square, triangular, pentagonal and hexagonal); cones; cylinders; spheres; hemi-spheres; frustum of pyramids and cone; when they are kept with their axis (a) perpendicular to HP/VP (c) parallel to HP and VP both. 25 Periods

PRACTICALS 20 Periods

5 practicals (minimum one from each point) with drawing/sketching of the views.

1. Making different types of graphic designs/ murals for interior/ exterior decorations in colour using the knowledge of geometrical figures with the use of any Computer Software such as Collab-CAD and/or any equivalent pertinent software.

2. Drawing the following engineering curve through activities - ellipse (by trammel & thread method) on the ground/ drawing sheet/ plywood/ cardboard etc.
3. Developing the following solids with the help of cardboard/ thick paper.
 - a) cube, cuboid

Note: The scheme of evaluation of practicals is as follows:

(a)	One practical with Drawing/ Sketch	10 Marks
(b)	Sessional Work	3 Marks
(c)	Viva-voce	2 Marks
Total		15 Marks

ACTIVITY

Industrial Visits (one) to any industry/ manufacturing plant to acquaint the students with the present - day methods & technology for better conceptual understanding can be done by virtual tour of the factory/plant due to present situation. The following links are given as an example for same:

Jindal Industrial visit

<https://www.youtube.com/watch?v=FYPbgr2Md-c>

Manufacturing process of glass bottle

https://www.youtube.com/watch?v=A_M8WBJMcM0

Power Plant/ Virtually Reality Tour (360°)

<https://youtu.be/34cXKIP39Pg>

Machine Tools and Manufacturing Systems

<https://www.youtube.com/watch?v=F2qXYyp0GjY>

COURSE STRUCTURE
CLASS XI (2021-22)
TERM – 2

S.No.	Unit	Marks	Periods
III	SOLID GEOMETRY 7. Orthographic projection of section of solids	05	10
IV	MACHINE DRAWING 8. Orthographic projections of simple machine blocks	18	25
V	ISOMETRIC PROJECTION 9. Isometric projection of laminae (plane figures)	12	25
Practicals		15	20
Total Marks		50	80

III. SOLID GEOMETRY

10 Periods

Unit 7: Section of right regular solids such as cubes; prisms and pyramids (square, triangular, pentagonal, and hexagonal); cones; cylinders; spheres, kept with their axis perpendicular to HP/VP, made by a vertical cutting plane.

IV. MACHINE DRAWING

25 Periods

Unit 8: Orthographic projection of simple machine blocks.

V. ISOMETRIC PROJECTION

25 Periods

Unit 9: Construction of isometric scale showing main divisions of 10mm and smaller divisions of 1mm, also showing the leading angles. Isometric projection (drawn to isometric scale) of regular plane figures - triangle, square, pentagon, hexagon, circle and semi-circle with their surface parallel to HP or VP (keeping one side either parallel or perpendicular to HP/VP).

PRACTICALS

20 Periods

5 practicals (minimum two from each point) with drawing/sketching of the views.

1. Developing the following solids with the help of cardboard/ thick paper.
 - a) prisms & pyramids (triangular, square, pentagonal and hexagonal)
 - b) right circular cylinder and cone
2. Preparing the section of solids (prisms, pyramids, sphere, etc.) with clay, soap, thermocol, plasticine, wax or any other material (easily and economically available). When the cutting plane is: parallel to the base, perpendicular to the base or inclined to the base.

Note: The scheme of evaluation of practicals is as follows:

(a)	One practical with Drawing/ Sketch	10 Marks
(b)	Sessional Work	3 Marks
(c)	Viva-voce	2 Marks
Total		15 Marks

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<https://www.youtube.com/watch?v=F2qXYyp0GjY>

COURSE STRUCTURE
CLASS XII (2021-22)

TERM – 1

S.No.	Unit	Marks	Periods
I	ISOMETRIC PROJECTION OF SOLIDS 1. Isometric Projections of Solids 2. Isometric Projections of Combination of Solids	25	40
II	Machine Drawing (Machine Parts) 3. Machine Parts – Drawing with instruments	10	20
	Practical	15	20
	Total Marks	50	80

THEORY

I. ISOMETRIC PROJECTION OF SOLIDS

40 Periods

Unit 1: Construction of isometric scale showing main divisions of 10mm and smaller divisions of 1mm, also showing the leading angles.

Isometric projection (drawn to isometric scale) of solids such as cube; regular prisms and pyramids (triangular, square, pentagonal and hexagonal); cone; cylinder; sphere; hemisphere; keeping the base side of the solid parallel or perpendicular to HP/VP. The axis of the solid should be either perpendicular to HP / VP or parallel to HP and VP.

20 Periods

Unit 2: Combination of any two above mentioned solids keeping the base side parallel or perpendicular to HP/VP and placed centrally together (Axis of both the solids should not be given parallel to HP).

20 Periods

Note: Hidden lines are not required in isometric projection.

II. Machine Drawing (Machine Parts) (as per SP 46: 2003)

20 Periods

Unit 3: Drawing to full size scale with instruments.

Introduction of threads: Standard profiles of screw threads - Square, Knuckle, B.S.W., Metric (external and internal); Bolts – Square head, Hexagonal head; Nuts – Square head, Hexagonal head; Plain washer; combination of nut and bolt with or without washer for assembling two parts together.

PRACTICALS

20 Periods

(i) To perform the following tasks (for One only) from the given views of the prescribed machine blocks from 1 to 5 from **ANNEXURE-I**.

Value-Points

1. Copy the given views

1

2.	Drawing the missing view with hidden lines	1
3.	Sketching the Isometric view without hidden edges	3
4.	To make the machine block of the above in three dimensions. (not to scale but approximately proportionately drawn with any medium i.e. thermocol, soap-cake, plasticine, clay, wax, orchis (available with florists), etc.)	3
(ii)	Computer Aided Design (CAD) – Project (5 sheets) Project on the simple solids (Prism, Pyramids etc.) or machine blocks as prescribed in part-I by using the CAD software.	3
(iii)	(a) Sessional work relating to machine blocks as prescribed.	2
	(b) Viva-voce	2

ACTIVITY

Industrial Visits (one) to any industry/ manufacturing plant to acquaint the students with the present - day methods & technology for better conceptual understanding can be done by virtual tour of the factory/plant in present situation. The following links are given as an example for same:

Bolt Making Machine Manufacturer

<https://www.youtube.com/watch?v=ARS87trb4u4>

Machine Tools Manufacturing Process -2

<https://www.youtube.com/watch?v=vIzjTEkGbN8>

BMW Engine Factory

https://www.youtube.com/watch?v=0z6E_1KonbA

Hydroelectric Virtual Plant Tour

<https://youtu.be/Ki8kSB1ThJQ>

COURSE STRUCTURE
CLASS XII (2021-22)

TERM – 2

S.No.	Unit	Marks	Periods
III	Machine Drawing (Machine Parts) 4. Machine Parts – Free Hand Sketches	7	10
IV	Machine Drawing (Assembly and Dis-assembly) 5. Bearings 6. Rod joints 7. Tie-rod and Pipe joint	28	50
Practical		15	20
Total Marks		50	80

III. Machine Drawing (Machine Parts) (as per SP 46: 2003)

10 Periods

Unit 4: Free-hand sketches

Conventional representation of external and internal threads; Types of studs – Plain stud, Square-neck stud, Collar stud; Types of rivets – Snap head, Flat head, Pan head (without tapered neck), 60° Counter Sunk Flat head.

IV. Machine Drawing (Assembly and Dis-assembly) (as per SP 46: 2003)

50 Periods

(Internal choice will be given between an Assembly drawing and a Dis-Assembly drawing).

Unit 5: Bearings

- (i) Open-Bearing
- (ii) Bush- Bearing

Unit 6: Rod-Joints

- (i) Cotter-joints for round-rods (Sleeve and cotter joint)
- (ii) Cotter-joints for square rods (Gib and cotter-joint)

Unit 7: Tie-rod and Pipe-joint

- (i) Turnbuckle
- (ii) Flange pipe joint

Note:

1. *In all Assembly drawings, half sectional front view will be asked. Side/End view or Top View/Plan will be drawn without section.*
2. *In all Dis-assembly drawings, only two orthographic views (one of the two views may be half in section or full in section) will be asked of any two parts only.*
3. *(a) In all sectional views, hidden lines/ edges are not to be shown.
(b) In all full views, hidden/edges are to be shown.*

PRACTICALS

20 Periods

(i) To perform the following tasks (for One only) from the given views of the prescribed machine blocks from 6 to 10 from **ANNEXURE-I**.

	Value-Points
1. Copy the given views	1
2. Drawing the missing view with hidden lines	1
3. Sketching the Isometric view without hidden edges	3
4. To make the machine block of the above in three dimensions. (not to scale but approximately proportionately drawn with any medium i.e. thermocol, soap-cake, plasticine, clay, wax, orchsis (available with florists), etc.)	3
(ii) Computer Aided Design (CAD) – Project (5 sheets) Project on the simple solids (Prism, Pyramids etc.) or machine blocks as prescribed in part-I by using the CAD software.	3
(iii) (a) Sessional work relating to machine blocks as prescribed.	2
(b) Viva-voce	2

ACTIVITY

Industrial Visits (one) to any industry/ manufacturing plant to acquaint the students with the present - day methods & technology for better conceptual understanding can be done by virtual tour of the factory/plant in present situation. The following links are given as an example for same:

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BMW Engine Factory

https://www.youtube.com/watch?v=0z6E_1KonbA

Hydroelectric Virtual Plant Tour

<https://youtu.be/Ki8kSB1ThJQ>

ANNEXURE -- 1



