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ENGINEERING GRAPHICS (Civil, Electrical, Mechanical and allied branches) Course Code : 311006

Programme Name/s	**: Automobile Engineering./ Agricultural Engineering/ Civil Engineering/ Chemical Engineering/ Civil & Rural Engineering/ Construction Technology/ Aeronautical Engineering/ Fashion & Clothing Technology/ Electrical Engineering/ Electrical Power System/ Food Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Manufacturing Technology/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Textile Technology/ Textile Manufactures**
Programme Code	**: AE/ AL/ CE/ CH/ CR/ CS/ DAE/ DC/ EE/ EP/ FC/ LE/ ME/ MK/ MRT/ MY/ PG/ PN/ PO/ TC/ TX**
Semester	**: First**
Course Title	**: ENGINEERING GRAPHICS (Civil, Electrical, Mechanical and allied branches)**
Course Code	**: 311006**

I. RATIONALE

Engineering graphics is the language of engineers. The concepts of graphical language are used in expressing the ideas, conveying the instructions, which are used in carrying out the jobs on the sites, shop floor etc. This course is useful in developing drafting and sketching skills in the student. It covers the knowledge & application of drawing instruments & also familiarizes the learner about Bureau of Indian Standards related to engineering drawing. The curriculum aims at developing the ability to draw and read various engineering curves, projections and dimensioning styles. The subject mainly focuses on use of drawing instruments, developing imagination and translating ideas into sketches. The course also helps to develop the idea of visualizing the actual object or part on the basis of drawings and blue prints. This preliminary course aims at building a foundation for the further courses related to engineering drawing and other allied courses in coming semesters

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Prepare engineering drawing manually using prevailing drawing instruments.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Draw geometrical figures and engineering curves.
- CO2 - Apply principles of orthographic projections for drawing given pictorial views.
- CO3 - Draw isometric views of given component or from orthographic projections.
- CO4 - Use various drawing codes, conventions and symbols as per IS SP-46 in engineering drawing.
- CO5 - Draw free hand sketches of given engineering elements.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
311006	ENGINEERING GRAPHICS (Civil, Electrical, Mechanical and allied branches)	EGR	DSC	2	-	4	-	6	3	-	-	-	-	-	50	20	50@	20	-	-	100

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Total IKS Hrs for Sem. : 2 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Prepare drawing using drawing instruments. TLO 1.2 Use IS SP-46 for dimensioning TLO 1.3 Use different types of lines. TLO 1.4 Draw regular geometrical figures. TLO 1.5 Draw figures having tangency constructions.	**Unit - I Basic Elements of Drawing** 1.1 Drawing Instruments and supporting material: method to use them with applications. 1.2 Standard sizes of drawing sheets (ISO-A series) 1.3 I.S. codes for planning and layout. 1.4 Letters and numbers (single stroke vertical) 1.5 Convention of lines and their applications. 1.6 Scale - reduced, enlarged & full size 1.7 Dimensioning techniques as per SP-46 (Latest edition) – types and applications of chain, parallel and coordinate dimensioning 1.8 Geometrical constructions.	Model Demonstration
2	TLO 2.1 Explain different engineering curves with areas of application. TLO 2.2 Draw different conic sections. TLO 2.3 Draw involute and cycloidal curves. TLO 2.4 Draw helix and spiral curves from given data TLO 2.5 Plot Loci of points from given data.	**Unit - II Engineering curves & Loci of Points.** 2.1 Concept and understanding of focus, directrix, vertex and eccentricity. Conic sections. 2.2 Methods to draw an ellipse by Arcs of circle method & Concentric circles method. 2.3 Methods to draw a parabola by Directrix-Focus method & Rectangle method 2.4 Methods to draw a hyperbola by Directrix-Focus method. 2.5 Methods to draw involutes: circle & pentagon 2.6 Methods to draw Cycloidal curve: cycloid, epicycloid and hypocycloid 2.7 Methods to draw Helix & Archimedean spiral. 2.8 Loci of points on Single slider crank mechanism with given specifications.	Demonstration

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain methods of Orthographic Projections. TLO 3.2 Draw orthographic views of simple 2D entities containing lines, circles and arcs only. TLO 3.3 Draw the orthographic views from given pictorial views. TLO 3.4 Use of IS code IS SP-46 for dimensioning technique.	**Unit - III Orthographic Projections** 3.1 Introduction of projections-orthographic, perspective, isometric and oblique: concept and applications.(No question to be asked in examination) 3.2 Introduction to orthographic projection, First angle and Third angle method, their symbols. Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle Pr	Model Demonstration Video Demonstrations
4	TLO 4.1 Prepare isometric scale. TLO 4.2 Draw isometric views of simple 2D entities containing lines, circles and arcs only. TLO 4.3 Interpret the given orthographic views. TLO 4.4 Draw Isometric views from given orthographic views	**Unit - IV Isometric Projections** 4.1 Introduction to Isometric projection. 4.2 Isometric scale and Natural Scale. 4.3 Isometric view and isometric projection. 4.4 Ilustrative problems related to simple objects having plain, slanting, cylindrical surfaces and slots on slanting surfaces. 4.5 Conversion of orthographic views into isometric View/projection. (For branches other than mechanical Engineering, the teacher should select branch specific elements)	Model Demonstration Video Demonstrations
5	TLO 5.1 Sketch proportionate freehand sketches of given machine elements. TLO 5.2 Select proper fasteners and locking arrangement.	**Unit - V Free Hand Sketches of Engineering Elements** 5.1 5.1 Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements. (For branches other than mechanical Engineering, the teacher should select branch specific elements for free hand sketching)	Model Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Use of drawing instruments	1	* Draw horizontal, vertical, 30 degree, 45 degree, 60 & 75 degrees lines using Tee and Set squares/ drafter. (Sketch Book).	2	CO1
LLO 2.1 Use of IS code related to dimensioning standard	2	* Draw different types of lines, dimensioning styles (Sketch Book)	2	CO1
LLO 3.1 Practice of drawing as per given sketch	3	* Draw one figure showing dimensioning techniques, two problems on redraw the figures and one problem on loci of points - slider crank mechanism. (Sketch Book)	2	CO1
LLO 4.1 Use IS Standard for drawing different figures	4	* Draw one figure showing dimensioning techniques, two problems on redraw the figures and one problem on loci of points - slider crank mechanism. (01 Sheet)	4	CO1
LLO 5.1 Identify different Engineering curves	5	* Draw any four Engineering Curves (Sketchbook)	2	CO1
LLO 6.1 Identify different Engineering curves	6	* Draw any four Engineering Curves – (01 Sheet)	4	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Apply method of projection for drawing simple orthographic views	7	* Draw two problems on orthographic projections using first angle method of projection having plain surfaces, slanting surfaces and slots etc.- (Sketchbook)	2	CO2 CO4
LLO 8.1 Apply method of projection for drawing simple orthographic views	8	Draw two problems on orthographic projections using first angle method of projection having plain surfaces, slanting surfaces and slots etc.- (01 Sheet)	4	CO2 CO4
LLO 9.1 Apply method of projection for drawing complex orthographic views	9	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs etc. (Sketchbook)	2	CO2 CO4
LLO 10.1 Apply method of projection for drawing complex orthographic views	10	* Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs etc.- (01 Sheet)	4	CO2 CO4
LLO 11.1 Draw simple isometric projections	11	* Draw two problems on Isometric view of simple objects having plain and slanting surfaces by using natural scale. (Sketchbook)	2	CO3 CO4
LLO 12.1 Apply different scales for drawing isometric projections.	12	Draw two problems on Isometric view of simple objects having plain and slanting surfaces by using natural scale. (01 sheet)	4	CO3 CO4
LLO 13.1 Draw simple isometric projections	13	Draw two problems on Isometric Projection of objects having cylindrical surfaces and slots on slanting surfaces by using isometric scale.(Sketchbook)	2	CO3 CO4
LLO 14.1 Apply different scales for drawing isometric projections	14	* Draw two problems on Isometric Projection of objects having cylindrical surfaces and slots on slanting surfaces by using isometric scale. (01 sheet)	4	CO3 CO4
LLO 15.1 Draw Orthographic views of a given object.	15	Problem Based Learning: Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views (sketch book).	2	CO2 CO4
LLO 16.1 Draw standard discipline oriented components using free hand .	16	* Draw freehand Sketches of 12 different standard components (Sketch book)	2	CO5
LLO 17.1 Draw standard discipline oriented components using free hand .	17	Draw freehand Sketches of 12 different standard components (1 Sheet)	2	CO5
LLO 18.1 Collect information of an ancient Indian culture related to engineering graphics	18	* Correlate ancient Indian sculptures, Indian temples, Monuments, etc. with Engineering Graphics	2	CO1 CO2 CO3 CO4 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

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- not Applicable

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Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Models/ Charts of objects mentioned in unit no. 5	16,17
2	Models of objects for orthographic / isometric projections	7,8,9,10,11,12,13,14,15
3	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
4	Set of various industrial drawings being used by industries.	All
5	Set of drawings sheets mentioned in section 6.0 could be developed by experienced teachers and made used available on the MSBTE portal to be used as reference/standards.	All
6	Drawing equipment and instruments for class room teaching-large size: a. T-square or drafter (Drafting Machine). b. Set squires (450 and 300-600) c. Protector. d. Drawing instrument box (containing set of compasses and dividers). Drawing sheets, Drawing pencils, Eraser, Drawing pins / clips	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basic Elements of Drawing	CO1	3	0	0	6	6
2	II	Engineering curves & Loci of Points.	CO1	6	0	0	6	6
3	III	Orthographic Projections	CO2,CO4	7	0	0	14	14
4	IV	Isometric Projections	CO3,CO4	8	0	0	14	14
5	V	Free Hand Sketches of Engineering Elements	CO4,CO5	6	0	0	10	10
Grand Total				**30**	**0**	**0**	**50**	**50**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work

Summative Assessment (Assessment of Learning)

- Practical

XI. SUGGESTED COS - POS MATRIX FORM

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Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-	2	-	2	-			
CO2	3	-	-	2	-	2	-			
CO3	3	-	-	2	-	2	-			
CO4	3	-	-	2	-	2	-			
CO5	3	-	-	2	-	2	-			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bureau of Indian Standards.	Engineering Drawing Practice for Schools and Colleges IS: SP-46	Third Reprint, October 1998 ISBN No. 81-7061-091-2
2	Bhatt, N.D.	Engineering Drawing	Charotar Publishing House, 2010 ISBN No. 978-93-80358-17-8
3	Bhatt, N.D.; Panchal, V. M	Machine Drawing	Charotar Publishing House, 2010 ISBN No. 978-93-80358-11-6
4	Jolhe, D.A.	Engineering Drawing	Tata McGraw Hill Edu. New Delhi, 2010, ISBN No. 978-0-07-064837-1
5	Dhawan, R. K.	Engineering Drawing	S. Chand and Company New Delhi, ISBN No. 81-219-1431-0
6	Pradhan, S.K Jain, K.K	Engineering Graphics	Khanna Book Publishing CO(P) LTD, New Delhi, ISBN No. 978-93-91505-50-9

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=dmt6_n7Sgcg	Free Hand Sketches
2	https://www.youtube.com/watch?v=_MQScnLXL0M	Orthographic Projection
3	https://www.youtube.com/watch?v=3WXPanCq9LI	Basics of Projection
4	https://www.youtube.com/watch?v=fvjk7PlxAuo	Introduction to Engineering Graphics
5	https://www.youtube.com/watch?v=8j7l1OWhMlE	Isometric Projection

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students