COMPUTER GRAPHICS **Course Code : 313001**

Programme Name/s	**: Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Computer Hardware & Maintenance/ Computer Science**
Programme Code	**: CM/ CO/ CW/ HA/ SE**
Semester	**: Third**
Course Title	**: COMPUTER GRAPHICS**
Course Code	**: 313001**

I. RATIONALE

Computer Graphics is the discipline of generating images with the aid of computers. This course provides an introduction to the principles of Computer Graphics. In particular, the course will consider methods for Object Design, Transformation, Scan Conversion, Visualization and Modelling of real world and enables student to create impressive graphics easily and efficiently.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain following Industry Identified Competency through various Teaching Learning Experiences:
Develop programs using Graphics concepts.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Manipulate Visual and Geometric information of Images.
- CO2 - Develop programs in C applying standard graphics algorithms.
- CO3 - Perform and Demonstrate basic and composite graphical transformations on given object.
- CO4 - Implement various Clipping algorithms.
- CO5 - Develop programs to create Curves.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313001	COMPUTER GRAPHICS	CGR	DSC	1	-	2	1	4	2	-	-	-	-	-	25	10	-	-	25	10	50

Total IKS Hrs for Sem. : 0 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 Describe coordinate system. TLO 1.2 Select and use various graphics file formats. TLO 1.3 Use different graphics functions and standards.	**Unit - I Basics of Computer Graphics** 1.1 Coordinate system 1.2 Graphics file formats: Basics, advantages, disadvantages – BMP – GIF – JPEG – TIFF – PCX 1.3 Graphics functions & standards: Text mode, Graphic mode, Shapes, Colors, Graphics standards.	Lecture Using Chalk-Board Demonstration Hands-on
2	TLO 2.1 Apply Line Drawing algorithms to generate Line. TLO 2.2 Apply Circle Drawing algorithms to generate Circle. TLO 2.3 Apply Polygon Filling algorithms to Fill Polygon.	**Unit - II Raster Scan Graphics** 2.1 Line Drawing Algorithms : Digital Differential Analyzer algorithm, Bresenham's algorithm. 2.2 Circle Generation- Symmetry of Circle, Bresenham's algorithm 2.3 Polygon Filling : Seed Fill algorithms- Flood Fill algorithm, Boundary Fill algorithm.	Lecture Using Chalk-Board Demonstration Hands-on
3	TLO 3.1 Perform various transformations on given graphics object. TLO 3.2 Use composite transformations. TLO 3.3 Write need of homogeneous coordinates.	**Unit - III Overview of 2D And 3D Transformations** 3.1 Basic Transformations: Translation, Scaling, Rotation. 3.2 Matrix representations & homogeneous coordinates. 3.3 Composite transformations. 3.4 Three-dimensional transformation. 3.5 Other transformations: Reflection, Shear.	Lecture Using Chalk-Board Demonstration Hands-on

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.
4	TLO 4.1 Define: Windowing and Clipping. TLO 4.2 Apply Clipping algorithms for Line and Polygon.	**Unit - IV Windowing and Clipping Techniques** 4.1 Windowing concepts. 4.2 Line Clipping: Cohen Sutherland Line Clipping algorithm, Mid-Point Subdivision Line clipping algorithm. 4.3 Polygon Clipping: Sutherland Hodgeman Polygon clipping algorithm.	Lecture Using Chalk-Board Demonstration Hands-on
5	TLO 5.1 Draw various Curves using Curve generation algorithms. TLO 5.2 Identify different types of Projections.	**Unit - V Introduction to Curves and Projections** 5.1 Bezier and B-Spline Curves. 5.2 Projections: Perspective and Parallel Projection and its types.	Lecture Using Chalk-Board Demonstration Hands-on

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 Implement a C program using different graphics functions.	1	*Write a C program to draw various graphics objects (Pixel, Circle, Line, Ellipse, Rectangle, Triangle, Polygon) using graphics functions.	2	CO1
LLO 2.1 Implement a C program to draw line using DDA algorithm.	2	*Write a C program to draw line using DDA algorithm.	2	CO2
LLO 3.1 Implement a C program to draw line using Bresenham's algorithm.	3	Write a C program to draw line using Bresenham's algorithm.	2	CO2
LLO 4.1 Implement a C program to draw circle using Bresennham's algorithm.	4	*Write a C program to draw circle using Bresenham's algorithm.	2	CO2
LLO 5.1 Implement a C program for Flood fill algorithm.	5	*Write a C program for Flood fill algorithm of polygon filling.	2	CO2
LLO 6.1 Implement a C program for Boundary fill algorithm.	6	Write a C program for Boundary fill algorithm of polygon filling.	2	CO2
LLO 7.1 Implement a C program for 2D Translation and Scaling	7	*Write a C program for 2D Translation and Scaling.	4	CO3
LLO 8.1 Implement a C program for 2D Rotation.	8	Write a C program for 2D Rotation.	2	CO3
LLO 9.1 Implement a C program for 2D Reflection and Shear.	9	*Write a C program for 2D Reflection and Shear.	4	CO3
LLO 10.1 Implement a C program for 3D Translation and Scaling.	10	*Write a C program for 3D Translation and Scaling .	4	CO3
LLO 11.1 Implement a C program for 3D Rotation	11	Write a C program for 3D Rotation.	2	CO3
LLO 12.1 Implement a C program for Line Clipping using Cohen-Sutherland algorithm.	12	*Write a C program for Line Clipping using Cohen-Sutherland algorithm.	2	CO4
LLO 13.1 Implement a C program for Line Clipping using Midpoint Subdivision algorithm.	13	Write a C program for Line Clipping using Midpoint Subdivision algorithm.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Implement C program for Sutherland Hodgeman Polygon Clipping.	14	Write a C program for Sutherland Hodgeman Polygon Clipping.	2	CO4
LLO 15.1 Implement a C program for Bezier Curve.	15	Write a C program for Bezier Curve.	2	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)

Micro project

- Implement Snake Game
- Design Smile Face
- Design Digital Clock
- Any other micro projects suggested by subject teacher.
- Develop program for moving Car

Self learning

- Develop C language code for relevant topics suggested by the teacher
- Any computer graphics course suggested by teacher (NPTEL, MOOCs courses etc.)

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	Computer System with basic configuration.	All
2	'C' Compiler	All

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

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Computer Graphics	CO1	2	0	0	0	0
2	II	Raster Scan Graphics	CO2	4	0	0	0	0
3	III	Overview of 2D And 3D Transformations	CO3	4	0	0	0	0
4	IV	Windowing and Clipping Techniques	CO4	3	0	0	0	0
5	V	Introduction to Curves and Projections	CO5	2	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous Assessment based on Process and Product related performance indicators. Each practical will be assessed considering

60% weightage to Process
40% weightage to Product

Summative Assessment (Assessment of Learning)

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XI. SUGGESTED COS - POS MATRIX FORM

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	2	2	2	2	1	1	1			
CO2	2	2	2	2	-	1	1			
CO3	2	2	2	2	-	1	1			
CO4	2	2	2	2	-	1	1			
CO5	2	2	2	2	-	1	1			

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

Sr.No	Author	Title	Publisher with ISBN Number
1	Donald Hearn , M Pauline Baker	Computer Graphics	Prentice-Hall • ISBN-10 : 0131615300 • ISBN-13 : 978-0131615304
2	William M. Newman Robert F. Sproull	Principles of Interactive Computer Graphics	McGraw-Hill • ISBN: 978-0-07-046338-7
3	Zhigang Xiang, Roy Plastock	Computer Graphics	Schaum O Series • ISBN: 9789389538847 • ISBN: 938953884X
4	Atul P. Godse, Dr. Deepali A. Godse	Computer Graphics	Technical Publications ISBN 933322338X, 9789333223386

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.javatpoint.com/computer-graphics-programs	Basic graphics programs
2	https://www.tutorialspoint.com/computer_graphics/index.htm	Basics of computer graphics
3	https://www.educba.com/line-drawing-algorithm/	Line drawing algorithm
4	https://www.javatpoint.com/computer-graphics-clipping	Clipping Algorithms
5	https://www.tutorialspoint.com/computer_graphics/computer_graphics_curves.htm	Curves in computer graphics
6	https://www.tutorialspoint.com/computer_graphics/2d_transformation.htm	2D and 3D Transformation
7	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013842008941903872103 61_shared/overview	Project on Computer Graphics

Note :

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