08	**Undecidability and Recursively Enumerable Languages:** • Recursive and Recursively Enumerable Languages. • Properties of Recursive and Recursively Enumerable Languages. • Decidability and Undecidability, Halting Problem, Rice's Theorem, Grebach's Theorem, Post Correspondence Problem, • Context Sensitivity and Linear Bound Automata.	**06**
09	**Comparison of scope of languages and machines:** • Subset and Superset relation between FSM, PSM and TM. • Subset and Superset relation between RL, CFL and Context Sensitive Language.	**02**

Text Books:

1. Michael Sipser, " Theory of Computation", Cengage learning.
2. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, " Introduction to Automata Theory, Languages and Computation", Pearson Education

References:

1. J. C. Martin, "Introduction to Languages and the Theory of Computation", Tata McGrawHill.
2. Krishnamurthy E. V., "Introductory Theory of Computer Science", East-West Press.
3. Kavi Mahesh, "Theory of Computation: A Problem Solving Approach", Wiley-India.

Theory Examination:

1. Question paper will comprise of total 6 questions, each of 20 Marks.
2. Only 4 questions need to be solved.
3. Question 1 will be compulsory and based on maximum part of the syllabus.
4. Remaining questions will be mixed in nature (for example suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

In question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Subject Code	Subject Name	Credits
CSC406	Computer Graphics	04

Course Educational Objectives:

1. The main objective is to introduce to the students in the graphics mode, with the help of basic algorithms and methodologies .
2. The objective of the course is to equip students with fundamental knowledge and basic technical competence in the field of computer graphics.
3. Provide an understanding of how a computer draws the fundamental graphics primitives.
4. To learn Computer Graphics methodologies/Algorithms and techniques .
5. To learn Implementation of Computer Graphics Algorithms

Course Outcomes:

Upon successfully completing Fundamentals of Computer graphics course, students will have, at a minimum, the qualities listed in the expected learning outcomes below.

1. Student will have understood basic concepts of computer graphics
2. Acquire knowledge about drawing basic shapes such as lines, circle ellipse, polygon.
3. Shall be able to perform processing of basic shapes by various processing algorithms /techniques.
4. Acquire knowledge about two and three dimensional transformations.
5. Shall be able to apply the transformation algorithms to the basic shapes.
6. Shall have basic knowledge of windowing and clipping.
7. Shall be able to apply various algorithms of clipping.
8. Acquire knowledge about Visible Surface Detection methods
9. Acquire knowledge about Illumination Models and Surface Rendering
10. Acquire knowledge about Color Models

Module	Contents	Hours
1.	**Introduction to Computer Graphics** (a) What is Computer Graphics? (b) Where Computer Generated pictures are used (c) Elements of Pictures created in Computer Graphics (d) Graphics display devices (e) Graphics input primitives and Devices	**(02)**
2.	**Introduction to openGL** (a) Getting started Making pictures	**(02)**

	(b) Drawing basic primitives (c) Simple interaction with mouse and keyboard (**For implementation use openGL programming**)	
3.	**Output Primitives** (a) Points and Lines, Antialiasing (b) Line Drawing algorithms • DDA line drawing algorithm • Bresenham's drawing algorithm • Parallel drawing algorithm (c) Circle and Ellipse generating algorithms • Mid-point Circle algorithm • Mid-point Ellipse algorithm (d) Parametric Cubic Curves • Bezier curves • B-Spline curves	**(06)**
4.	**Filled Area Primitives** (a) Scan line polygon fill algorithm (b) Pattern fill algorithm (c) Inside-Outside Tests (d) Boundary fill algorithms (e) Flood fill algorithms	**(02)**
5.	**2D Geometric Transformations** (a) Basic transformations (b) Matrix representation and Homogeneous Coordinates (c) Composite transformation (d) Other transformations (e) Transformation between coordinated systems	**(04)**
6.	**2D Viewing** (a) Window to Viewport coordinate transformation (b) Clipping operations – Point clipping (c) Line clipping • Cohen – Sutherland line clipping • Liang – Barsky line clipping • Midpoint subdivision (d) Polygon Clipping • Sutherland – Hodgeman polygon clipping • Weiler – Atherton polygon clipping	**(04)**
7.	**3D Geometric Transformations and 3D Viewing** (a) 3D object representation methods B-REP , sweep representations , CSG (b) Basic transformations • Translation • Rotation	**(06)**

	• Scaling (c) Other transformations 1. Reflection 2. Rotation about an arbitrary axis (d) Composite transformations (e) Projections – Parallel and Perspective (f) 3D clipping	
8.	**3D Geometric Transformations and 3D Viewing** (a) Classification of Visible Surface Detection algorithm (b) Back Surface detection method (c) Depth Buffer method (d) Scan line method (e) BSP tree method (f) Area Subdivision method	**(04)**
9.	**Illumination Models and Surface Rendering** (a) Basic Illumination Models (b) Halftone and Dithering techniques (c) Polygon Rendering Constant shading , Goraud Shading , Phong Shading	**(03)**
10.	**11. Fractals** (a) Introduction (b) Fractals and self similarity Successive refinement of curves, Koch curve, Fractional Dimension, (c) String production and peano curves **(For implementation use C Programming)**	**(03)**

The journal should consist of 12 experiments and 3 assignments.

Following is the list of compulsory 10 experiments.

Additional 2 experiments can be implemented relevant to the course

1. Drawing the basic primitives and sierpinsky gasket using openGL*.
2. Create a polyline using mouse interaction using openGL*.
3. Bresenham's line drawing algorithm.
4. Mid-Point ellipse drawing algorithm.
5. Implementing Bezier curve.
6. Scanline fill algorithm.
7. 2D transformations.
8. Any one Line clipping algorithm cohen-sutherland / liang barsky.
9. Polygon Clipping algorithm sutherland hodgeman.
10. Any one Fractal generation (Koch curve / Hilbert curve / peano curves using string production)

***Implementation of experiments 1 and 2 must be in openGL.**
Implementation of experiments 3 to 10 must be done in C language.

Termwork:

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

Term Work: 25 Marks (total marks) = 15 Marks (Experiment) + 5 Marks (Assignment) + 5 (Attendance (theory+practical))

Practical Exam will be based on above syllabus

TEXT BOOKS

1. Donald D. Hearn & M. Pauline Baker, " Computer Graphics-C Version", 2nd Edition, Pearson Education, 2002, ISBN 81-7808-794-4
2. F.S.Hill , Jr. , "Computer Graphics using OpenGL" , second edition PHI publication.
3. James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice, 2nd Edition in C, Audison Wesley, ISBN – 981-235-974-5
4. William M. Newman, Roberet F. Sproull, " Principles of Interactive Computer Graphics", Second Edition, Tata McGraw-Hill Edition

REFERENCE BOOKS

1. Rajesh K. Maurya, "Computer Graphics", 1st Edition, Wiley India Publication ISBN 978-81-265-3100-4.
2. Amarendra N Sinha, Arun D Udai, "Computer Graphics" ISBN 10: 0070034378, ISBN 13: 9780070634374, Tata McGraw-Hill Education, 2007.
3. Peter Shirley, Steve Marschner, A K Peters, "Fundamentals of Computer Graphics", 3rd Edition, A. K. Peters Ltd. , Natick, Massachusetts, Distributed by Shroff Publishers and Dist. Pvt. Ltd.
4. Zhigang Xiang, Roy A Plastock, " Computer Graphics", second edition, Shaum's Outlines, Tat McGraw Hill
5. David F. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publications, 2001, ISBN 0-07-04-7371-4.

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