**COURSE PLAN**

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| --- | --- |
| Target | 50% (marks) |
| Level-1 | 40% (population) |
| Level-2 | 50% (population) |
| Level-3 | 60% (population) |

1. **Method of Evaluation**

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| --- | --- |
| **UG** | **PG** |
| Quizzes/Tests, Assignments (30%) | Quizzes/Tests, Assignments, seminar (50%) |
| Mid Examination (20%) | End semester (50%) |
| End examination (50%) |  |

1. **Passing Criteria**

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| --- | --- | --- |
| **Scale** | **PG** | **UG** |
| **Out of 10 point scale** | SGPA – “6.00” in each semester  CGPA – “6.00”  Min. Individual Course Grade  –  “C”  Course Grade  Point –  “4.0” | SGPA – “5.0” in each semester  CGPA – “5.0”  Min. Individual Course Grade  –  “C”  Course Grade  Point –  “4.0” |

\*for PG, passing marks are 40/100 in a paper

\*for UG, passing marks are 35/100 in a paper

1. **Pedagogy**

* Blackboard
* Presentation
* Class Test
* Quizzes
* Voiceover Presentation & Video lectures
* Assignments
* NPTEL videos
* YouTube videos
* Concept diary (needs to be maintained by students-short and concise notes that include course concepts that he/she has understood)

1. **References:**

|  |  |  |  |
| --- | --- | --- | --- |
| Text Books | Web resources | Journals | Reference books |
| 1. Computer Graphics- C version, Second Edition, Pearson, Donald D. Hearn and M. Pauline Baker 2. Computer Graphics with OpenGL, Fourth Edition, Pearson, Donald D. Hearn, M. Pauline Baker and Warren Carithers | <https://youtube.com/results?search_query=Computer>+  Graphics+IIT+Madras |  | 1. Mathematical Elements for Computer Graphics, Second Edition, McGraw Hill, David F. Rogers and J. Alan Adams 2. Procedural Elements for Computer Graphics, Second Edition, McGraw Hill, David F. Rogers |

**GUIDELINES TO STUDY THE SUBJECT**

**Instructions to Students:**

1. Go through the 'Syllabus' in the Black Board section of the website (https://learn.upes.ac.in) in order to find out the Reading List.
2. Get your schedule and try to pace your studies as close to the timeline as possible.
3. Get your on-line lecture notes (Content, videos) at Lecture Notes section.  These are our lecture notes. Make sure you use them during this course.
4. Check your blackboard regularly
5. Go through study material
6. Check mails and announcements on blackboard
7. Keep updated with the posts, assignments and examinations which shall be conducted on the blackboard
8. Be regular, so that you do not suffer in any way
9. C**ell Phones and other Electronic Communication Devices:** Cell phones and other electronic communication devices (such as Blackberries/Laptops) are not permitted in classes during Tests or the Mid/Final Examination. Such devices MUST be turned off in the class room.
10. **E-Mail and online learning tool:** Each student in the class should have an e-mail id and a pass word to access the LMS system regularly. Regularly, important information – Date of conducting class tests, guest lectures, via online learning tool. The best way to arrange meetings with us or ask specific questions is by email and prior appointment. All the assignments preferably should be uploaded on online learning tool. Various research papers/reference material will be mailed/uploaded on online learning platform time to time.
11. **Attendance:** Students are required to have minimum attendance of 75% in each subject. Students with less than said percentage shall NOT be allowed to appear in the end semester examination.
12. **Online Content:** Over 30% of your syllabus will be covered in fully online mode, Details of which is mentioned in the Syllabus details section.

This much should be enough to get you organized and on your way to having a great semester! If you need us for anything, send your feedback through e-mail [to](mailto:abc@ddn.upes.ac.in) your concerned faculty. Please use an appropriate subject line to indicate your message details.

There will no doubt be many more activities in the coming weeks. So, to keep up to date with all the latest developments, please keep visiting this website regularly.

**RELATED OUTCOMES**

1. **The expected outcomes of the Program are:**

|  |  |
| --- | --- |
| PO1 | Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| PO2 | Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| PO3 | Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| PO4 | Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| PO5 | Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. |
| PO6 | The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| PO7 | Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| PO8 | Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| PO9 | Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| PO10 | Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| PO11 | Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| PO12 | Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

1. **The expected outcomes of the Specific Program are: (upto3)**

|  |  |
| --- | --- |
| PSO1 | Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques, |
| PSO2 | Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms. |
| PSO3 | Able to design, develop and deploy Mobile Applications (Apps) and protocols for Ubiquitous computing. |

1. **The expected outcomes of the Course are: (minimum 3 and maximum 6)**

|  |  |
| --- | --- |
| CO 1 | Explore various graphics display devices and use graphical tool OpenGL. |
| CO 2 | Apply scan converting algorithms to create various geometrical shapes. |
| CO 3 | Carry out complex 2D and 3D geometric transformations. |
| CO 4 | Design and develop curves and surfaces of higher order. |
| CO 5 | Apply shading, colouring and hidden surface removal techniques to create 3D realistic imagery. |

1. **Co-Relationship Matrix**

Indicate the relationships by1- Slight (low) 2- Moderate (Medium) 3-Substantial (high)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Program**  **Outcomes**  **Course Outcomes** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO 1** | 1 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| **CO 2** | 1 | 1 | 2 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO 3** | 1 | 2 | 2 | - | - | - | - | - | - | - | - | - | 1 | - | - |
| **CO 4** | 1 | 2 | 2 | - | 2 | - | - | - | - | - | - | - | 1 | 1 | - |
| **CO 5** | 1 | 2 | 2 | - | 2 | - | - | - | - | - | - | - | 2 | - | - |
| **Average** | **1** | **1.8** | **2** | **0.4** | **0.8** |  |  |  |  |  |  |  | **1.2** | **0.2** |  |

1. **Course outcomes assessment plan:**

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| --- | --- | --- | --- | --- | --- |
| **components**  **Course Outcomes** | **Assignment** | **Test/Quiz** | **Mid Semester** | **End Semester** | **Any other** |
| **CO 1** | **√** | **√** | **√** | **√** | **□** |
| **CO 2** | **√** | **√** | **√** | **√** | **□** |
| **CO 3** | **√** | **√** | **√** | **√** | **□** |
| **CO 4** | **√** | **√** | **√** | **√** | **□** |
| **CO 5** | **√** | **√** | **√** | **√** | **□** |

**BROAD PLAN OF COURSE COVERAGE**

**Course Activities:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S. No.** | **Description** | **Planned** | | | **Remarks** |
| **From** | **To** | **No. of Sessions** |
| **1.** | **UNIT -1**  **Introduction to computer graphics :** Overview of computer graphics,  Raster /Random scan display,  Calligraphic refresh graphics , Display  Input and output Device(CRT)  Introduction to OpenGL  GL,GLU,GLUT  3D Viewing Pipeline, Demo of OpenGL code. |  |  | 4 | ONLINE CONTENT (Voice over PPT and Lecture Notes)  1 Synchronous and 3 Asynchronous  Quiz 1 |
| **2.** | UNIT 2:  **Scan conversion-Lines, Circles and Ellipses. Polygon Filling Algorithms and Clipping Algorithms**  Points & lines:  Line drawing algorithms  DDA algorithm  Bresenham’s line algorithm  Problems of Aliasing ,end point and clipping lines  Circle generation algorithms  Ellipse generating algorithm  Scan line polygon  Flood fill algorithm  Boundary fill algorithm  Point clipping  Line clipping  Liang-Barsky line clipping algorithm  Cohen Sutherland line clipping algorithm  Polygon clipping  Sutherland –Hodgman algorithm  Weiler-Atherton Polygon clipping  Text clipping |  |  | 8 | 6 Synchronous and 2 Asynchronous Lecture (Online Lectures over Blackboard Collaborate and Offline Content via Voice Over PPT and Lecture Notes)  Test 1 |
| **3.** | **UNIT-3:**  **2D Transformations**  Homogenous coordinate system (HCS).  Translation  Rotation  Scaling  Shearing  Composite transformation  Window to viewport transformations  Rotation about point  Reflection about a line |  |  | 5 | 4 Synchronous sessions for Lecture and  1 session for doubt clearance |
| **4.** | **UNIT-4:**  **3D Transformations**  Translation  Rotation  scaling  Instance  Rotation about an arbitrary axis in space  reflection through an arbitrary plane  polygon meshes |  |  | 4 | 3 Lectures on Blackboard Collaborate and 1 OFFLINE Session via Voice over PPt and Lecture Notes  Quiz 2 |
| **5.** | **UNIT-5:**  **Curves**  Curve Representation,  Non Parametric curves  Cubic Splines  Bezier Curves  B-spline curves  Rational B-spline curves  Curved surfaces  Quadric Surfaces  Bezier Surfaces  fractal – geometry |  |  | 6 | 4 Synchronous and 2 Asynchronous Lecture (Online Lectures over Blackboard Collaborate and Offline Content via Voice Over PPT and Lecture Notes) |
| **6.** | **UNIT-6:**  **Hidden Surfaces**  Techniques for Efficient VSD,  Depth comparison,  Z-buffer algorithm,  Back face detection,  \*BSP tree method,  \*The Printer’s algorithm,  Scan-line algorithm,  Hidden line elimination, Area sub division methods |  |  | 5 | 3 Synchronous and 2 Asynchronous Lecture (Online Lectures over Blackboard Collaborate and Offline Content via Voice Over PPT and Lecture Notes)  Test 2 |
| **7.** | **UNIT-7:**  **Color & Shading**  Transparency,  Shadows,  Constant – Intensity shading,  Gouraud Shading,  Phong shading,  Wireframe –visibility methods,  Recursive ray, tracing algorithm ,  Radiosity model |  |  | 4 | 3 Synchronous and 1 Asynchronous Lecture (Online Lectures over Blackboard Collaborate and Offline Content via Voice Over PPT and Lecture Notes) |

Synchronous Sessions: Lectures done through Blackboard Collaborate

Asynchronous Sessions: Lectures Content will be uploaded on Blackboard via Voice over PPt and

Handwritten Lecture Notes

Sessions: Total No. of Instructional periods available for the course

**SESSION PLAN**

**UNIT-I**

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| **Lecture No.** | **Topics to be Covered** | **CO Mapped** |
| 1 | Detailed Overview of the Course plan: Discussion on mode of delivery i.e. classroom  /blackboard.  Computer Graphics overview and its various applications | CO1 |
| 2 | Pixels, Raster and Random scan display, Frame buffers. | CO1 |
| 3 | CRT, Rasterization, Horizontal retrace and Vertical Retrace.  Introduction to various 3D APIs and Introduction to OpenGL. | CO1, CO2 |
| 4 | Discussion on various Libraries and its Programming syntax. OpenGL Rendering  Pipeline and Demo of OpenGL code. | CO1 |
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**SESSION PLAN**

**UNIT-II**

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| **Lecture No.** | **Topics to be Covered** | **CO Mapped** |
| 1 | Overview of point and lines, their equations:  Points & lines  Line drawing algorithms  DDA algorithm | CO2 |
| 2 | Bresenham’s line algorithm  Problems of Aliasing ,end point and clipping lines | CO2 |
| 3 | Circle generation algorithms  Ellipse generating algorithm | CO2 |
| 4 | Introduction to various polygon filling Techniques:  Scan Line | CO2 |
| 5 | Flood fill algorithm  Boundary fill algorithm  Introduction to Window and Viewport, Point clipping  Line clipping. | CO2, CO3 |
| 6 | Cohen Sutherland line clipping algorithm, with numerical | CO2 |
| 7 | Liang-Barsky line clipping algorithm with numerical and other doubts related to clipping | CO2 |
| 8 | Polygon clipping:  Sutherland –Hodgman algorithm  Weiler-Atherton Polygon clipping  Text clipping | CO2 |

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**SESSION PLAN**

**UNIT-III**

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| --- | --- | --- |
| **Lecture No.** | **Topics to be Covered** | **CO Mapped** |
| 1 | Homogenous coordinate system (HCS).  Translation  Rotation  Scaling | CO3 |
| 2 | Shearing  Composite transformation  Window to viewport transformations | CO3 , CO4 |
| 3 | Rotation about point.  Reflection about a line. | CO3 |
| 4 | Doubt clearing session on Composite transformations and Numerical. | CO3 , CO4 |
| 5 | Doubt Clearance Session/Pending Topics.  **Quiz 1 (Online)** | CO3 |
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**SESSION PLAN**

**UNIT-IV**

|  |  |  |
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| **Lecture No.** | **Topics to be Covered** | **CO Mapped** |
| 1 | 3D transformations:  Translation  Rotation  Scaling  Instance  MID SEM | CO3 , CO4 |
| 2 | Rotation about an arbitrary axis in space, with numerical | CO3 |
| 3 | Reflection through an arbitrary plane with numerical | CO3, CO4 |
| 4 | Polygon Meshes | CO3 |
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**SESSION PLAN**

**UNIT-V**

|  |  |  |
| --- | --- | --- |
| **Lecture No.** | **Topics to be Covered** | **CO Mapped** |
| 1 | Curve Representation(Introduction) :  Non Parametric curves, Conic sections, Cubic Splines | CO4 |
| 2 | Cubic Splines continued from Previous Lecture.  Conic Sections(2D-Curves) | CO4 , CO3 |
| 3 | B-Spline Curve | CO4, CO5 |
| 4 | Bezier Curves and its Properties. | CO4 |
| 5 | Bezier surfaces and Fractals | CO4 |
| 6 | Pending topics and Numerical on the Curves. | CO4 , CO5 |
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**SESSION PLAN**

**UNIT-VI**

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| **Lecture No.** | **Topics to be Covered** | **CO Mapped** |
| 1 | Techniques for Efficient VSD,  Depth comparison,  Z-buffer algorithm | CO5 |
| 2 | Back face detection, BSP tree method, | CO5 |
| 3 | The Painter’s algorithm,  Scan-line algorithm, | CO5 , CO4 |
| 4 | Hidden line elimination, Area sub division methods | CO5 |
| 5 | Pending topics in VSD: Numerical on VSD  Quiz 2 (Online) | CO5 |
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**SESSION PLAN**

**UNIT-VII**

|  |  |  |
| --- | --- | --- |
| **Lecture No.** | **Topics to be Covered** | **CO Mapped** |
| 1 | Transparency,  Shadows,  Constant – Intensity shading, | CO5, CO4 |
| 2 | Gouraud Shading,  Phong shading, | CO5 , CO4 |
| 3 | Wireframe –visibility methods  Recursive ray tracing algorithm  Radiosity model | CO5 |
| 4 | Class Test |  |
|  | **END SEM** |  |
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|  |  |  |