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UNIVERSITY OF PETROLEUM & ENERGY STUDIES

College of Engineering Studies

Dehradun

COURSE PLAN

Programme : B.Tech (CSE)

Course : Computer Graphics Lab

Subject Code : CSEG 3103

No. of credits : 1

Semester : V

Session : July 2021- December 2021

Batch :

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COURSE PLAN

A. **PREREQUISITE:**

a. Basic Knowledge of Mathematics like Matrix and Geometry.
b. Good knowledge of C and C++ for OpenGL.

B. PROGRAM OUTCOMES (POs) and PROGRAM SPECIFIC OUTCOMES (PSOs) for Computer Graphics :

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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.

Program Specific Outcomes (PSOs)

Computer Science Engineering with specialization in MAD/Devops Graduates will be able to:

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. Ability to understand and apply graphical tools and modeling algorithms to design games and animations.

C. COURSE OUTCOMES FOR COMPUTER GRAPHICS: At the end of this course student should be able to

On completion of this course, the students will be able to

CO1. Acquaint with OpenGL library and understand the graphics code structure with it
CO2. Apply primitive operations to create 2D and 3D objects and perform various operations on them
CO3. Carry out complex 2D and 3D transformations on objects and create curves of 2^{nd} and 3^{rd} degree
CO4. Explore and implement various hidden surface removal techniques.

Table: Correlation of POs and PSOs v/s COs

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	2	2	-	-	-	-	-	-	-	-	-	-	3
CO2	1	1	2	-	-	-	-	-	-	-	-	-	2	-	2
CO3	1	2	2	-	-	-	-	-	-	-	-	-	1	-	1
CO4	1	2	2	-	2	-	-	-	-	-	-	-	1	-	1

		Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual or team work	Communication	Project management and finance	Life-long Learning	Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques	Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms.	Ability to understand and apply graphical tools and modeling algorithms to design games and animations
Course Code	Course Title	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CSEG 3103	Computer Graphics	1	3	2	2	2				1				**2**		**3**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

D. OUTLINE OF PRACTICALS

Experiment 1: **Introduction to OpenGL**
Experiment 2: **Drawing line using DDA, Bresenham's algorithm**
Experiment 3: **Drawing Circle and Ellipse using Mid-point algorithm**
Experiment 4: **Filling the objects using flood fill, boundary fill and scan line fill algorithm.**
Experiment 5&6: **Performing Clipping operation on line and polygon using Cohen Sutherland and Sutherland Hodgeman algorithms respectively.**

Experiment 7&8:	**Performing 2D & 3D TRANSFORMATIONS on objects.**
Experiment 9:	**Drawing Bezier curves.**
Experiment 10:	**Animation & Event Handling using Mouse and Keyboard**
Experiment 11&12:	**Creating 3D Shapes like Cube, Sphere and others.**

E. PEDAGOGY

1. **Students need to maintain a practical file which will contain all the executed experiments; file should contain all the output of all experiments, students will be evaluated on the basis of that file.**
2. **Student should carry mini lab copy which contains discussion of teachers note or algorithms of the experiments which will be executed.**

F. COURSE COMPLETION PLAN

Total Lab sessions	12

One Session =120 minutes

G. EVALUATION & GRADING

Continuous Evaluation- The performance of a student in a Practical subject will be evaluated as per process given below:

1. Components of evaluation
   a. Viva voce / Quiz (50%) + Performance & Records (50%).
   b. Lab performance and record evaluation shall be a continuous process throughout the semester.
   c. Minimum three Viva voce/ Quiz based on practical sessions shall be conducted during the semester.
2. Distribution of marks for the lab sessions and the methodology should be conveyed to the students at the time of commencement of semester.
3. Final Grade Award Sheet needs to be submitted to SRE department before completion of End semester examination.

H. DETAILED LAB EXERCISE PLAN

Experiment 1: Introduction to OpenGL: [Virtual Lab Environment Setup]

- **What is OpenGL?**
- **What is GLU/GLUT?**
- **What is OpenGL Architecture?**
- **Setting up the environment.**
- **First OpenGL Program: This initializes a window of Green color.**

 # Discuss all the steps & functions in the program.

Experiment 2: Drawing a line [Usage of Open GL on Linux Environment for Virtual Environment]

- **Draw a line using equation of line Y=m*X+C.**
- **Draw a line using DDA algorithm for slope m<1 and m>1.**
- **Draw a line using Bresenham algorithm for slope m<1 and m>1.**

 # Take the input from user for all the three scenarios i.e. value of (x1, y1) and (x2, y2).

Experiment 3: Drawing a Circle and an Ellipse [Done on OpenGL Environment]

- **Draw the circle with the help of polar equations**
- **Draw the circle with the help of mid-point method.**
- **Draw the Ellipse with the mid-point method.**

 # Take the value of radius, major axis and minor axis as input from the user.

Experiment 4: Filling –Area [Small Project will be given for demonstration]

- **WAP to fill the polygon using scan lines.**
- **WAP to fill a region using boundary fill algorithm using 4 or 8 connected approaches.**
- **WAP to fill a region using flood fill algorithm using 4 or 8 connected approaches.**

 # Take the value of seed point, intensity of new color as input from user.

Experiment 5 & 6: Viewing and Clipping [Geographical Animation for demonstration]

- **Write an interactive program for line clipping using Cohen Sutherland line clipping algorithm.**
- **Write an interactive program for line clipping using Liang-Barsky line clipping algorithm.**
- **Write an interactive program for polygon clipping using Sutherland – Hodgeman polygon clipping algorithm.**

 # Take the window coordinates as input from the user, also take polygon coordinates as input.

Experiment 7 & 8: Basic Two3 & Three Dimensional Transformations

- **Write an interactive program for following basic transformation.**
- **Translation**
- **Rotation**
- **Scaling**
- **Reflection about axis.**
- **Reflection about a line Y=mX+c and aX+bY+c=0.**
- **Shear about an edge and about a vertex.**

 # Perform all the experiment for 3-D transformation.
 # Take the following values as input from user: Theta (angle of rotation),translation factor, scaling factor and other values. Make necessary assumptions.

Experiment 9: Drawing Bezier curves. [Virtual GLUT based demonstration]

- **Write a program to draw a cubic spline.**
- **WAP to draw a Bezier curve.**

 # Take necessary values as input from the user like degree of the Bezier curve.

Experiment 10: Animation & Event Handling using Mouse and Keyboard

- **WAP to implement following scenarios**
  - **Mouse Handling**
  - **Mouse Motion Handling**
  - **Keyboard Handling**
  - **Animation Using Mouse**

 # Take necessary values as input from the user like time, how long you want animation to run.

Experiment 11&12: Creating 3D Shapes like Cube, Sphere and others.

- **WAP to create various 3D objects:**
  - **CUBE**
  - **SPHERE**
  - **CONE**
  - **TEAPOT.**

#Make necessary assumption for creating the 3-D objects, you can use inbuilt functions to simplify the coding, lightning and shading effect should also be there.

Suggestive reads:

1. OpenGL: Programming Guide, the Official Guide to Learning OpenGL.

Authors: Dave Shreiner, John Kessenich, Bill Licea-Kane,The Khronos OpenGL ARB Working Group.

2. OpenGL Programming Guide Paperback – 2008

Author by Mason Woo (Author), Dave Shreiner (Author)

GUIDELINES

***Cell 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.

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.

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.

Course outcome assessment: To assess the fulfilment of course outcomes two different approaches have been decided. Degree of fulfillment of course outcomes will be assessed in different ways through direct assessment and indirect assessment. In Direct Assessment, it is measured through quizzes, tests, assignment, Mid-term and/or End-term examinations. It is suggested that each examination is designed in such a way that it can address one or two outcomes (depending upon the course completion). Indirect assessment is done through the student survey which needs to be designed by the faculty (sample format is given below) and it shall be conducted towards the end of course completion. The evaluation of the achievement of the Course Outcomes shall be done by analyzing the inputs received through Direct and Indirect Assessments and then corrective actions suggested for further improvement.

Passing criterion: Student has to secure minimum 30%/40% marks of the "highest marks in the class scored by a student in that subject (in that class/group class)" individually in both the 'End-Semester examination' and 'Total Marks' in order to pass in that paper.

- Passing Criterion for B. Tech: minimum 30% of the highest marks in the class
- Passing Criterion for M. Tech: minimum 40% of the highest marks in the class

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Sample format for Indirect Assessment of Course outcomes

NAME:
ENROLLMENT NO:
SAP ID:
COURSE:
PROGRAM:

Please rate the following aspects of course outcomes of computer graphics.

Use the scale 1-4*

Sl. No.		1	2	3	4
1	CO1 - Acquaint with OpenGL library and understand the graphics code structure with it				
2	CO2 - Apply primitive operations to create 2D and 3D objects and performing various operations on them				
3	CO3 - Carry out complex 2D and 3D transformations on objects and creating curves of 2nd and 3rd degree				
4	CO4 - Explore and implement various hidden surface removal techniques				
5	CO5 - Apply shading and colouring techniques on created 2D and 3D objects and also create 3D realistic imagery				

* 1 Below Average 3 Good

2 Average 4 Very Good