



**Bangladesh University of Business and Technology (BUBT)**  
**Faculty of Engineering & Applied Sciences (FEAS)**  
**Department of Computer Science and Engineering (CSE)**

**THEORY COURSE OUTLINE**

1	Program	B.Sc. Engg. in CSE											
2	Course Code	CSE 341											
3	Course Title	Computer Graphics											
4	Course Type	Core Course											
5	Academic Session	Spring 2021											
6	Credit Hour	3.0											
7	Intake	39											
8	Section	1											
9	Pre-requisites	CSE 231 Data Structures, MAT 111 Co-Ordinate Geometry and Vector Calculus											
10	Campus	Permanent Campus											
11	Course Teacher	Name: Sudipto Chaki		Designation: Lecturer									
		Specialization: Artificial Intelligence, Machine Learning, Image processing, Deep Learning, IoT, Software Engineering											
		Room No. 502/B3	Email: sudipto@bubt.edu.bd	Cell No. 01750742782									
12	Class Schedule	<table><tr><th>Class Day</th><th>Class Hours</th><th>Class Room</th></tr><tr><td>Sunday</td><td>11:30 AM – 1.00 PM</td><td>313 (B-1)</td></tr><tr><td>Thursday</td><td>11:30 AM – 1.00 PM</td><td>909 (B-2)</td></tr></table>			Class Day	Class Hours	Class Room	Sunday	11:30 AM – 1.00 PM	313 (B-1)	Thursday	11:30 AM – 1.00 PM	909 (B-2)
Class Day	Class Hours	Class Room											
Sunday	11:30 AM – 1.00 PM	313 (B-1)											
Thursday	11:30 AM – 1.00 PM	909 (B-2)											
13	Counselling Schedule	<table><tr><th>Class Day</th><th>Class Hours</th><th>Class Room</th></tr><tr><td>Sunday</td><td>1:00 PM – 2.20 PM</td><td>502(B-3)</td></tr><tr><td>Monday</td><td>11:30 AM – 1.00 PM</td><td>502(B-3)</td></tr></table>			Class Day	Class Hours	Class Room	Sunday	1:00 PM – 2.20 PM	502(B-3)	Monday	11:30 AM – 1.00 PM	502(B-3)
Class Day	Class Hours	Class Room											
Sunday	1:00 PM – 2.20 PM	502(B-3)											
Monday	11:30 AM – 1.00 PM	502(B-3)											
14	Course Objectives	The course introduces the fundamental concepts of computer graphics. In particular, the course will cover the basic concepts of vector and raster graphics, modern graphics hardware, applications of computer graphics. This course focuses on different computer graphics algorithms such as scan-conversion algorithms, clipping algorithms, transformation techniques, projection, illuminations and ray tracing, representation of curves and surfaces etc. and solve complex mathematical problems relating to these topics.											
15	Course Synopsis	Introduction to Computer Graphics, Image Representation, Display Devices, Basic Vector concepts, Vector Rotation and Reflection, Plane Representation and Intersection, Line and Circle drawing Algorithms, Antialiasing Effect, 2D and 3D Transformations, Composite Transformations and Matrix Representation, Mathematics of Projection, 2D and 3D Perspective Projection and Camera Positioning, Projection and Transformation, Representing Curves and Surfaces, Hermit, Bezier Curves, Line and Polygon Clipping, Visible Surface Determination, Scan Line Algorithm, Illumination Components, Phong											

		model and Adding Color, Texturing Effect, Shading Model, Ray Tracing, Triangle Intersection.																																																																
16	Text Book	1. Computer Graphics (Schaum’s Series) - Roy Plastock																																																																
17	Reference Book	1. Computer Graphics Using OpenGL - F.S. Hill 2. Computer Graphics Principles and Practice – James D. Foley																																																																
18	Course Outcomes (COs)	Upon completing this course students will be able to: <b>CO1: Understand</b> basic concepts of computer graphics and graphics related mathematics such as basic vector concepts, matrices, geometric modeling etc. <b>CO2: Explain</b> 2D & 3D graphical model by understanding of the theory of 2D and 3D transformations, projection, viewing and clipping. <b>CO3: Apply</b> different algorithms and mathematics to design different solution of geometric objects. <b>CO4: Analyze</b> different graphical algorithms, illumination and texturing.																																																																
	Mapping of COs to POs	<table><tr><td>CO</td><td>PO1</td><td>PO2</td><td>PO3</td><td>PO4</td><td>PO5</td><td>PO6</td><td>PO7</td><td>PO8</td><td>PO9</td><td>PO10</td><td>PO11</td><td>PO12</td></tr><tr><td>CO1</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO3</td><td></td><td></td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO4</td><td></td><td>√</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	CO1	√												CO2	√												CO3			√										CO4		√									
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12																																																						
CO1	√																																																																	
CO2	√																																																																	
CO3			√																																																															
CO4		√																																																																
<table><tr><th>CO No.</th><th>PO No.</th><th>Bloom’s Domain / Level</th><th>Delivery Methods / Activities</th><th>Assessment Tools</th></tr><tr><td>CO1</td><td>PO1</td><td>Cognitive / Understanding</td><td>Class Lecture</td><td>Midterm</td></tr><tr><td>CO2</td><td>PO1</td><td>Cognitive / Explaining</td><td>Class Lecture</td><td>Midterm and Final</td></tr><tr><td>CO3</td><td>PO3</td><td>Cognitive / Applying</td><td>Class Lecture</td><td>Midterm and Final</td></tr><tr><td>CO4</td><td>PO2</td><td>Cognitive/ Analyzing</td><td>Class Lecture</td><td>Final</td></tr></table>			CO No.	PO No.	Bloom’s Domain / Level	Delivery Methods / Activities	Assessment Tools	CO1	PO1	Cognitive / Understanding	Class Lecture	Midterm	CO2	PO1	Cognitive / Explaining	Class Lecture	Midterm and Final	CO3	PO3	Cognitive / Applying	Class Lecture	Midterm and Final	CO4	PO2	Cognitive/ Analyzing	Class Lecture	Final																																							
CO No.	PO No.	Bloom’s Domain / Level	Delivery Methods / Activities	Assessment Tools																																																														
CO1	PO1	Cognitive / Understanding	Class Lecture	Midterm																																																														
CO2	PO1	Cognitive / Explaining	Class Lecture	Midterm and Final																																																														
CO3	PO3	Cognitive / Applying	Class Lecture	Midterm and Final																																																														
CO4	PO2	Cognitive/ Analyzing	Class Lecture	Final																																																														
19	Teaching Strategy	Maximum topics will be covered from the textbook. For the rest of the topics, reference books will be followed. Some class notes will be uploaded on the web. White board will be used for most of the time. Multimedia projector and a PC will be used for the convenience of the students to understand algorithms and codes practically. Students must participate in classroom discussions for case studies, problems solving and project developments.																																																																

20	Assessment and Marks Distribution:					
		Class Participation		:	10%	
		Assignment/Presentation		:	10%	
		Class Test		:	10%	
		Midterm Examination		:	30%	
		Final Examination		:	40%	
21	Lecture Plan (Weekly Schedule)					
	Week	Lecture #	Selected Topics	Chapter #	COs	Assessment
	1	1	Overview of the course, General discussion about Computer Graphics. Image Representation Display devices	01, 02	CO1	Mid Term Exam  30
		2	Basic Vector concepts, Graphics Pipeline, Vector rotation and reflection Plane representation and intersection	01, 02	CO1	
	2	3	Line drawing: DDA algorithm	03	CO3	
		4	DDA Line drawing algorithm: mathematical problems	03	CO3	
	3	5	Line drawing: Mid-Point algorithm	03	CO3	
		6	Mid-Point Line drawing algorithm: mathematical problems	03 CT-1	CO3	
	4	7	Circle drawing: Mid-point algorithm	03	CO3	
		8	Mid-point Circle drawing algorithm: mathematical problems	03	CO3	
	5	9	Line clipping: Cohen–Sutherland algorithm	04	CO3	
		10	Line clipping: Cyrus Beck Algorithm	04	CO3	
	6	11	Polygon clipping: Sutherland–Hodgman	06	CO3	
		12	Region filling algorithms	06	CO3	
	7	13	Antialiasing effect	06	CO2	
		14	Review class for Midterm Examination: Fall 20-21			
	8	Midterm Examination				
9	15	Two dimensional transformations	07	CO2	Final Exam  40	
	16	Two dimensional composite transformations and matrix representation	07	CO2		

	10	17	Three dimensional transformations	07, 08 <b>CT-2</b>	CO2		
		18	Three dimensional composite transformations and matrix representation	07, 08	CO2		
	11	19	Projection basics, Mathematics of Projection,	15	CO2		
		20	Perspective projection and Camera positioning, Parallel projection and Camera positioning	15	CO3		
	12	21	Visible Surface Determination, Representing Surfaces, Raster Scan display system, Color model, conversion, Hermit, Bezier and Spline Curves	08	CO4		
		22	Illumination components: Light source, Different types of lights, Phong model and adding color	08	CO4		
	13	23	Solving Illumination related mathematical problems	08	CO3		
		24	Texturing effect & Shading model	12	CO4		
	14	25	Ray Tracing & solving Ray Tracing related mathematical problems	12	CO3		
		26	Final Exam Review Class				
	15	Final Exam					
22	Overall CO Assessment Criteria	Assessment methods of COs are given below:					
		Assessment Area	CO			Assessment Area Mark	
			CO1	CO2	CO3	CO4	
		Class Participation					
		Assignment/Presentation					
		Class Test					
		Midterm Exam	10	10	10		30
		Final Exam		10	15	15	40
		Total Marks	10	10	35	15	70

23	Rubrics	COs (Bloom’s Level)	Excellent (80%-100%)	Good (70%-79%)	Satisfactory (60%-69%)	Poor (40%-59%)	Unsatisfactory (0-39%)	Marks (70)																				
		CO1 (Understanding)	Answer is complete and sufficient detail provided to support issues related to the question.	Answer is brief with sufficient detail provided to support issues were introduced.	Answer is brief with insufficient detail provided to support issues were introduced.	Answer is incomplete and excessive discussion of unrelated issues.	None of the relevant details were included or didn’t answer.																					
		CO2 (Explaining)	Answer is complete and sufficient detail provided to support issues related to the question. And also deals fully with the entire question.	Answer is brief with sufficient detail provided to support issues were introduced. And most of the basic details are included but some are missing.	Answer is brief with insufficient detail provided to support issues were introduced.	Answer is incomplete and excessive discussion of unrelated issues.  And serious gaps in the basic details.	None of the relevant details were included or didn’t answer.																					
		CO3 (Applying)	The question is answered correctly by applying the suggested method in the question.	The question is answered briefly by applying the suggested method in the question	The question is answered by applying the suggested method in the question but some steps are missing.	The question is answered incompletely by applying the suggested method in the question but some steps are correct.	No attempt to implement the suggested method.																					
		CO4 (Analyzing)	A clear, complete, and properly ordered chain of analyzing steps is followed to answer the question.	The chain of analyzing steps is complete and correctly ordered.	One or more intermediate analyzing steps are missing or unclear, but the correctness of the analysis is not compromised.	One or more intermediate analyzing steps are missing or unclear to answer the question.	The stated chain of analysis does not lead to the stated question.																					
24	Grading Policy	The following chart will be followed for grading. This has been customized from the guideline provided by the School of Engineering and Computer Science. <table><tr><td>A+</td><td>A</td><td>A-</td><td>B+</td><td>B</td><td>B-</td><td>C+</td><td>C</td><td>D</td><td>F</td></tr><tr><td>≥ 80</td><td>75-&lt;80</td><td>70-&lt;75</td><td>65-&lt;70</td><td>60-&lt;65</td><td>55-&lt;60</td><td>50-&lt;55</td><td>45-&lt;50</td><td>40-&lt;45</td><td>&lt;40</td></tr></table>							A+	A	A-	B+	B	B-	C+	C	D	F	≥ 80	75-<80	70-<75	65-<70	60-<65	55-<60	50-<55	45-<50	40-<45	<40
A+	A	A-	B+	B	B-	C+	C	D	F																			
≥ 80	75-<80	70-<75	65-<70	60-<65	55-<60	50-<55	45-<50	40-<45	<40																			
25	Additional Course Policies	Assignments	There will be at least two assignments. Average marks of the assignments will be counted. No late homework will be accepted. <i>Any kind of copy/manipulation in assignment will carry zero mark.</i> Two or more copied assignments will carry zero mark in all assignments. <b>Zero tolerance will be shown in this regard.</b> Solutions to assignment problems will be provided through web and on hand.																									

		Class Test	There will be at least three class tests (CT).Best two of three or best three of four CTs will be counted. Both of regular and surprise CTs can be conducted.																								
		Exams	CT, Mid-term and final exam will be closed book, closed notes. Mobile phone is strictly prohibited in exam hall. Students are insisted to carry their own watch and synchronize time during exam hours.																								
		Test Policy	If a student is absent from class test anyway and made no report to the class teacher personally beforehand, his/her score for that test will be zero. No make-up for the class test will be allowed as 2 of 3 or 3 of 4 CTs are being considered. No make-up for Mid-exam will be entertained without physical presence and recommendation of the guardian along with written permission of the department. Make-up of Mid-exam may be much harder than the regular one.																								
26	Additional Information	a. Academic Calendar Spring 2021: <a href="http://www.bubt.edu.bd/academics/academic-calendar">http://www.bubt.edu.bd/academics/academic-calendar</a> . b. Academic Policies: <a href="http://www.bubt.edu.bd/academics/academic-rules-a-regulations">http://www.bubt.edu.bd/academics/academic-rules-a-regulations</a> . c. Grading & Evaluation: <a href="http://www.bubt.edu.bd/academics/academic-rules-a-regulations">http://www.bubt.edu.bd/academics/academic-rules-a-regulations</a> . d. Proctorial Rules: <a href="http://www.bubt.edu.bd/administrator/proctors-office">http://www.bubt.edu.bd/administrator/proctors-office</a> .																									
27	Bloom’s Taxonomy for Teaching-Learning																										
	<p>Bloom's Taxonomy is a set of three hierarchical models used to classify educational learning objectives into levels of complexity and specificity. The three lists cover the learning objectives in Cognitive, Affective and Psychomotor domains. The Cognitive domain list has been the primary focus of most education and is frequently used to structure curriculum learning objectives, assessments and activities. The three domains and respective levels are illustrated below.</p> <table><tr><th>Cognitive [C] (Knowledge-based)</th><th>Affective [A] (Emotion-based)</th><th>Psychomotor [P] (Action-based)</th></tr><tr><td>1. Remembering</td><td>1. Receiving</td><td>1. Imitating</td></tr><tr><td>2. Understanding</td><td>2. Responding</td><td>2. Manipulating</td></tr><tr><td>3. Applying</td><td>3. Valuing</td><td>3. Précising</td></tr><tr><td>4. Analyzing</td><td>4. Organizing</td><td>4. Articulating</td></tr><tr><td>5. Evaluating</td><td>5. Characterizing</td><td>5. Naturalizing</td></tr><tr><td>6. Creating</td><td>--- --- ---</td><td>--- --- ---</td></tr></table>						Cognitive [C] (Knowledge-based)	Affective [A] (Emotion-based)	Psychomotor [P] (Action-based)	1. Remembering	1. Receiving	1. Imitating	2. Understanding	2. Responding	2. Manipulating	3. Applying	3. Valuing	3. Précising	4. Analyzing	4. Organizing	4. Articulating	5. Evaluating	5. Characterizing	5. Naturalizing	6. Creating	--- --- ---	--- --- ---
Cognitive [C] (Knowledge-based)	Affective [A] (Emotion-based)	Psychomotor [P] (Action-based)																									
1. Remembering	1. Receiving	1. Imitating																									
2. Understanding	2. Responding	2. Manipulating																									
3. Applying	3. Valuing	3. Précising																									
4. Analyzing	4. Organizing	4. Articulating																									
5. Evaluating	5. Characterizing	5. Naturalizing																									
6. Creating	--- --- ---	--- --- ---																									
28	Descriptions of Cognitive Domain (Anderson and Krathwohl’s Taxonomy 2001): The <b>cognitive domain</b> involves the development of our mental skills and the acquisition of knowledge.																										
	Level	Category	Meaning	Keywords																							
	C1	Remembering	Recognizing or recalling knowledge from memory. Remembering is when memory is used to produce or retrieve definitions, facts, or lists, or to recite previously learned information.	Define, describe, draw, find, identify, label, list, match, name, quote, recall, recite, tell, write																							
	C2	Understanding	Constructing meaning from different types of functions be they written or graphic messages or activities like interpreting, exemplifying, classifying, summarizing, inferring, comparing, or explaining.	Classify, compare, exemplify, conclude, demonstrate, discuss, explain, identify, illustrate, interpret, paraphrase, predict, report																							

	C3	Applying	Carrying out or using a procedure through executing, or implementing. Applying relates to or refers to situations where learned material is used through products like models, presentations, interviews or simulations.	Apply, change, choose, compute, dramatize, implement, interview, prepare, produce, role play, select, show, transfer, use
	C4	Analyzing	Breaking materials or concepts into parts, determining how the parts relate to one another or how they interrelate, or how the parts relate to an overall structure or purpose. Mental actions included in this function are differentiating, organizing, and attributing, as well as being able to distinguish between the components or parts. When one is analyzing, he/she can illustrate this mental function by creating spreadsheets, surveys, charts, or diagrams, or graphic representations.	Analyze, characterize, classify, compare, contrast, debate, deconstruct, deduce, differentiate, discriminate, distinguish, examine, organize, outline, relate, research, separate, structure
	C5	Evaluating	Making judgments based on criteria and standards through checking and critiquing. Critiques, recommendations, and reports are some of the products that can be created to demonstrate the processes of evaluation.	Appraise, argue, assess, choose, conclude, critique, decide, evaluate, judge, justify, predict, prioritize, prove, rank, rate, select, Monitor
	C6	Creating	Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing. Creating requires users to put parts together in a new way, or synthesize parts into something new and different creating a new form or product. This process is the most difficult mental function.	Construct, design, develop, generate, hypothesize, invent, plan, produce, compose, create, make, perform, plan, produce

<b>29</b>	<b>Graduate Attributes (Program Outcomes) for B.Sc. in Engineering Program based on Washington Accord</b>
-----------	---

	<p>Program Outcomes (POs) are narrower statements that describe what students are expected to know and be able to do by the Time of graduation. These relate to the knowledge skills and attitudes that students acquire while progressing through the program. The students of the B.Sc. in EEE program are expected to achieve the following graduate attributes or program outcomes at the time of graduation.</p> <p><b>PO1–Engineering knowledge (Cognitive):</b> Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.</p> <p><b>PO2–Problem analysis (Cognitive):</b> Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.</p> <p><b>PO3–Design/development of solutions (Cognitive, Affective):</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.</p> <p><b>PO4–Investigation (Cognitive, Psychomotor):</b> Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.</p> <p><b>PO5–Modern tool usage (Psychomotor, Cognitive):</b> 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.</p> <p><b>PO6–The engineer and society (Affective):</b> Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.</p> <p><b>PO7–Environment and sustainability (Affective, Cognitive):</b> Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.</p> <p><b>PO8–Ethics (Affective):</b> Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.</p> <p><b>PO9–Individual work and teamwork (Psychomotor, Affective):</b> Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.</p> <p><b>PO10–Communication (Psychomotor, Affective):</b> Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.</p>
--	---

	<p><b>PO11–Project management and finance (Cognitive, Psychomotor):</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work as a member or a leader of a team to manage projects in multidisciplinary environments.</p> <p><b>PO12–Life-long learning (Affective, Psychomotor):</b> Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.</p>		
<b>30</b>	<b>Social &amp; Moral Capital</b>		
	<p>Our promises are based on the three cardinal principles:            (a) What we do believe (b) What we do practice, and (c) What we will promote</p> <p>However, students are advised to undertake the following commitments for moral development.</p>		
	<ol style="list-style-type: none"> <li>1. To be punctual and attentive in class</li> <li>2. To maintain inclusive learning environment</li> <li>3. To ensure mutual respect</li> <li>4. To be cooperative in group learning.</li> <li>5. To be innovative and Creative</li> <li>6. To follow dress code and wearing ID card</li> <li>7. To be always proactive</li> </ol>	<ol style="list-style-type: none"> <li>8. Try to follow and review day to day class</li> <li>9. To avoid conspiracy</li> <li>10. To prioritize honesty &amp; faith</li> <li>11. To be motivated for asking question and encourage feedback</li> <li>12. To develop attitude for speaking in English</li> <li>13. Do not ignore to carry out any assignments or commitments</li> <li>14. To be clean and decent in all levels.</li> </ol>	<ol style="list-style-type: none"> <li>15. To be sincere for class preparation</li> <li>16. Do not forget to switch-off the cell phone in class</li> <li>17. Do not forget to carry course pack and learning stuffs in class</li> <li>18. To maintain loyalty and trust to the university</li> <li>19. Must avoid unfair means and plagiarism in exam, reports and assignments</li> <li>20. Must maintain eco-friendly environment in the campus.</li> </ol>

Prepared by:

Checked by:

Approved by: