	DEPARTMENT OF ELECTRICAL, ELECTRONIC, AND COMPUTER ENGINEERING	Revision History	
Cape Peninsula University of Technology **Faculty of Engineering and the Built Environment** **2024**		**Revision:**	**00**
		Approved Date:	
		Approved By	
		Programme Coordinator:	
		Signature	
	SUBJECT GUIDE Computer Graphics 2: CGD260S	**HOD: Dr. Marco Adonis**	
		Signature	

QUALIFICATION INFORMATION	
QUALIFICATION TYPE:	Bachelor of Engineering Technology in Computer Engineering
SAQA CODE:	EEBSD100
SAQA CREDITS:	14
NQF LEVEL (EXIT):	6
SUBJECT GUIDE	
SUBJECT NAME:	Computer Graphics 2
SUBJECT CODE:	CGD260S
IMPLEMENTATION:	January 2020
SEMESTER OR YEAR COURSE:	Semester
LEVEL OF SUBJECT WITHIN PROGRAMME:	2nd
DURATION:	Semester
COURSE LINKAGE/S	
QUALIFICATION LINKAGE/S:	
PROGRAM-LEVEL LINKAGE/S:	
PRE-REQUISITE SUBJECT/S:	SDN150S
C0- REQUISITE SUBJECTS:	None
RECOGNITION AND EXEMPTION:	Yes
COMPULSORY OR ELECTIVE SUBJECT:	Compulsory
MAJOR SUBJECT:	Yes
ORGANISATIONAL COMPONENT	
INTRODUCTION	
WORD OF WELCOME:	Welcome to Computer Graphics 2. This course is about rendering two- and three-dimensional graphics on computer screens using open graphics language application programming interface. The programs written will be computed directly on the graphics processing unit. HTML5 canvas is used to get a graphics programmable context whose user interface is written in JavaScript. The vertex and fragment shaders that constitute the graphics program are written in a C like language.
SIGNIFICANCE OF THE SUBJECT:	To solve broadly defined engineering problems, one often needs to simulate in the place of building the physical system. This course equips the students to build interactive 3D models and simulate their movement. Computer Games and movie animations are also created using these.
GENERAL	

CONTACT INFORMATION

	Name	Building/Room	Telephone	e-mail address	Consulting Hours
LECTURER/EXAMINER:	Mr. MT Adonis		0721239050	AdonisMT@cput.ac.za	
INTERNAL MODERATOR:	Mr. V. Moyo		021 959 5655	MoyoV@cput.ac.za	
EXTERNAL MODERATOR:					
COURSE COORDINATOR:	Dr. Z.T. Nkosi		021 959 4375	NkosiZ@cput.ac.za	
HEAD OF DEPARTMENT:	Dr. Marco Adonis		021 959 6488	AdonisMa@cput.ac.za	
DEPARTMENT SECRETARY:	Ms. A. Leo		021 959 6911	LeoA@cput.ac.za	

TIMETABLE

FOR OFFICIAL SUBJECT TIMETABLE REFER TO: DEPARTMENTAL NOTICEBOARD & WebCT

LENGTH OF COURSE

DURATION IN WEEKS	**15 Weeks**

METHOD	Week Number	CONTACT HOURS				
		Monday	Tuesday	Wednesday	Thursday	Friday
Formal Lecturers	15				4 hours	
Tutorials	15				0.5 hours	
Practical Work						
Industrial Visits						
TOTAL						

NOTE:
1. **ATTENDANCE POLICY RULE: 80% attendance. Medical certificate to be produced if absent from tests and assessments.**

NOTIONAL HOURS

Time Units (hours) and Total Contact (hours)											Credits
Lecture (L)	TL=	Tutorial (T)	TT=	Practical (P)	TP =	Other (X)	TX=	Assignment (A)	Assessment (E)		
64	0.75	5	1.00	0	0	0	0	8	9		14.1

METHOD	NOTIONAL HOURS
FORMAL LECTURES	**96**
TUTORIALS	**10**
ASSIGNMENTS	**8**
ASSESSMENT	**27**
TOTAL	**141**

COURSEWARE

COMPULSORY COURSE TEXTBOOK/S:	Angel, E. and Shreiner, D. (2015). Interactive computer graphics: A Top-down Approach with OpenGL. 7th ed. Boston, Mass.: Addison-Wesley.
RECOMMENDED BOOK/S:	Slater, M., Steed, A. and Chrysanthou, Y. (2002). Computer graphics and virtual environments. Harlow, England: Addison Wesley.
RECOMMENDED READINGS:	
LEARNER MANAGEMENT SYSTEM:	Blackboard (myclassroom.cput.ac.za)

COURSE SOFTWARE:	VS Code and any web server (mostly Live Server)
ADDITIONAL WEBSITE/S:	https://developer.mozilla.org/en-US/docs/Web/API/WebGL_API
OTHER MATERIALS:	
SUBJECT NOTICE BOARD LOCATION:	Blackboard (myclassroom.cput.ac.za)

STUDY COMPONENT

SUBJECT OBJECTIVES

On successful completion of this subject, the learner will be able to:

For the lecture component of this subject the student will be able to:
1. Analyse a design using UML, develop algorithms, implement the solution and test it.
2. Explain the operation of software applications, document their software appropriately and provide aesthetically pleasing graphical user interfaces.

For the design project component, the student will be able to:
1. Integrate and apply knowledge learnt to solve engineering problems.
2. Design engineering solutions using recognized standard methods.
3. Plan and execute an engineering project.
4. Communicate

LEARNING OBJECTIVES

Primary learning objective:
1. Describe and explain the basic principles, techniques and algorithms of computer graphics.
2. Implement some basic graphics techniques using a graphics system.
3. Implement a practical animation and multimedia project in a team.

SPECIFIC OUTCOMES	SUB-OUTCOMES	Graduate Attributes
Create user friendly HTML 5 document with a canvas	As part of an assessment HTML must be used to create an HTML 5 canvas	
Design all necessary controls to interact with user in HTML and CSS	As part of an assessment add cascading style sheet describing the layout of the HTML page. Add required buttons and drop-down menus	
Implement logic to deal with user interaction in JavaScript.	An assessment using JavaScript to obtain WebGL context from the HTML canvas, and adding event listeners to deal with user input	
Conceptualize x, y, z geographical vertex positions in 3D canvas clip space	Tutorial drawing 3D clip space. In the clip space draw basic object. Determine how the object can be drawn using primitives (lines, points or triangles). Determine 3D vertex co-ordinates of the primitives that make up the object.	
Translate mathematical matrix multiplication into JavaScript functions with inputs and outputs	Assignment deriving formula to rotate along z-axis. Use this formula to derive a 4x4 rotation matrix used to multiply homogenous co-ordinates of a vector. Write JavaScript implementation of the rotation matrix	
Create matrix models that represent the objects	Assessment creating more that one object on the scene using matrix models. Each object starting as an identity matrix, and manipulated to appear drawn at a different place	
Transform the models in the clip space (rotate, scale, translate/move)	Assessment doing object transformations only using matrices to manipulate each object model. This includes rotation, scaling and translation of each object	
Map image data as Textures of the models	Tutorial mapping a given texture whose dimensions are not powers of two to a triangle. Assessment mapping a given texture whose dimensions are powers of two to a cube using generated mipmaps.	

Graduate Attribute Assessed					
None					
ASSESSMENT					
ASSESSMENT SPECIFICATIONS*					
ASSESSMENT NUMBER	ASSESSMENT TYPE	ASSESSMENT DATE	ASSESSMENT ELEMENTS		MAXIMUM MARK
ASSESSMENT 1:	Class Test	13 March	2D Graphics, Shaders, movements		10%
ASSESSMENT 2	Class Test	03 April	3D Graphics with matrices		15%
ASSESSMENT 3:	Class Test	08 May	Matrices, projection, multiple objects		20%
ASSESSMENT 4:	Project	15 May	Planning, documenting and the above		5%
ASSESSMENT 5:	FISA	June	Summative assessment of all elements		50%

* Assessment Criteria are given in individual assignment/project briefs location						
ASSESSMENT ADMINISTRATION						
	T1	T2	T3	T4	T5	
DESCRIPTION:	Class test 1	Class test 2	Class Test 3	Group Project	FISA	
TERM:						
WEIGHT IN %:	10%	15%	20%	5%	50%	
MODERATION SELECTION:	No	No	No	No	Yes	

ASSESSMENT OUTLINE
ASSESSMENT 1:
2D Graphics, Shaders, movements
ASSESSMENT 2:
3D Graphics with matrices
ASSESSMENT 3:
Matrices, projection, multiple objects
ASSESSMENT 4:
Planning, documenting and the above
ASSESSMENT 5:
Summative assessment of all elements

ASSESSMENT POLICY

➢ All assessments are compulsory and must be completed.

➢ Assessment type: formative, summative continuous assessment.

➢ Copying is prohibited, assignments must be submitted as student's own work.

➢ Assignments and the project must be completed and submitted on time.

➢ Minimum of 50% overall is required to pass the module.

➢ 75% and above overall is a distinction pass

Students are encouraged to refer to the university Hand book for more information.

Assessment of Graduate Attributes

Where is the outcome assessed?

Formative Assessments

These consist of guided theory tutorials and laboratory practical exercises that are designed to assist the student to measure their learning progress and understanding of the study material.

Summative Assessments (Continuous Evaluations)

Two written class tests spaced over the duration of the course will be conducted under examination conditions. At the end of the course, a final written integrated summative assessment (FISA) will be conducted under examination conditions. The purpose of these assessments is to ascertain whether the student has achieved the specific outcomes as listed above.

Practical assessments, evenly spaced over the duration of the course, will be conducted. The practical assessments are conducted in the laboratory and will assess whether the student can apply in practice what they have learnt in both the theoretical and practical components of the course.

A written report on an industry and subject relevant self-study assignment is required.

- Assessments will be done as specified in assessment specifications below.

- Evidence of competency in assessments will be done in all summative assessments (Class tests & Final Test) and selective formative assessments.

How is the outcome assessed?

- Carefully crafted questions are asked in line with the aforementioned graduate attributes.

- Problem-based questions are asked in which students must demonstrate astuteness in defining, formulating, analyzing, interpreting, presenting and drawing meaningful and logical conclusions.

What constitutes satisfactory performance?

- A 50% or more overall mark having passed the subminimum in column T3 as indicated in the table.
- Minimum required to pass   =   50% overall (for module)
- Distinction   =   75% overall (for module)
- It is mandatory that students achieve satisfactory performance (achieve ≥50% for all the assessment criteria assessed.

What strategy(ies) should be followed should the outcome be not satisfactorily attained?

- A second chance is given to both performance and competency related assessments. For performance related assessments, the only chance will be in the final summative assessment having scored between 45% to 48% while for competency related assessments a second chance is afforded through a summative assessment when the subminimum requirements are not met even for a pass mark.

RULES AND RESPONSIBILITIES

1. *Minimum attendance/participation rate.*
   a. All students are required to maintain a *minimum attendance/participation rate of 80%*.
   b. Applies to *all* subjects offered in DEECE.
   c. Applies to *all* qualifications offered in DEECE.
   d. Any student that fails to maintain the minimum attendance rate of 80% *prior to an assessment* **may be disqualified from such assessment.**
      i. The implication is not retroactive. i.e. forfeited assessments cannot be returned to at a later stage.
      ii. This applies to all assessments and includes, e.g. written, practical, project, etc.

2. *Student contact sessions.*
   a. All subject contact sessions (e.g. lectures, practicals, assessments, etc.) will *only be conducted on*

campus, face-to-face (i.e. in-person).

    b. Students access supplementary learning materials via Myclassroom/Blackboard.

3. ***CPUT rules and regulations***
    a. Students should carefully read the CPUT rules handbook.
    b. All lecturers will provide a copy of the handbook on Myclassroom/Blackboard subject folders.
    c. The latest version of the rules should be adhered to.
    d. ***Ignorance of the rules does not absolve students from its enforcement.***

4. ***Submission of official documents as evidence***
    a. Submit only the original hardcopy official documents.
    b. Submit your documents (e.g. medical certificates, etc.) as evidence of missing an assessment or contact session.
    c. Submit your documents to the secretary, Ms Amy Leo, (2nd floor, new building; office phone number: 021 959 4370; email: leoa@cput.ac.za).
    d. Clearly provide the following details to the secretary: student full name; student number; affected subject name and subject code; lecturer's name; registered qualification name.
    e. **Submit hardcopy documents no later than 7 days after the scheduled day of the assessment or contact session (as per CPUT rules & regulation handbook).**
    f. Students can collect their original documents 14 days after submission to the department.
    g. Students are reminded that the authenticity of all submitted documents will be verified by the department.

REFER TO BLACK BOOK

It is of paramount importance that classes are attended regularly and promptly – progress / homework assignments will be checked regularly. Practical competence on activities (covering all the assessment criteria listed above) is assessed. Satisfactory Graduate Attribute performance must be achieved as indicated above.

SUBMISSION DATE: All submissions must be submitted by the due date. No excuses will be tolerated. A "0" (zero) will be awarded for any late submission. (In the workplace engineers must be able to execute tasks and complete projects on time).

PRACTICALS		
TOPIC	**PRACTICAL NAME**	**RELATED THEORY AND TECHNIQUES REQUIRED**
No practical	No practical	No practical

INDUSTRY VISITS
Related companies to be identified

REGISTRATION DEADLINES
Students who cancel their studies/subjects may be allowed credit according to the following table

SEMESTER 1 :COURSES and MODULARIZED SUBJECTS

REDUCTION IN FEES	DATES
100%	Please refer to institutional and faculty dates
50%	Please refer to institutional and faculty dates
0%	Please refer to institutional and faculty dates

SUBJECT STRUCTURE		
SYLLABUS AND SCHEDULE		
Year **TERM 1** **[31st January 2024 to 13th March 2024]**		
WEEKS	**TOPIC**	**DATE**
1	Introduction to 2D and 3D and translating basic objects in canvas	31-Jan
2	Rotating objects in vertex shader using trigonometry	07-Feb
3	Drawing objects using different primitives (triangles, lines, points…)	14-Feb
4	Adding colour to objects	21-Feb
5	Using multiple buffers	28-Feb
6	Object translation and scaling	06-Mar
7	Assessment 1	13-Mar
	FIRST TERM BREAK	
7	Object rotation	27-Mar
8	Assessment 2	03-Apr
9	Creating matrices and matrix multiplication functions	10-Apr
10	Creating matrix models	17-Apr
11	Drawing multiple objects using matrix models	24-Apr
12	Drawing multiple objects using multiple shader programs	01-May
13	Assessment 3	08-May
14	Texture and mipmaps (Project hand in)	15-May
	SECOND TERM BREAK	

WORK INTEGRATED LEARNING	
WORK-DIRECTED THEORETICAL LEARNING	**Through lectures and demonstrations**
PROBLEM-BASED LEARNING	**Solving problems emanating from different topics**
PROJECT-BASED LEARNING	**Report assignment that covers selected topics**
WORKPLACE LEARNING	

SERVICE LEARNING PROJECTS

GRADUATE ATTRIBUTES

Graduate Attributes	Developed through:
1. Problem solving 2. Application of scientific and engineering knowledge 3. Engineering design 4. Investigations, experiments and data analysis 5. Engineering methods, skills and tools, including Information Technology 6. Professional and technical communication 7. Sustainability and impact of Engineering Activity 8. Individual, Team and Multidisciplinary Working 9. Independent Learning Ability 10. Engineering Professionalism	4. Deriving various matrices needed for translations, scaling, rotations, orthographic projection and perspective projection. Writing an implementation of each of these. Comparing these implementations with well-known implementations by others. 7. Using JavaScript to develop 3D models that replace physical models at a fraction of the time and cost.

STUDENT SUPPORT

SUPPORT PROGRAMMES AT THE UNIVERSITY
THE GRIEVANCE PROCESS

ADDITIONAL NOTES

1. **This document is subject to revision.**
2. **Subject Guide is electronically available on the Learner Management System.**