NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY
Faculty of Computing and Informatics
School of Computing
Department of Software Engineering

13 Jackson Kaujeua Street
Private Bag 13388
Windhoek
NAMIBIA

T: +264 61 207 2052
F: +264 61 207 9052
E: dse@nust.na
W: www.nust.na

Compiler Techniques (CTE711S) Course Outline

Effective Start Date: ***10 February 2025***

STATEMENT ABOUT ACADEMIC HONESTY AND INTEGRITY

All staff and students of the Namibia University of Science and Technology (NUST), upon signing their employment contracts and registration forms, commit themselves to abide by the policies and rules of the institution. The core activity of NUST is learning and in this respect academic honesty and integrity is very important to ensure that learning is valid, reliable and credible.

NUST therefore does not condone any form of academic dishonesty, including plagiarism and cheating on tests and assessments, amongst other such practices. NUST requires students to always do their own assignments and to produce their own academic work, unless given a group assignment.

Academic Dishonesty includes, but is not limited to:

- Using the ideas, words, works or inventions of someone else as if it is your own work.
- Using the direct words of someone else without quotation marks, even if it is referenced.
- Copying from writings (books, articles, webpages, other students' assignments, etc.), published or unpublished, without referencing.
- Syndication of a piece of work, all or part of an assignment, by a group of students, unless the assignment was a legitimate group assignment.
- The borrowing and use of another person's assignment, with or without their knowledge or permission.
- Infringing copyright, including documents copied or cut and pasted from the internet.
- Asking someone else to prepare an assignment for you or to write or sit an assessment for you, whether this is against payment or not.
- Re-submitting work done already for another course or programme as new work, so-called self-plagiarism.
- Bringing notes into an examination or test venue, regardless of whether the notes were used to copy or not.
- Receiving any outside assistance in any form or shape during an examination or test.

All forms of academic dishonesty are viewed as misconduct under NUST Student Rules and Regulations. Students who make themselves guilty of academic dishonesty will be brought before a Disciplinary Committee and may be suspended from studying for a certain time or may be expelled. All students who are found guilty of academic dishonesty shall have an appropriate endorsement on their academic record, which will never be erased.

COURSE INFORMATION

COURSE CODE AND TITLE:	CTE711S – Compiler Techniques
DEPARTMENT:	Software Engineering
PROGRAMMES:	07BACS, Bachelor of Computer Science 07BCCS, Bachelor of Computer Science in Cyber Security
NATIONAL HOURS:	120 hours: (Contact: 45 hours; Directed Self-learning and Self-directed Learning: 55 hours; Assessment: 20 hours)
NQF LEVEL AND CREDIT:	NQF Level 7, 12 Credits
SEMESTER OFFERED:	5
PRE-REQUISITES:	Programming 2
COURSE EQUIVALENCIES:	None
COURSE AIMS:	This course aims to introduce students to the principles behind language design and compiler techniques. The course further gives emphasis on grammar definition, lexical analysis, syntax analysis, Abstract Syntax Tree (AST), semantics analysis, code generation and optimization.

Course Delivery Method:
The course will be facilitated through face-to-face lectures, classroom presentations, classroom and online discussions, case studies, theory and practical demonstrations, self-guided learning, student presentations, assignments and exercises.

Lectures - this will present the foundation theories of the course. Students will deepen their knowledge and understanding of the covered subjects through guided self-study.

Laboratory activities – this will be an avenue for the students to try out and acquire practical skills of theoretical knowledge gained. Laboratory materials will be prepared with clear indication of what the student is expected to achieve, problem statement and guidelines on how to approach the problem.

Course Format:

- 45 hours of face –to-face
- 55 hours Directed self-learning and Self-Directed learning:
    - out-of-class study time,
    - reading prescribed material,
    - organisational overhead,
    - organising and conducting team meetings,
    - consultations with the lecturer and fellow students,
    - collecting prescribed material
- 20 hours of preparation for quizzes, tests and examination (an average of 2.7hrs weekly)

Student Support and Learning Resources:

There are several facilities that students can use as a course resource at NUST and home.

a) **NUST Level:** The main library, Department of Student Services, Writing centre and student academic problems - Teaching & Learning Unit (TLU), Campus Health and Wellness Centre (CHWC) - NUST Clinic.

b) **Faculty Level:** Faculty-based induction, learning support units, and tutor systems, computer laboratories. Lecturers are available for consultation and the hours are shown on their doors. Emails can be sent to the lecturers as well.

c) **Course Level:** Course Outline; Electronic learning resources in the course folder on IsNotes; Microsoft Teams; E-learning materials will be developed. Make use of the MyNUST eLearning platform as the learning management application.

Quality Assurance:

Moderation of assessments will be done in accordance with NUST's general rules and guidelines on moderation.

Lecturer Information

Lecturer's name: Prof Ambrose Azeta (*Course Coordinator*)

Email: aazeta@nust.na

Office phone: +264 813643798

Office location: IT House, Room 14 Office

Hours: 08H00 AM – 16H30 PM

Consultation hours: By appointment via e-mail. Course Coordinator and Practical instructor's office hours will be posted on E-Learning or on their office doors. When there are many students waiting to ask questions, a time limit of 10 minutes per student will be used. Students should come to office hours with clear and well-organized questions to avoid wasting time.

Student Readiness

Technology & Equipment Readiness:
This course will only utilize already existing NUST equipment.

Student Commitments and Contact Times:

a) **Class Attendance:** Attend all classes, and be on time, and make appropriate notes. If a student fails to attend a class, it is their responsibility to catch-up on what was covered. The students have access to the recommended books from the library. If any special presentations are used in class, it will be made available and do not need to be copied by the student.

b) **Self-Directed Study:** After every class, and before the start of the next class, sort, complete, and annotate own lecture notes, and select further reading in case any particular item was not understood on the first attempt. A student must spend their notational hours revising, practicing or/and completing homework for the course. A student should take the reading list (prescribed and recommended reading seriously. Read all prescribed material to the extent that the student could write a one-page essay, summarising the content, without looking at the material again.

c) **Communications:** Maintain active communication with your group lecturer. Students are expected to use established channels of communication and platform to solve course-related issues on time. The end of the semester is not the best time to fix issues. Use the available time to deal with matters at hand.

Prescribed Textbook:

- Aho, A., Lam, M., Sethi, R. & Ullman, J. (2013). Compilers: principles, techniques, and tools: International Edition. Harlow, Essex: Pearson. ISBN-10: 9781292024349

Recommended Reading:

- Cooper, K., & Torczon, L. (2011). *Engineering a compiler* (2nd ed.). Morgan Kaufmann. ISBN-10: 012088478X.
- Sebesta, R.W. (2016). *Concepts of programming languages* (11th ed.). Pearson. ISBN-13: 978-1-292-10055-5

Specific Learning Outcomes:

Upon completion of the course students will, through assessment activities, show evidence of their ability to:

- Analyse the principles of language design;
- Demonstrate knowledge of program compilation and interpretation;
- Design and implement a simple compiler.

Comprehensive Learning Outcome:
Evaluate appropriate techniques for program compilation and interpretation.

Course Schedule: The following are the key knowledge areas and each knowledge area has sub-knowledge units:

WEEK #	WEEK DATES	TOPICS	Activities: Discussion Forums, Reading Materials and Assessments
Week 1	**10 – 14 FEB 2025**	**Introduction to course** a) Course outline and Schedule b) Learning platforms c) Why study Compiler Techniques d) Introduction to Compilers and Language Processing system	- Final registration - Groupings and intro to practical session - MS Teams Overview - Self Enrollment to E-learning -Set up the tone for the course, and outline expectations based on the learning outcomes.
Week 2	**17 – 21 FEB 2025**	**Grammar Definition** a) Structure of a Compiler b) Phases of a Compiler c) Definition of Grammars d) Context-Free Grammars and Languages e) A review of how to use Virtual Programming Lab (VPL)	-Description of a Grammar (with examples) -In-Class Exercises -Labs **Distribution of Group Assignment**
Week 3	**24 – 28 FEB 2025**	**Grammar Definition** a) Structure of a Compiler b) Phases of a Compiler c) Definition of Grammars d) Context-Free Grammars and Languages	-Description of a Grammar (with examples) -In-Class Exercises -Labs
Week 4	**3 – 7 MAR 2025**	**Scanning and Parsing** a) Lexical Analysis (Scanner) b) Syntax Analysis (Parser) c) Ambiguity and operator precedence	-Demonstration(s) of Scanning. -Parsing -Practicals/Guided exercise(s) -Labs
Week 5	**10 – 14 MAR 2025**	**Scanning and Parsing** a) Lexical analysis (Scanner) b) Syntax Analysis (Parser) c) Ambiguity and operator precedence d) Finite Automata (FA) e) Deterministic Finite Automata (DFA) f) Non-Deterministic Finite Automata (NFA)	-Demonstration(s) of Scanning. -Parsing -Practicals/Guided exercise(s) on FA, DFA and NFA -Labs **Test 1**
Week 6	**17 – 21 MAR 2025**	**Abstract Syntax Tree (AST)** a) What are AST? b) Building the AST Example c) Parsing and Parse Trees d) Recursion	-Creation of an AST -Practicals/Guided exercise(s) -Labs
Week 7	**24 – 28 MAR 2025**	**Abstract Syntax Tree (AST)** a) What are AST? b) Building the AST Example c) Parsing and Parse Trees d) Recursion	-Creation of an AST - Practicals/Guided exercise(s) -Labs

Week 8	**31 MAR – 4 APR 2025**	**SEMESTER BREAK**	
Week 9	**7 – 11 APR 2025**	**Semantic Analysis** a) What is Semantic Analysis b) Semantic Analyzer c) The Symbol Table	-Description of Semantic Analysis. -The Semantic Analysis example -Labs
Week 10	**14 – 18 APR 2025**	**Semantic Analysis** d) What is Semantic Analysis e) Semantic Analyzer f) The Symbol Table	-Description of Semantic Analysis. -The Semantic Analysis example -Labs
Week 11	**21 – 25 APR 2025**	**Semantic Analysis** a) What is Semantic Analysis b) Semantic Analyzer c) The Symbol Table	-Description of Semantic Analysis. -The Semantic Analysis example -Labs
Week 12	**28 APR – 2 MAY 2025**	**Code Generation and Optimization** a) Intermediate code generation b) Code optimization c) Machine independent optimization	-Design of Code generation and optimization techniques. -Labs **Test 2**
Week 13	**5 – 9 MAY 2025**	**Program Interpretation** a) Source level Interpretation b) Intermediate level interpretation c) Target code interpretation	-Description of sample program Interpretation. -Practicals/Guided exercise(s) **Presentation of Group Assignments**
Week 14	**12 – 16 MAY 2025**	**LLVM Compiler Infrastructure (REVISION)**	**Supplementary**
Week 15	**19 – 23 MAY 2025**	**Consolidation of marks**	

Important Dates

NOTE: The dates are subject to change based on the needs of the students at the lecturer's prerogative. Students will be notified ahead of time of any changes.

Sn	Assessments	Date	Week
1	Distribution of Group Assignment	21 February 2025	2
2	Individual Assignments (Practical Labs)	Weekly	Starting from week 2
3	Test 1	10 March 2025	5
4	Test 2	28 April 2025	12
5	Presentation of Group Assignments	5 - 9 May 2025	13
6	Supplementary	12 May 2025	14

Assessment and Evaluation

The course will be assessed through diversified continuous assessment made up of the following:

Assessments	Weight
Test 1	30%
Individual Assignments	20%
Test 2	30%
Group Assignment	20%
Total	100%

A minimum of 50% total mark will be required to pass this course.

Students who have missed one or more of the assessments for valid reasons such as health challenges, etc, will be allowed access to the supplementary assessment.

General Academic Policies:
It is the student's responsibility to be familiar with and adhere to the NUST's Policies. These Policies can be found in the NUST Prospectus or online at:
https://www.nust.na/sites/default/files/prospectus/2024_NUST_Prospectus_FCI-web.pdf

Plagiarism and Deduction of Marks:
Marks will be deducted if students do not adhere to the rules of the University according to Rule AC3.2. All **assignments should be submitted through Turnitin**, the similarity software that is integrated into the MOO DLE Learning Management System. If plagiarism is detected, marks should be deducted as follows:

% Similarity Detected	% Marks Deduction
0 – 20	0
20 – 40	10
40 – 60	25
60 – 100	100

**** Please note that the % shown above is an average % for all Faculties and should be used as a Guideline.***

Assignments found with a similarity report above 20%, will not be allowed to apply for a remark or a recheck of marks. For students who fall into the 60 to 100%
similarity group, Rule AC3.2 will apply, and the misconduct procedure will start.

Kindly note the difference between similarity and plagiarism.
The Turnitin software detects the similarity and assists staff and students with academic integrity. It should be used as follow:

- Pay attention to the repository setting. It should be set to "no repository" to avoid self plagiarism. Please note that the submitted work is compared with existing information in the database and other work that is available on the internet, such as electronic journals, websites, and internet resources.
- Turnitin should not be seen as a system that detects plagiarism, but it generates a similarity report. It identifies text matches and therefore guides staff and students to pay attention t o certain areas. A high text match does not indicate plagiarism, but rather a match with existing content in the database.
- A low level match, on the other hand might be plagiarised work which Turnitin could not detect because it is from a source that cannot be accessed or not available in the database.
- Set the error margin not to detect references.

Plagiarism is the act of taking someone else's work or ideas and passing them off as one's own and by failing to include quotations or give the appropriate citation by not adequately acknowledging an author of a source (NUST Policy on Plagiarism, 2020).
Lecturers will assess if the detected similarities are plagiarized materials
If it is found that the materials are plagiarised, then action as indicated in Rule AC3.2 will be taken.

Assessment Submission:
All assessments (assignments, projects, and activities) should be submitted on the eLearning platform to ensure that it goes through the Turnitin software to check for similarity.
Assessments should be typed and submitted in MS Word or PDF format. Please note that students should not submit an assignment as a JPG or any other image format, because Turnitin cannot read images.

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Course Policies
General Academic Policies:

Failure to Pay Fees:
A student who fails to pay his/her fees may not be allowed to write the examination and if allowed, the results will be withheld until all outstanding fees are paid in full.

Important Student Services at NUST
There are a variety of services that you can use at NUST. These services are to your advantage – Use them!!! They include the following:

- Student Counseling and Career Development - Dean of Students Office.
- The Writing Centre and student academic problems – Centre for Teaching & Learning (CTL)
- Campus Health and Wellness Centre (CHWC) - Dean of Student's office/ NUST Clinic

AUTHORISATION:
This course is authorised for use by:

_____ _____
Head of Department Date

ACKNOWLEDGEMENT BY STUDENT

(To be completed by all students on the course, detached from the course outline and kept on record in the department)

I, _____, hereby acknowledge that I have received this course outline for (insert course title and code), and that I have familiarised myself with its content, in particular the statement about academic honesty and integrity. I agree to abide by the Policies and arrangements spelt out in this course outline.

_____ _____
Signature of Student Date