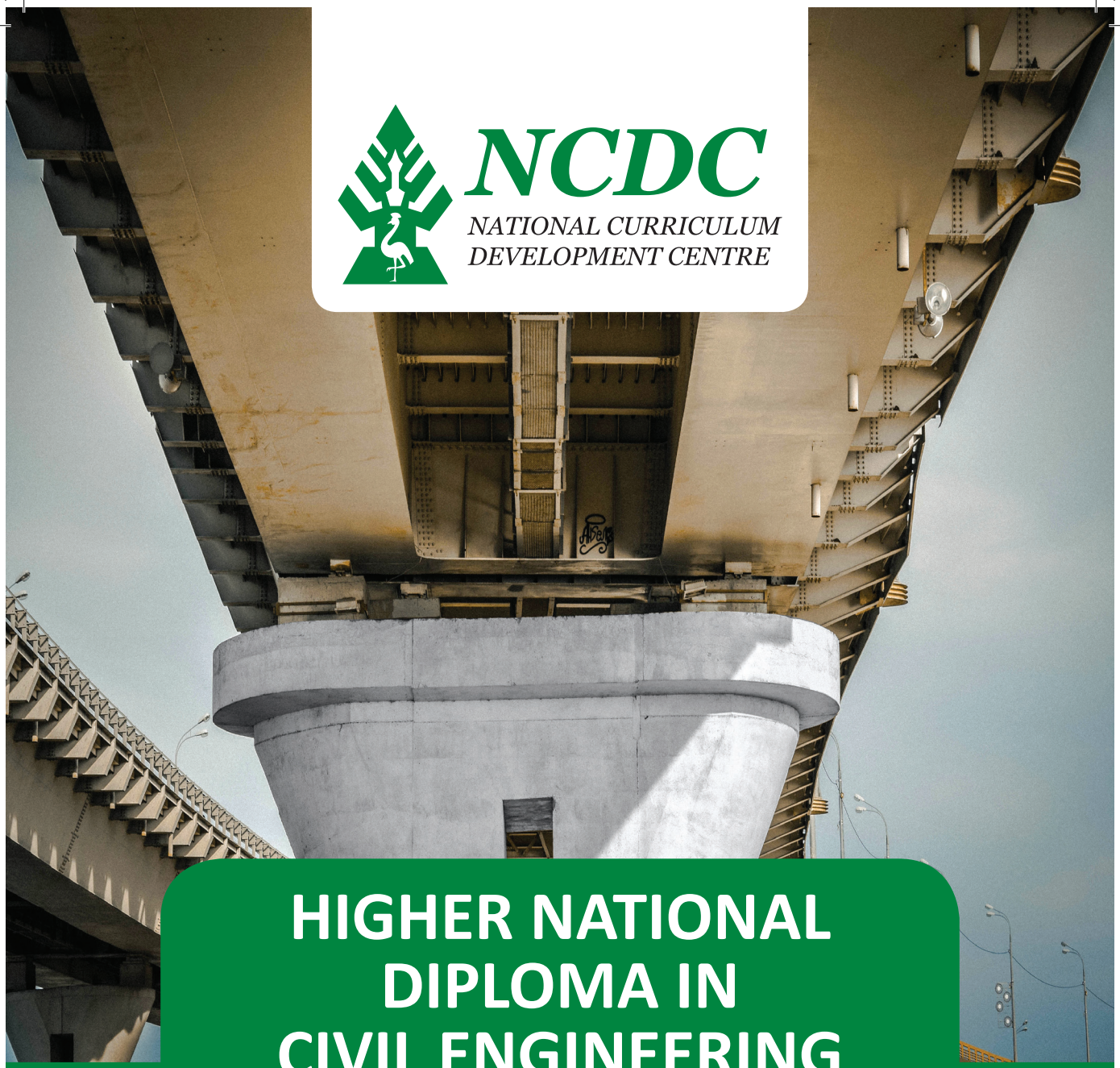

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

HIGHER NATIONAL DIPLOMA IN CIVIL ENGINEERING (HNDCE)

TEACHER'S GUIDE TO THE SYLLABUS FOR TECHNICAL COLLEGES AND OTHER TERTIARY INSTITUTIONS

THE REPUBLIC OF UGANDA
Ministry of Education and Sports

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

HIGHER NATIONAL DIPLOMA IN CIVIL ENGINEERING (HNDCE)

TEACHER'S GUIDE TO THE SYLLABUS FOR TECHNICAL COLLEGES AND OTHER TERTIARY INSTITUTIONS

THE REPUBLIC OF UGANDA
Ministry of Education and Sports

THE REPUBLIC OF UGANDA
Ministry of Education and Sports

A product of the National Curriculum Development Centre for the Ministry of Education and Sports with support from the Government of Uganda.

Published by
National Curriculum Development Centre
P.O. Box 7002,
Kampala- Uganda
www.ncdc.co.ug

ISBN: 978-9970-00-171-2

Contents

Foreword

Improvement of the curricula for Higher Technical Diploma Programmes is part of the Ministry of Education and Sports' (MoES) Strategy (2008) for the provision of Technical and Vocational Education. Technical colleges are the institutions training technologists in the country. The Government of Uganda aims at providing technical, scientific and vocational skills for the majority of Ugandans, in line with its emphasis on the BTVET Strategic Plan of 'Skilling Uganda'.

This curriculum is learner-centred and competence-based, updated bearing in mind the current labour market demands. It focuses on core tasks and assignments. Each module begins with a preparatory assignment and each semester involves execution of a real life project that makes the technologists competent in the profession.

The development of this curriculum came as a response to the emerging needs of the labour market and stakeholders such as employers and graduates of Technical Certificate Courses and Diploma Programs. The needs assessment report led to the development of a professional profile which includes all jobs and tasks that the graduates of Higher National Diploma in Mechanical Engineering perform and hence the development of all modules in this curriculum.

This curriculum aims at making Technical colleges the centres of excellence for training technologists which will result in greater development and industrialisation of the country.

Hon. Janet Kataaha Museveni
Minister
Ministry of Education and Sports

Acknowledgement

National Curriculum Development Centre (NCDC) extends its appreciation to all panel members and institutions that participated in developing this Syllabus.

NCDC recognises the historic contributions of City and Guilds of London Institute, East African Examinations Council and Uganda National Examinations Board (UNEB) for providing the foundation of technical education in Uganda.

NCDC further acknowledges the following ministries and institutions: Education and Sports, Works and Transport, Labour Gender and Social Development, Uganda Business and Technical Examinations Board, Directorate of Education Standards, National Council for Higher Education, Technical and Vocational Institutions and the World of Work for providing panellists during the development of this curriculum.

Special thanks go to Islamic Development Bank (IDB) Project for the financial support that enabled the development of this Curriculum.

Grace K. Baguma
Director
National Curriculum Development Centre

List of Acronyms

AASHTO	American Association of State Highways and Transportation Officials
APC	Anti-Proof Course
BIM	Building Information Modelling
BOQ	Bill of Quantities
BS	British Standard
CGPA	Cumulative Grade Point Average
CESMM	Civil Engineering Standard Method of Measurements
CH	Contact Hours
CU	Credit Units
DES	Directorate of Education Standards
DIT	Directorate of Industrial Training
DPC	Damp Proof Course
DPM	Damp Proof Membrane
EC	Euro Code
EDM	Electro-Magnetic Distance Measurement
ETL	Excavation to Level
FIDIC	International Federation of Consulting Engineers
GP	Grade Point
GPA	Grade Point Average
GPS	Global Positioning System
HNDCE	Higher National Diploma in Civil Engineering
HDCE	Higher Diploma in Civil Engineering Core modules
HDEM	Higher Diploma Engineering Mathematics modules
HDEE	Higher Diploma Electrical core modules
IDB	Islamic Development Bank
KES	Kyambogo Engineering Services
LH	Lecture Hours
MOES	Ministry Of Education and Sports
MOGLSD	Ministry of Gender, Labour and Social Development
NCDC	National Curriculum Development Centre
NCHE	National Council for Higher Education
NDAR	National Diploma in Architecture
NGO	Non-Governmental Organisation
NP	Normal Progress

PH	Practical Hours
PP	Probationary Progress
PPDA	Public Procurement and Disposal of Public Assets
SMM	Standard Method of Measurements
TRL	Transport Research Laboratory
UBTEB	Uganda Business and Technical Examinations Board
UNEB	Uganda National Examinations Board
UTC	Uganda Technical College
WOW	World of Work

Introduction

This Teacher's Guide is aimed at equipping you with learner-centred methods of conducting training sessions here referred to as teaching and learning strategies, by ensuring that the learner gains the desired competences. You should therefore ensure that the learner fully participates in the teaching/learning process.

This Guide emphasises practical teaching, projects and acquisition of skills by the learner. The competences that learner is expected to acquire are clearly spelt out in each module covered in the semester. You should ensure that the learner is well versed with practical work.

The teaching methodologies developed in this guide, if implemented effectively, should be able to produce construction technologists who are able to:

i. design, draw and detail architectural and civil engineering drawings.

ii. set out, construct, supervise and maintain buildings.

iii. estimate, measure and cost quantity of materials and works.

iv. prepare reports, budgets and operation plans.

v. ensure safety, health and welfare of workers and the community as well as the security of workers, works and plants

Rationale of the Teacher's Guide

This Teacher's Guide is meant to facilitate you to effectively interpret and use the syllabus to deliver a more updated and relevant content to the learners. It outlines the methods you may use, the procedures to be taken, and the assessment and evaluation techniques. It is an essential tool kit in the success of the teaching/learning process of the Higher National Diploma in Civil Engineering (HNDCE).

Components of the Teacher's Guide

This Teacher's Guide is composed of the following:

Module: This shows the identification number of the module in a particular year of study and semester. The module is the subject of study in a given time. It has particular skills that learners are expected of being able to perform at varying levels during and after the course.

Module credit: This shows the weight of the module.

Duration: This is the suggested time allocation for a given module and the respective sub-modules within a specific academic year of study.

Module overview: This contains the general summary of the content in the module.

Learning outcome: This is the general learning objective of a given content in the module. It clarifies generally what the learner shall be able to do as a result of passing through the learning process.

Preparatory assignment: This is the realistic guide on the way you should present the module content to stimulate the learner's curiosity to studying the module.

Result: This is the outcome of the tasks from the preparatory assignment. Each preparatory assignment must have results indicating the learners' participation, as this becomes the basis of continuous assessment

Sub-module: This presents a topic with its content outline.

Competences: These are the specific skills which the learner is expected to acquire and exhibit, during and after going through every specific module and sub-module content.

Content: This is an outline of the subject matter to be learnt in a particular module and within a prescribed timeframe.

Teaching/ learning strategies: These are some of the methods that you will use to facilitate learning that suit a particular content and learners. The teaching/ learning strategies require the active participation of both you and the learners during the teaching/learning process.

Assessment strategies: These are samples of class exercises, tests, laboratory tests as well as field and workshop practical activities given to the learners to perform in order to score the level of achievements of the completed content for both you and the learners.

Teaching/learning resources: These are the identified teaching aids used by both you and the learners during learning to clarify the concept or ideal situation being learnt.

Aims of the HNDCE Teacher's Guide

This Teacher's Guide is aimed at:

i) introducing and guiding you through the new concept of competence based education and training.
ii) supporting you with practical methodologies to equip the learners with the skills required to solve the day to day societal needs by creating jobs to reduce unemployment.
iii) empowering you with creative and innovative teaching/learning methodologies to enhance learners' research and development.
iv) strengthening your ability to equip learners with knowledge and skills of marketing their enterprises and lobbing for any form of support.
v) guiding you to empower learners with knowledge and skills that will enable them upgrade to higher levels of education.
vi) pedagogically aiding you to equip learners with knowledge and skills for effective communication.
vii) providing methodologies that will guide you in equipping learners with basic Kiswahili to widen their communication and employment opportunities in the East African Community.
viii) directing you to foster an attitude change and understanding in learners and the public on the fact that "technical education is not for academic failures rather for more creative and gifted persons".
ix) guiding you on the use of local teaching/learning resources that aid the imparting of knowledge and skills to learners.
x) guiding you on approaches of administering continuous assessment so as to consolidate the achievement of competences and update the learners' performance record.

How to Use this Teacher's Guide

You should ensure that the practical, related knowledge, values and attitudes are integrated during the teaching / learning process.

For effective implementation of this Teacher's Guide, you are expected to:

i) guide learners through the proposed preparatory assignment, or create your own approach of introducing the module.
ii) actively participate and stand as a role model for the learners to appreciate their choice of joining technical education.

iii) refer to the content of the outlined sub-module and extract the specific area to be learnt.
iv) extract competences, the teaching/learning strategies and resources relative to the content.
v) re-distribute the total time allocated to each sub-module to suit the content.
vi) involve learners in active participation during the teaching and learning process.
vii) assess learners using the suggested assessment criterion or innovate other effective assessment strategies relative to the competences.
viii) guide learners to effectively use the suggested teaching and learning resources to acquire the set competences.
ix) innovatively create resources for teaching/ learning other than the ones suggested.
x) put into consideration health, safety, security and environment concerns during the teaching/learning process.

Methodology

The teaching/learning methodologies in this Teacher's Guide are just samples. It is at your discretion to apply any other methodologies deemed suitable to the classroom setting. The type of methodology selected should be guided by the competences to be acquired by the learner. You are encouraged to use a variety of methodologies in a lesson to make it more interesting and practical. Examples of some of the teaching/learning methodologies include:

Discussion

a) Group Discussions

Learners discuss issues in groups. This methodology enables knowledge/information to come from the learners rather than from you, the teacher. It promotes teamwork and allows all learners to have an opportunity to give their opinions and ideas; and also stimulates their interest as they learn from each other.

Guidelines for using group discussion methodology

i) Group learners
ii) Give clear instructions to learners as to what each group should do.
iii) Assign task(s) to each group.
iv) Learners discuss issues raised in the task with your guidance.

v) Learners agree on the issues to be presented.
vi) Group presentations and general discussions.
vii) Summary of agreed class points.

b) Guided discussions

Guidelines for using guided discussion methodology:

i) Lead the discussion and act as the chairperson/secretary.
ii) Give clear instructions to learners as to what they should do.
iii) Learners discuss issues raised in the task with your guidance.
iv) Learners agree on the issues.
v) Summarise the session by drawing on the main points.

Case study

This methodology is where learners are given information about a situation and they have to come up with decisions or solutions to a problem. The purpose of case study is to:

i) help learners to identify and solve problems in a typical situation.
ii) provide learners with confidence in decision-making.
iii) help learners develop analytical skills.

Brainstorming

This is a way of obtaining as many views as possible from the learners in a short time. Guide the learners to give as many ideas as they can, on a particular issue. It is recommended that all ideas are accepted without questioning. The ideas should be ranked according to the relevance to the issue being brainstormed.

Basic rules for brainstorming are:

i) Encourage as many ideas as possible.
ii) Criticisms of ideas should not be allowed.

Buzz methodology

This is a method of training that requires learners seated near each other to discuss an issue that could have a lot of points or controversy to be agreed upon. The noise is the murmur that the class makes like that of buzz. Therefore some manageable noise or murmur should not be mistaken for no learning. This method is good in situations where one cannot conduct effective training like when it is raining. Ask questions on what learners have discussed to find out if they have understood.

Guided discovery

This method is based on the notion that the learners know more than they think they know. The assumption is that they only need to be prompted to discover this knowledge for themselves. Your role is to organise the learning environment and present the content in such a way that the learners can discover more knowledge and ideas.

Demonstration

This is the act of exhibiting, describing and explaining the operation or process by use of a device, machine, process or product to learners. A demonstration can be carried out by you or the learners.

Illustration

This is a depiction or representation of a subject matter, such as a drawing, sketch, painting, photograph, or other kind of image of things seen, remembered or imagined, using a graphical representation. This method is best used where words are not sufficient to clearly bring out a concept. It gives a visual impression to what is being taught.

Guest speaker

Guest speakers could be local entrepreneurs, government officials, professional practitioners or community leaders invited to make a presentation to learners. Guest speakers can provide a variety to entrepreneurship education learning, share experience and add value by engaging learners in an educational or informative manner.

The methodology provides learners with an opportunity to physically interact with a practitioner and motivates them to develop an entrepreneurial attitude.

Role play

This methodology is where learners are presented with a situation they are expected to explore by acting out the roles of those represented in this situation. In the role play, learners should be carefully selected and properly prepared for their roles. The remaining learners should be equally prepared for the role play by briefing them on how they are to act during the presentation. The players should try to behave naturally during the presentation.

You should:

i) observe when the presentation is taking place.

ii) guide learners in the course of presentation to ensure that they focus on the theme of the play.

iii) engage learners in a discussion or ask them questions about what they have learnt from the role play with a view of finding out if the role play has provided sufficient information.

Study tour

This is when learners are taken out to perform particular tasks with the aim of carrying out an observation, practice or witness the flow of events. It enables the learners to link the school situation with the reality in the communities or world of work.

Field attachment

This is when learners are attached to some entrepreneur(s) to practise during their study time. It does not only enable them to relate what they have learnt in class but also allows them to acquire more knowledge and skills beyond what was covered. It further motivates learners to become practitioners or entrepreneurs.

Description of Year 1 Semester 1

Code	Module Title	L	P	CH	CU
HDEM 111	Engineering Mathematics IV	45	0	45	3
HDCE 111	Structural Mechanics I	45	0	45	3
HDCE 112	Specifications	30	30	45	3
HDCE 113	Engineering Surveying	30	30	45	3
HDCE 114	Construction Technology III	30	30	60	4
HDEE 111	Computer Programming	30	30	45	3
HDCE 115	Real Life Project I	0	120	60	4
Semester Load = 23					

HDEM 111: Engineering Mathematics IV

Duration: 45 Hours

Module Overview

This module equips the learner with skills of solving various problems involving evaluations of material requirements, determination of their related costs and analysis of the collected data for quality assurance in production.

Learning Outcomes

By the end of this module, the learner should be able to:

- evaluate material requirements and their costs.
- analyse collected data for quality assurance in production.

Preparatory Assignment

Prior to teaching this module, group learners and task them to research and determine the heat transfer loss across a parallel composite wall, write a group report and present in class.

Result

Learners write a group report and present in class.

Sub-module 1: Differential Calculus

Duration: 04 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • uses limits of functions to analyse a range of parameters in determining sizes of structural components. • applies differential calculus to determine the rate of discharge in pipes and channels. • differentiates higher order derivatives for heat transfer in composite walls.	• Limits of functions • Review of differentiation • The Differentiability Theorem • Partial differentiation • Higher order derivatives • Applications of differential calculus in engineering	• Lead learners through practise on how to use limits of functions to analyse a range of parameters in order to determine sizes of parts. • Demonstrate using three similar pens with lids, and interchange lids of similar pens, relating it to limits of functions. • Illustrate with examples the technique of analysing ranges of parameters in determining the sizes of parts. • Illustrate with different examples, the manipulation of differential calculus to carry out partial differentiation. Task learners to solve a wave equation. • Guide learners to practise with examples how to differentiate higher order derivatives for heat transfer in composite walls.

Assessment Strategy

Task the learners to:

- differentiate higher order derivatives for heat transfer in composite walls.
- apply differential calculus in determining the rate of discharge in pipes and channels.

Teaching Resources

- Walls of composite nature
- Scientific calculator

Sub-module 2: Integral Calculus

Duration: 04 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • integrates functions to calculate areas under curves, weight to determine the type of support structure required. • uses integration to size templates for the formation of water vessels.	• Review of integration • Solids of revolution • Double integrals • Multiple integrals • Reduction formula • Integration of rational functions • Application of integral calculus in engineering	• Illustrate with examples the integration of functions to determine areas under curves. • Lead learners through integration of functions to determine volumes transcribed by revolving solids. • Demonstrate the use of integration in the sizing of templates for the formation of water vessels and guide the learners as they practise.

Assessment Strategy

Task the learners to:

- integrate functions and calculate areas under curves, weight to determine the type of support structure required.
- use integration to size templates for the formation of water vessels.

Teaching/Learning Resources

- Various templates
- Graph papers
- Scientific calculator

Sub-module 3: Statistics

Duration: 14 Hours

Competence	Content	Teaching/ Learning Strategies
The learner applies statistical methods to analyse data for research and development	• Measures of dispersion • Variance and Standard deviation • Population and sample • Distributions; $z-$ distribution and $t-$ distribution • Hypothesis testing. Chi-square. • Contingency tables. • Moments, skewness and Kurtosis • Correlation and regression tests	• Task learners to count the number and types of vehicles using a particular road near the college, analyse the collected data, write a group report and present in class. • Illustrate the application of statistical methods to analyse data for research and development. • Demonstrate the use of variance in analysing learners' ages or learners' scored marks on given assignments and guide the learners as they practise.

Assessment Strategy

Assign the learners to apply statistical method in analysing data for research and development.

Teaching/Learning Resources

- Scientific calculator
- Z- distribution chart
- T- distribution chart
- Graph paper
- Contingency tables
- Writing board

Sub-module 4: Real Analysis

Duration: 09 Hours

Competences	Content	Teaching/ Learning Strategies
The learner applies real analysis to compare production rates and outputs in construction industry.	• Limits of functions • Generation of Taylor's series • L'hopital's rule • Continuity and differentiability • Mean value theorem • Integratability • The definite and indefinite Integral • The fundamental theorem of calculus • Differentiation and repeated integral	• Demonstrate the use of real analysis to determine solutions for sequential functions and guide the learners as they practise. • Illustrate using examples the methods of solving sequential equations and task learners to work out tasks. • Guide learners to use real analysis for comparing production rates and outputs in construction industry.

Assessment Strategy

Task the learners to:

- determine solutions for sequential functions using real analysis.
- apply real analysis in comparing production rates and outputs in the construction industry.

Teaching/Learning Resources

- Scientific calculator
- Writing board

Sub-module 5: Numerical Analysis

Duration: 08 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • calculates areas of sections using numerical methods. • determines volumes of cut and fill.	• Iterative methods • Finite differences • Interpolation • Numerical differentiation • Numerical integration • Mid-ordinate rule • Trapezoidal rule • Prismoidal method • Simpson's rule • Numerical solution of differential equations • Euler's method	• Illustrate the methods of solving equations using numerical analysis for summation of various quantities. Give learners exercises and task them to practise. • Demonstrate the techniques of determining volumes of cut and fill earth and guide learners as they practise. • Using examples, guide learners on the methods of manipulating the mid-ordinate, trapezoidal and Simpsons rules in calculating earth volumes and task them to practise.

Assessment Strategy

Assign the learners to determine the volumes of cut and fill of any site using mid-ordinate, trapezoidal and Simpson's rules.

Teaching/Learning Resources

- Scientific calculator
- Graph paper
- Writing board
- Surveying equipment
- Staff

Sub-module 6: Blocking and Statistical Modelling

Duration: 06 Hours

Competence	Content	Teaching/ Learning Strategies
The learner uses blocking and statistical modelling for the analysis of data to select the best method of operation.	• Completely randomised blocks • Latin squares	• Illustrate the methods applied in blocking and statistical modelling for the analysis of data to select the best method of operation and guide learners as they practise.

Assessment Strategy

Task the learners to use blocking and statistical modelling for the analysis of data to select the best method of operation.

Teaching/Learning Resources

- Scientific calculator
- Latin square
- Graph paper
- Contingency tables

Bibliography

Bolton, W. (1997). *Essential Mathematics for Engineering.* Butterworth-Heinemann, London.

Greenberg, D.M. (1998). *Advanced Engineering Mathematics*. 2nd ed. Prentice-Hall International Inc., New Jersey.

HDCE 111: Structural Mechanics I

Duration: 45 Hours

Module Overview

This module is aimed at enabling the learner attain skills and methods of analysing statically determinate and indeterminate structures. It equips the learner with concepts of structural analysis, loads investigation, stress analysis, selection of elements and development of general layout, drawing and detailing.

Learning Outcome

By the end of this module, the learner should be able to analyse structures and determine their safety in construction.

Preparatory Assignment

Display various sketches of structures and task the learners in groups to identify statically determinate and indeterminate structures. Task them to compile their findings and make a presentation in class.

Result

Groups present their solutions in class.

Sub-module 1: Introduction to Forces in Structural Elements

Duration: 10 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • determines forces in frames and trusses to avoid overloading. • applies the principle of virtual work and superposition in analysing moving loads on structures.	• External equilibrium and internal forces in members • Stability and determinacy • Principal of virtual work • Principal of superposition	• Display sketches of frames and trusses and task learners to illustrate the action of forces in members and brainstorm on the determination of forces in the members of frames and trusses. • Group learners to brainstorm on the tasks on stability and determinacy. • Illustrate with examples the application of virtual work and superposition in analysing structures and task learners to make illustrations of given tasks and guide learners through practise.

Assessment Strategies

Task the learners to:

- determine forces in members of trusses to avoid overloading.
- use virtual work and superposition methods for analysing moving loads on structures.

Teaching/Learning Resources

- Models of frames and trusses
- Scientific calculator

Sub-module 2: Statically Determinate and Indeterminate Structures

Duration: 20 Hours

Competence	Content	Teaching/Learning Strategies
The learner: • applies unit load method, Castigliano's theorem, area moment method and conjugate beam method to determine moments, shear forces and deformations in beams, trusses and frames.	• Analysis of beams. trusses and frames for moments, shear forces, axial forces and deformations due to loads and temperature change • Application of unit load method, Castigliano's theorem, area moment method, conjugate beam methods, trusses and rigid frames	• Illustrate with examples the ways of determining moments, shear forces, and deformation of beams, trusses and frames using unit load method, Castigliano's theorem, area moment method and conjugate beam methods. Guide the learners as they practise. • Group learners to brainstorm different techniques and approaches applied to determine moments and shear forces using unit load method, Castigliano's theorem, area moment method, conjugate beam methods in trusses, beams and frames and task them to work out some examples.

Assessment Strategy

Assign the learners to determine moments, shear forces and deformation of beams, and frames using unit load method, Castigliano's Theorem, area moment method, conjugate beam methods.

Teaching/Learning Resources

- Models of frames and trusses
- Scientific calculator

Sub-module 3: Influence Lines of Statically Determinate Systems

Duration: 15 Hours

Competence	Content	Teaching/ Learning Strategies
The learner determines support reactions, critical section (maximum support reaction and internal forces), and maximum absolute bending moment using influence lines.	• Analysis of support reactions, critical section (maximum support reaction and internal forces), and maximum absolute bending moment	• Group learners to brainstorm and suggest the methods of calculating the support reactions, critical sections and maximum absolute bending using influence lines and present their solutions in class. • Illustrate with examples the application of influence lines to determine support reactions, critical section and maximum absolute bending moment and task learners to practise working out given examples.

Assessment Strategy

Assign the learners to determine support reactions, critical sections and maximum absolute bending moments using influence lines.

Teaching/Learning Resources

- Models of frames and trusses
- Scientific calculator

Bibliography

Beer, F. P. and Johnston, E. R. (1988). *Vector Mechanics for Engineers*: *Statics and Dynamics.* Tata McGraw Hill Publishing Co

Cain, I. J. and Hulse R. (1997). *Structural Mechanics.* 2nd Edition, Macmillan

Durka, A. and Morgan, W. (1998*). Structural Mechanics.* 2nd Edition, Palgrave Macmillan

French, S.E. (1995). *Fundamentals of Structural Analysis*. West Publishing Company. New York

HDCE 112: Specifications

Duration: 45 Hours

Module Overview

This module introduces the learner to specification writing, its evolution and functions, forms of specifications and their relevance to construction works. It equips the learner with knowledge and skills of writing and interpreting specification clauses.

Learning Outcome

By the end of this module, the learner should be able to write and interpret building specifications and other manuals.

Preparatory Assignment

Provide a detailed drawing of a building and task learners to write a specification for sub structure works, and walling up to wall plate level.

Result

Learners present their specifications in class.

Sub-module 1: Introduction to Specification Writing

Duration: 6 Hours

Competence	Content	Teaching/Learning Strategies
The learner stresses the need for specification writing.	• Evolution of specification writing. • Functions of a specification • Need for writing specifications.	• Lead a guided discussion on evolution and functions of specification writing. • Group and guide learners to brainstorm the need for writing specification in reference to law, contracts, disputes, quality of work, workmanship and materials.

Assessment Strategy

Assign the learners to describe functions of a specification.

Teaching/Learning Resource

- Plan with specifications writing

Bibliography

Ashworth, A. (1996). *Pre-contract Studies: Development Economics Estimating and Tendering.* Longman

Ashworth, A. (1996). *SMM7 The Standard Method of Measurement of Building Works.* Longman

Mc George, D. and Palmer, A. (2002). *Tenders and Contracts for Buildings*. 3rd Edition, Blackwell Science

The Aqua Group (2000). *Contractual Procedures in the Construction Industry*. E & F N Spon

Sub-module 2: Contractual Status

Duration: 8 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses forms of contracts to prepare specifications. • prepares a tender document.	• Contractual status of a specification in the common forms of contracts • Tendering	• Lead a guided discussion on contractual status of a specification, and the common types of contracts. • Group and guide learners to write a tender document using a real life advert from the public media.

Assessment Strategy

Task the learner to:

- use forms of contracts to prepare specifications.
- write a tender document.

Teaching/Learning Resources

- Plan with specifications
- Sample of tender document
- BS/Euro Code document

Bibliography

- Ashworth, A. (1996). *Pre-contract Studies: Development Economics Estimating and Tendering*. Longman
- Ashworth, A. (1996). *SMM7 The Standard Method of Measurement of Building Works.* Longman

Sub-module 3: Types of Specifications

Duration: 06 Hours

Competence	Content	Teaching/Learning Strategies
The learner examines various forms of specifications and their relevance in a construction.	• Forms of specifications; prescriptive/ product and performance specifications and their relevance	• Lead a guided discussion to examine various forms of specifications and their relevance in a construction. • Group learners to brainstorm the difference between various forms of specifications and their relevance and task them to write a group report and present group findings.

Assessment Strategy

Assign the learners to examine various forms of specifications giving their advantages and disadvantages in construction.

Teaching/Learning Resources

- Plan with specifications
- Sample of tender document
- BS/Euro Code document

Sub-module 4: Standard Specifications

Duration: 06 Hours

Competence	Content	Teaching/Learning Strategies
The learner uses standard specifications, manufacturers' specification, British Standards and Codes of Practice to write specifications for various construction works.	• Use of standard specifications, manufacturer's specifications and reference British Standards and Codes of Practice.	• Group learners to brainstorm the interpretation of standard specifications, manufacturer's specifications, reference British Standards and Codes of Practice and task them to write specifications in relation to construction work. • Guide learners through interpreting standard specifications, manufacturers' specifications and reference British Standards and Codes of Practice.

Assessment Strategy

Assign the learners to interpret and write standard specifications, manufacturers' specifications, British Standards and Codes of Practice in relation to construction works.

Teaching/Learning Resources

- Plan with specifications
- Sample of tender document
- BS/Euro Code document
- Codes of practice document
- Manufacturer's specifications

Sub-module 5: Specification Clauses

Duration: 19 Hours

Competence	Content	Teaching/Learning Strategies
The learner applies standard clauses for writing specifications.	• Specification clauses for preliminaries and general conditions, earthworks, concrete, brick and block work, roof coverings, carpentry and joinery, metal work, finishing, glazing, painting, plumbing, drainage and electrical	• Guide learners through the steps of interpreting clauses of written specifications for various construction works emphasising areas of concern. • Group learners to brainstorm the interpretation of various clauses to written specifications for various construction work and task them to write a group report and make presentations.

Assessment Strategy

Assign the learner to interpret various clauses and write specifications in relation to construction works.

Teaching/Learning Resource

- Plan with specifications
- Sample of tender document
- BS/Euro Code document
- Codes of practice document
- Manufacturer's specifications

Bibliography

Ashworth, A. (1996). *Pre-contract Studies: Development Economics Estimating and Tendering*, Longman

Ashworth, A. (1996). *SMM7 The Standard Method of Measurement of Building Works.* Longman

Mc George, D. and Palmer, A. (2002). *Tenders and Contracts for Buildings.* 3rd Edition, Blackwell Science

The Aqua Group (2000). *Contractual Procedures in the Construction Industry* E & F N Spon

HDCE 113: Engineering Surveying

Duration: 45 Hours

Module Overview

This module introduces the learner to the techniques and science of accurately determining the terrestrial or three-dimensional position of points, distances and angles. It equips the learner with practical skills of operating surveying equipment in the construction industry.

Learning Outcome

By the end of this module, the learner should be able to:

- correctly use surveying equipment in the construction industry.
- carry out survey works of building sites.

Preparatory Assignment

Group learners and task them to survey a plot of land of $40m^2$ using surveying instruments and tools then enter the data and book.

Result

Groups present the booked data in a class.

Sub-module 1: Application of Linear Surveying

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • identifies and uses survey equipment correctly. • carries out tape corrections. • plots chain survey	• Equipment and methods used in surveying • Tape corrections • Errors and accuracy in linear survey • Precision of measurements, • Obstacles in	• Demonstrate the techniques of operating different equipment and guide the learners as they practise. • Illustrate with examples the methods of correcting the tape errors and task learners to practise. • Group learners to discuss how they can identify and

Competences	Content	Teaching/Learning Strategies
coordinates.	chaining • Plotting of a chain survey	overcome obstacles in chaining and task them to write a group report and present it in class. • Guide a class discussion on how to plot a chain survey and task learners to practise.

Assessment Strategy

Assign the learners to plot a chain survey.

Teaching/Learning Resources

- Field books
- Calculator
- Surveying equipment
- Staff

Sub-module 2: Heighting

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • books and reduces levels. • corrects errors in levelling. • produces contour plans. • sets out drains and sewers.	• Differential levelling • Booking and reducing levels • Profile levelling, errors in levelling • Precision in levelling • Application of levelling • Production of contour plans and profiles • Setting out drains and sewers	• Guide learners on methods applied when booking and reducing levels. • Illustrate with examples the techniques of correcting errors in levelling and task learners to collect row survey data and correct the errors that may be identified. • Group learners to discuss correction of errors in levelling, precision and application of levelling and task them to write a group report and make

Competences	Content	Teaching/Learning Strategies
		presentations. • Demonstrate the plotting and drawing of contour plans and guide learners as they practise. • Guide learners on the methods of setting out drains and task them to practise.

Assessment Strategy

Task the learners to:

- book and reduce levels.
- produce contour plan.

Teaching/Learning Resources

- Field books
- Calculator
- Surveying equipment
- Staff

Sub-module 3: Theodolites and their Use

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • correctly sets up and levels a theodolite. • measures, books and calculates angles. • computes coordinates. • uses a theodolite	• Centering a theodolite • Measuring, booking and calculation of angles • Computations and adjustment methods • Application to contour	• Demonstrate the procedure of setting up and levelling a theodolite at different terrains and guide the learners as they practise. • Group learners to measure, book and calculate angles and task them to write a group report and make presentations. • Lead a guided discussion on adjustment methods and application to contour surveys.

Competences	Content	Teaching/Learning Strategies
to set engineering work.	surveys • Computation of coordinates • Misclosure and precisions • Setting out engineering works	• Illustrate with examples computations of coordinates and misclosure and task learners to work out some examples. • Demonstrate setting out of engineering work using a theodolite and guide the learners as they practise.

Assessment Strategies

Task the learners to:

- set and level a theodolite.
- measure, book and calculate angles.

Teaching/Learning Resources

- Books
- Calculator
- Theodolite
- Staff
- Computer

Sub-module 4: Tachometry

Duration: 08 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • applies principles of tachometry during survey. • measures and books angles with horizontal line of sight with vertical	• Principles of tachometry • Horizontal line of sight with vertical staff • Inclined line of sight with vertical and normal to staff	• Guide learners to discuss the principles of tachometry and their application in surveying. • Group learners and task them to measure, and book angles with horizontal line of sight with vertical staff, and

Competences	Content	Teaching/Learning Strategies
staff, inclined line of sight with vertical and normal staff. • plots coordinates to produce topographic maps. • corrects errors in subtends tachometry.	• Errors in vertical staff stadia tachometry • Field procedure and tachometric field booking • Plotting • Subtends tachometry and its errors • Application of tachometry	inclined line of sight with vertical and normal staff. • Illustrate the methods applied in the plotting of coordinates to produce topographic maps and guide learners as they practise. • Demonstrate the process of conducting subtends tachometry and correction of errors in vertical staff stadia and guide the learners as they practise.

Assessment Strategy

Task the learners to:

- correct errors in vertical staff stadia tachometry.
- plot coordinates.

Teaching/Learning Resources

- Books
- Calculator
- Surveying equipment
- Staff

Sub-module 5: Electromagnetic Distance Measurement (EDM)

Duration: 05 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses principles of electromagnetic	• Electromagnetic waves	• Lead a guided discussion on the

Competences	Content	Teaching/Learning Strategies
distance measurement to execute survey work. • selects and correctly uses different types of EDM systems and EDM instruments. • correctly uses the total station correctly in carrying out survey work.	• Principle of distance measurement • Types of electromagnetic distance measurement (EDM) systems, EDM instruments and application of EDM (emphasis on total station)	principles of EDM and their applications. • Group learners and task them to discuss the types of EDM systems, EDM instruments and present their solutions in class. • Demonstrate the operation of total station and guide learners as they practise.

Assessment Strategy

Assign the learners to carry out any fieldwork survey using total station.

Teaching/Learning Resources

- Books
- Calculator
- Total Station
- Staff

Sub-module 6: Earth Works

Duration: 6 hours

Competence	Content	Teaching/Learning Strategies
The learner determines plane areas, cross sectional areas, volumes from cross sections, spot heights and contours.	• Calculation of areas and volumes using (triangles, coordinates, give and take lines, graphical methods, trapezoidal rule,	• Illustrate with examples the calculation of plane areas using triangles, coordinate, give and take lines, graphical method, Simpson's rule, trapezoidal rule and Plano meter and guide the learners as they practise.

Competence	Content	Teaching/Learning Strategies
	Simpson's rule, Prismoidal and Plano meter) • Calculation of volumes from spot heights and contours	• Demonstrate the procedure of calculating cross sectional areas and volumes of cross sections using end areas and prismoidal method and guide the learners as they practise. • Guide learners to calculate volumes from spot heights and contours and give them examples to practise on.

Assessment Strategy

Assign the learners to determine plan areas using (triangles, coordinates, give and take lines, graphical methods, trapezoidal rule, Simpson rule and Plano meter).

Teaching/Learning Resource

- Calculator

Sub-module 7: Mass Haul Diagrams

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • determines the volume of cut and fill. • draws the mass haul diagram. • differentiates between free haul charge and mass haul charge.	• Terminologies used • Calculation of cut and fill • Mass haul diagram drawing, characteristics of the mass haul diagram and economics of the mass haul diagram • Free haul charge, overhaul charge	• Lead a guided discussion on the terminologies used in mass haul diagram and their application. • Illustrate the methods of calculating the volume of cut and fill and task learners to practise. • Demonstrate the procedure of drawing mass haul diagram and guide learners as they practise. • Lead a guided discussion on the characteristics and

Competences	Content	Teaching/Learning Strategies
	and choice of balancing line	economics of mass haul diagram. • Group learners to discuss free haul and overhaul charge and choice of the balancing line and task them to present their findings in class.

Assessment Strategy

Assign the learners to determine volume of cut and fill.

Teaching/Learning Resource

- Calculator

Sub-module 8: Curve Ranging

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • designs curves. • sets out curves of different radii. • provides a smooth gradient of highways, railways and canals in different types of terrains.	• Horizontal curves (circular): simple, compound and reverse circular curves, terminologies used, radius and degree curves through chainage, location of intersection point (I) and tangent points (T and U) in the field and setting out circular curves • Horizontal curves (transition): radial force and design speed, super elevation and cant, minimum curvature for standard velocity, uses of	• Lead a guided discussion on terminologies used, design of curves and their applications. • Illustrate the methods of developing curves and task learners to come up with different designs in groups and make class presentations. • Guide learners to discuss the use of vertical and horizontal curves in

Competences	Content	Teaching/Learning Strategies
	transition curves, length and types of transition curves, shift of cubic parabola and setting out of composite curve • Vertical curves: gradients, types of curves used, equation of vertical curve, sight distances and k-values and setting out vertical curves	construction and highway works. • Demonstrate setting out of curves, gradients for highways and canals and guide learners as they practise.

Assessment Strategy

Assign the learners to:

- set out curves.
- determine the gradients of different curves.

Teaching/Learning Resource

- Calculator

Bibliography

Bannister, A. and Baker, R. (1999). *Surveying*. 2nd Ed. Longman, London.

Oliver J. G. and Clendiinning, J. (1984). *Principles of Surveying.* Van Nostrand Reinhold (UK)

Uren, J. and Price, W. F. (1994). *Surveying for Engineers*. 3rd Ed. MacMillan, London.

HDCE 114: Construction Technology III

Duration: 60 Hours

Module Overview

This module introduces the learner to basic engineering principles and technical skills necessary in areas like construction and supervision of buildings and other structures. It equips the learner with skills and knowledge of building regulations, mechanical plants, and of registration of all applications for building plan approval.

Learning Outcomes

By the end of this module, the learner should be able to:

- set out and build foundations.
- submit plans for approval.
- construct temporary work.

Preparatory Assignment

Guide learners in a discussion to establish the quality of materials and sequence of constructing a building.

Result

Learners present their findings on the quality of building materials and steps involved in constructing a house.

Sub-module 1: Construction Materials

Duration: 08 Hours

Competence	Content	Teaching/Learning Strategies
The learner selects appropriate materials for construction.	• Metals • Timber • Clay products • Concrete and Concrete products	• Lead a guided discussion on the characteristics/qualities, manufacture and process of selecting quality construction materials.

Competence	Content	Teaching/Learning Strategies
	• Stones and soil • Review of building services including builder's work	• Guide learners to tour the buildings around the institutions identify and observe the materials used, their preservation, maintenance and task them to write a group report and make a presentation. • Group learners to brainstorm building services, works, procedures and task them to write a group report and make presentations.

Assessment Strategy

Assign the learners to manufacture clay and concrete products.

Teaching/Learning Resources

- Pieces of timber
- Precast concrete products
- Clay bricks
- Stones

Sub-module 2: Preliminaries

Duration: 08 Hours

Competences	Content	Teaching/Learning Strategies
The learner, • observes the regulations governing submission and approval of plans.	• Regulations governing submission and approval of plans • Notices of commencement of work	• Lead a guided discussion on the regulations to be observed when submitting plans for approval. • Group learners to brainstorm notices of commencement of work, the conditions attached, the parties involved and their obligations. • Lead a guided tour to a nearby site in the initial stage of construction

Competences	Content	Teaching/Learning Strategies
• determines building line and site level. • constructs temporary services.	• Building line, datum or site levels • Provision of temporary services	for the learners to observe how to determine building line and datum level, and task them to write a report and present in class. • Guide learners to discuss the safety, security, health and environmental concerns taken care of when erecting and using temporary services. Task learners to write a group report and present in class.

Assessment Strategy

Assign the learners to draw a site layout showing temporary services.

Teaching/Learning Resources

- A copy of building regulations
- A copy of notice of commencement of work

Sub-module 3: Site Works

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • clears and levels a site using mechanical equipment. • sets and lays drains. • builds permanent roads within the site. • constructs	• Site clearance • Levelling • Use of mechanical equipment • Transport and disposal of surplus soil • Land drainage • Setting out	• Lead a guided tour to a nearby site undergoing construction for the learners to observe site clearance and levelling using mechanical equipment, task them to write a group report and present in class. • Group learners to brainstorm on transport and disposal of surplus soil or debris and task them to write a group report and make presentations. • Demonstrate the methods of

Competences	Content	Teaching/Learning Strategies
framed structures.	drainage • Permanent roads • Framed concrete, timber and steel structures	building permanent roads; setting and laying drains within or outside the college. Guide the learners as they practise. • Show a documentary for the learners to observe construction of concrete, steel and timber structures, write a report and present in class. Task them to develop sketches, write a report and present in class.

Assessment Strategy

Task the learners to:

- clear and level the site.
- construct frame structures.

Teaching/Learning Resources

- The Internet
- Charts
- Steel
- Timber
- Rollers
- Graders
- Binders

Sub-module 4: Foundations

Duration: 20 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • carries out tests on bearing capacity of the soil. • builds	• Functional requirements • Bearing tests • Types of foundations and choice of	• Guide learners to tour a site in the initial stage of construction for them to observe excavation of trial holes, task them to write a report and

Competences	Content	Teaching/Learning Strategies
foundations. • designs foundations to resist subsidence and earthquakes. • de-waters trenches. • underpins structures. • lays pipes through walls. • promotes and observes safety guideline when executing works.	foundation, strips, pads and rafts; isolated and continuous column foundations; pile foundations; bored piles, bearing piles, friction piles, sheet piling, pile caps; pier foundations, foundations in expansive clays • Subsidence and earthquakes • Excavations of deep trenches and basements • Exclusion and removal of water (dewatering techniques) • Retaining walls of mass and reinforced concrete • Underpinning • Piping through walls • Safety measures and regulations	present in class. • Demonstrate the procedure of setting out and building foundation and driving of piles. • Group learners to brainstorm design of foundations to resist subsidence, earthquakes and task them to write a group report and make class presentation. • Guide learners to discuss methods of constructing retaining walls in some areas within the college and lay pipes, weep holes through a wall. • Illustrate the methods of underpinning using sketches and task learners to make sketches in their notebooks. • Demonstrate the procedure of underpinning failing structures and guide learners as they practise. Emphasise the safety measures to be put in place while carrying out the repairs.

Assessment Strategy

Task the learners to:

- draw timbering to deep trenches.
- build foundations and lay pipes through walls.
- underpin any failing wall.

Teaching/Learning Resources

- The Internet
- Charts
- Timber
- Bricks
- Binder
- Aggregates

Sub-module 5: Temporary Works

Duration: 14 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • designs and erects temporary work. • observes safety regulations while designing and executing works.	• Design, supervision and erection of temporary works • Timbering to trenches • Shafts and tunnels. • Shoring • Shuttering and formwork to walls, floors, beams, columns, stairs and roofs of concrete • Climbing and moving shutters • Scaffolding; types, materials, and components, causes of failure, safety regulations, safe working provisions. ladders, hoists, lifting gear, gantries • Hoarding	• Lead a guided discussion on the design of temporary works, their relevancy and construction methods. • Illustrate the techniques of timbering to trenches and task learners to make sketches of timbering. • Demonstrate erection of temporary works and guide the learners as they practise. • Guide learners to discuss safety regulations and working provisions for scaffold, timbering to trenches and shoring, emphasising the safety regulations to be observed while erecting and dismantling scaffolds. • Group learners to brainstorm the materials used for temporary works. • Illustrate the sketches and application of site hoarding and task learners to make the illustrations in their notebooks.

Assessment Strategy

Task the learners to:

- erect a simple scaffold.
- carryout formwork shuttering.

Teaching/Learning Resources

- The Internet
- Charts
- Timber
- Fittings
- Steel
- Nails
- Release agents

Bibliography

Chudley, R. (1987). *Building Superstructure.* 2nd Edition, Longman Scientific and Technical

Chudley, R. and Greeno, R. (1999). *Building Construction Handbook.* 3rd Ed. Butterworth-Heinemann, London.

Hall, F. (1990). *Building Services and Equipment, Volumes 1 &2.* 9th Edition, Longman Scientific & Technical

Mckay, W. B. (2000). *Building Construction, Vols 1 to 4.* Longman

Mitchells, (2003). *Building Construction Series.* B. T. Batsford Ltd

Nash, G.W. (1990). *Brickwork*. Stanley Thornes Publishers, London.

Rheid, E. (2000). *Understanding Building: A Multi-disciplinary Approach.* E & FN Spon

Roberts, K. (1981). *Construction Technology Levels 1 -3*. Nelson TEC books

HDEE 111: Computer Programming

Duration: 45 Hours

Module Overview

This module equips the learner with the necessary skills in developing a program algorithms using software development process and modelling methods, implementing control structures and functions, using templates in designing programs, implementing arrays, strings, classes and creating objects, performing dynamic memory allocation in program codes, using inheritance and polymorphism in the program code and performing type conversions of data execution.

The module covers introduction to programming, basics of C++, program structure, compound data types, classes and objects and standard libraries as applied in programming. By learning this module, the learner attains skills of designing and writing computer programs to solve real problems encountered in engineering applications using C++ object-oriented programming language.

Learning Outcomes

By the end of this module, the learner should be able to design and write computer programs to solve real problems encountered in engineering applications using C++ object-oriented programming language.

Preparatory Assignment

Prior to teaching this module, group learners and task them to design a simple program algorithm, write a report and present in class.

Result

Learners present the design of simple program algorithm in class.

Sub-module 1: Introduction to Programming

Duration: 04 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • identifies real life problems such as fluid flow in pipes that require computer programming. • develops a program algorithm using software development process modelling methods and develops drawings.	• Review of computing as applied in engineering • Software development process and modelling methods • C++ and object-oriented programming concepts • Compilers	• Lead a guided discussion on identification of real life problems that require computer programming. • Guide the learners on the use and application of software development and task them to practise. • Demonstrate how to design program algorithm using software development process and modelling methods. Task learners to develop their own programme basing on a particular problem.

Assessment Strategy

Assign the learner to develop a program algorithm using software development process and modelling methods and come up with drawings.

Teaching/Learning Resources

- Computer
- C++ software
- Code editors and compilers
- Writing board

Sub-module 2: Basics of C++ Programming

Duration: 10 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • applies the basics of C++ programming in designing and writing programs. • develops a simple program code.	• Structure of a program • Variables and types • Constants • Operators • Basic input/output	• Demonstrate the approaches applied in developing program structure and guide learners in groups to practise developing different program structures. • Lead a discussion in designing and writing programs using C++ code, emphasising what is to be avoided while writing the programs. • Guide learners on the application of constants, operators, basic input and output.

Assessment Strategy

Task the learners to develop a simple program code.

Teaching/Learning Resources

- Computer
- C++ software
- Code editors and compilers
- Writing board

Sub-module 3: Program Structure

Duration: 06 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • implements the control structures and functions. • uses templates in designing programs correctly.	• Control structures • Functions • Overloads and templates • Name visibility	• Demonstrate the processes of implementing control structures in a program code and guide the learners as they practise. • Guide learners on the steps of developing a program and task learners to write a code and implement control structure and functions. • Guide learners through practise on how to create and use templates in programming.

Assessment Strategy

Assign the learners to correctly use templates in designing programs.

Teaching/Learning Resources

- Computer
- C++ software
- Code editors and compilers
- Writing board

Sub-module 4: Compound Data Types

Duration: 06 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • implements arrays and strings. • performs dynamic memory allocation in a program code.	• Arrays and strings • Character sequence • Pointers • Dynamic memory • Data structure • Other data types	• Demonstrate the procedure of declaring and creating arrays in a C++ program code and guide the learners as they practise. • Lead a discussion to implement pointers and allocate dynamic memory in a program code.

Assessment Strategy

Task the learners to implement arrays, strings and perform dynamic memory allocation in a program code.

Teaching/Learning Resources

- Computer
- C++ software
- Code editors and compilers
- Writing board

Sub-module 5: Classes and Objects

Duration: 04 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • applies operators in a program code using classes and creating objects correctly. • uses inheritance and polymorphism in the program code.	• Classes I & II • Special members • Friendship and inheritance • Polymorphism • Objects	• Guide learners through practise on how to apply operators in a program code using classes and creating objects. • Demonstrate the processes of inheriting classes and task learners to write a program code that implements inheritance and polymorphism.

Assessment Strategy

Task the learners to apply operators in a program code using classes and objects.

Teaching/Learning Resources

- Computer
- C++ software
- Code editors and compilers
- Writing board

Sub-module 6: Standard Libraries and Application

Duration: 13 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • performs type conversions of data execution. • uses the C++ code syntax and semantics for designing programs.	• Type conversions • Exceptions • Input / output files • Header files • Pre-processor directives • Cpp.sh (C++ Shell) • The Standard Template Library	• Demonstrate how to perform type conversions for program executions and guide the learners as they practise. • Guide learners through practice on how to use the C++ code syntax and semantics for designing programs.

Assessment Strategy

Task the learners to perform type conversions of data execution.

Teaching/Learning Resources

- Computer
- C++ software
- Code editors and compilers
- Writing board

Bibliography

- Deitel and P. J. Deitel. (2005). *C++ How to Programme. Pearson International.* Prentice Hall, New Jersey, US. Distributors, Naj Sarak Delhi

HDCE 115: Real Life Project I

Duration: 60 Hours

Module Overview

In this module, the learner is tasked to carry out topographical survey, landscaping and construction of a swimming pool. It involves production of architectural designs, selection of equipment, materials, hands on, investigations/tests and writing of reports.

Learning Outcome

By the end of this module, the learner should be able to:

- produce a contour map.
- build a swimming pool and landscaping.
- write a report.

Preparatory Assignment

Task learners to establish temporary benchmarks and carry out a survey of a plot 40m^2, come up with a contour map and write a report.

Result

Learners present the plotted contour map in class.

Possible Projects in Semester 1 Year 1

Duration: 40 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • takes care of the tools and equipment under his/her control. • selects the appropriate materials for the project.	Possible projects in Year I Semester 1 (choose one project that is to be completed during the semester). A real product should be verifiable. **Proposed project: Topographical map** • Choice of site	• Guide learners to discuss the care for tools and equipment, selection of materials, and identification of the correct tools and machines for the project. • Guide the learners through site selection,

Competences	Content	Teaching/Learning Strategies
• identifies the correct tools, equipment and machines for the project/job. • develops a designed sketch of the required work. • carries out engineering surveying. • produces architectural design. • carries out geotechnical investigation. • follows sequence of operations. • interprets working drawings. • observes health and safety regulations at sites and workshops. • carries out landscaping. • treats formwork against concrete getting stuck on the sides. • carries out site fencing/ hoarding.	• Local authority involvement • Identifying surveying tools and equipment • Identifying reference point e.g. benchmark and building line • Identifying existing features • Carrying out survey exercise on a plot not less than 50x50 m • Field report • Office work • Geotechnical investigations (soil tests) • Drawing topographical map **Proposed project: Landscaping** • Surveying a plot of not less than 40x40 m • Appropriate drawings on A1 paper or blue print • Cutting, levelling • Constructing of retaining wall • Drainage channels • Fencing • Driveway, walkway and parking • Compound and garden details **Proposed project: Construction of a simple and economical swimming pools** • Surveying	local authority involvement, identifying existing features, reference points, surveying processes and map development. • Illustrate the techniques of carrying out geotechnical investigation and drawing of topographical maps. • Lead a guided discussion on safety at site and workshop. • Demonstrate the processes of landscaping a given compound and building retaining walls. • Guide the learners on methods of treating formwork to prevent concrete getting stack on the sides and through site fencing /hoarding. • Illustrate the methods applied in estimating and costing of materials required for the project and task them to determine the cost of their projects. • Guide the learner through setting out, excavation, timbering and constructing a swimming pool and task learners to excavate and level the trench. • Demonstrate the

Competences	Content	Teaching/Learning Strategies
• estimates and costs the required materials. • carries out excavations and timbering. • constructs a swimming pool.	• Design drawing • Estimates and bills materials • Soil tests • Setting out • Excavations • Timbering • Construction • Finishing	processes of plastering and flooring walls and floor of swimming pool and guide learners as they practise.

Assessment Strategy

Task the learners to:

- develop site sketches and working drawings.
- carryout geotechnical investigation and produce topographic maps.
- estimate and cost materials.
- carry out excavations and timbering.
- construct a swimming pool.

Teaching/Learning Resources

Total station
Theodolite
Dampy level
Plumb bobs
Hand saws
Staff
Pair of pliers
Head pan
Wheelbarrow
Spades and shovels
Ladders
Water jericans
Cement
Gauge box
Wooden float
Steel float
Panga
Hand hoe
Pick axe
Stones
Cement blocks
Pit and river sand
Murram
Coarse aggregates
Hard core

Description of Year 1 Semester 2

Year 1 Semester 2				
Semester 2 Year 1 (All Core Modules)	L	P	CH	CU
HDEM 121: Engineering Mathematics V	45	0	45	3
HDCE 121: Structural Mechanics II	45	0	45	3
HDCE 122: Soil Mechanics	30	30	45	3
HDCE 123: Construction Technology IV	30	60	60	4
HDCE 124: Specifications	30	30	45	3
HDCE 125: Water Treatment	30	60	60	4
HDCE 126: Real Life Project	0	120	60	4
Semester Load = 24				
Recess Term (Core Module)	L	P	CH	CU
HDCE 131: Industrial Training	0	480	45	3
Total First Year Credits = 49				

HDEM 121: Engineering Mathematics V

Duration: 45 Hours

Module Overview

This module equips the learner with the skill of solving various problems involving fluids, waves and heat, finding derivatives of functions, using probability theory to do scientific research and applies network flow concepts in project scheduling, planning and control.

Learning Outcomes

By the end of this module, the learner should be able to:

- use probability theory to do scientific research and apply network flow concepts in project scheduling, planning and control.
- use differential equations analysing structural loads.

Preparatory Assignment

Prior to teaching this module, group learners and task them to establish the shortest route across major towns in the region.

Result

Learners research and determine the shortest route across major towns in the region and make group presentations in class.

Sub-module 1: Differential Equations

Duration: 08 Hours

Competence	Content	Teaching/ Learning Strategies
The learner applies differential equations for addressing the theory underlying heat and moisture diffusion within porous media.	• Ordinary differential equations • Second order ordinary differential equations with constant coefficients • Partial differential equations • Exact first order linear equations • The characteristic auxiliary equations • Solution of first and second order equations by separation of variables • Applications to wave equation, heat equation, diffusion equation	• Guide learners through practise to solve partial differential equations and their applications in fluid mechanics. • Illustrate with examples application of differential equations in addressing the theory underlying heat and moisture diffusion within porous media and task the learners to work out examples.

Assessment Strategy

Task the learners to:

- solve partial differential equations and their applications in fluid mechanics.
- use differential equations for addressing the theory underlying heat and moisture diffusion within porous media.

Teaching/Learning Resources

- Writing board
- Fluid
- Charts
- Scientific calculator

Sub-module 2: Integral Transforms

Duration: 12 Hours

Competence	Content	Teaching/ Learning Strategies
The learner uses laplace transforms to provide basic building blocks for control engineering using block diagrams.	• Laplace transforms; definition, theorems, the inverse laplace transform and applications of laplace • Fourier transforms; from fourier series to fourier transforms, properties, differentiation, transfer function • Application to solving differential equations	• Illustrate using examples the methods applied when manipulating integral transforms like fourier transforms, laplace transforms and guide the learners as they practise.

Assessment Strategy

Task the learners to use laplace transforms to provide basic building blocks for control engineering using block diagrams.

Teaching/Learning Resources

- Writing board
- Math tables
- Graph papers
- Scientific calculator

Sub-module 3: Complex Variable Analysis

Duration: 08 Hours

Competence	Content	Teaching/ Learning Strategies
The learner applies complex variables in calculating structural vibration systems.	• Functions of a complex variable; curves and regions • Limits and differentiability of complex functions • Analytic functions cauchy-rieman equations • Complex integrals cauchy's integral formula • The derivative of an analytic function • Contour integrals • Laurent series • Singularities, residues poles	• Illustrate using examples the application of complex variable analysis in determining the structural vibrations in systems and task the learners to work out examples. • Demonstrate how to obtain and sketch transformations of functions of complex variables and guide the learners as they practise. • Guide learners through practise on the evaluation of complex variables for calculating structural vibration systems and task them to work out some examples.

Assessment Strategy

Task the learners to apply complex variables in calculating structural vibration systems.

Teaching/Learning Resources

- Scientific calculator
- Charts
- Graph paper
- Writing board

Sub-module 4: Probability Theory

Duration: 09 Hours

Competence	Content	Teaching/ Learning Strategies
The learner applies statistics and probability in analysing and interpreting collected raw data.	• Definition and assignment of probabilities • Experiments and sample spaces • Conditional probability • Total probability • Mathematical expectation: mean, variance • Probability and moment generating functions • Random variables • Independence of random variables • Discrete and continuous distributions • Common distributions: binomial, poisson, normal, exponential and variance.	• Illustrate the methods of manipulating statistical variables and probability in scientific research and task learners to analyse and interpret given raw data. • Demonstrate the methods used to select data sample size and guide the learners as they practise. • Guide learners through the methods of manipulating the binomial, poison, normal, exponential and variance, relating them to data sampling and analysis and task them to work out given examples.

Assessment Strategy

Assign the learner to apply statistical variables and probability in scientific research.

Teaching/Learning Resources

- Scientific calculator
- Graph paper
- Writing board

Sub-module 5: Linear Programming and Optimisation

Duration: 08 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • uses simplex method to optimise a given function representing a process. • applies network flow concepts in project scheduling, planning and control.	• Formulation • Optimisation by graphical methods and the Simplex method, Min/Max, Max/Min methods, stepping stone method • Dynamic programming • Decision and game theory • Network flow problems and critical paths method (CPM) and project evaluation and review techniques (PERT) in project scheduling, planning and control	• Guide learners through different approaches and practise on the use of simplex method to optimise a given function representing a process. • Group learners and task them to discuss, write a group report and present about the dynamic programming, decision and game theory. • Illustrate the application of network flow concepts in project scheduling, planning and control and task learners to work out some examples.

Assessment Strategy

Assign the learners to use simplex method to optimise a given function representing a process.

Teaching/Learning Resources

- Scientific calculator
- Graph paper
- Charts
- Writing board

Bibliography

Bolton, W. (1997). *Essential Mathematics for Engineering.* Butterworth-Heinemann, London.

Greenberg, D.M. (1998). *Advanced Engineering Mathematics.* 2nd Ed. Prentice-Hall International Inc., New Jersey.

Stroud, K. A. (1984). *Engineering Mathematics, Programmes and Problems,* MacMillan Publishers Ltd, ISBN 0 333 34052 3.

HDCE 121: Structural Mechanics II

Duration: 45 Hours

Module Overview

This module introduces the learner to loads investigation, stress analysis, selection of elements, development of general layout, drawing and detailing structures.

Learning Outcome

By the end of this module, the learner should be able to construct arches and cables.

Preparatory Assignment

Group learners and task them to analyse deformation of a beam using virtual work and energy methods, tasking them to find out the forces causing deformation of materials, write a report and make class presentations.

Result

Learners present in groups forces causing deformation of materials.

Sub-module 1: Analysis of Deformations

Duration: 10 Hours

Competence	Content	Teaching/Learning Strategies
The learner applies virtual work, energy methods and Castigliano's theorem for analysing deformation of structures.	• Virtual work and energy methods • Castigliano's theorem	• Guide learners through analysis of structures using virtual work, energy methods and Castiglino's theorem. Task learners to work out examples from real life situations. • Illustrate with examples analysis of deformation in structures using virtual work and energy methods, Castigliano's theorem and guide the learners as they practise.

Assessment Strategy

Assign the learners to calculate deformations using virtual work, energy methods and Castigliano's theorem

Teaching/Learning Resource

- Calculators

Sub-module 2: Analysis of Indeterminate Structures

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • analyses the rigid frame joint by the moment distribution and slope deflection theorem, three-moment area equations. • draws bending moment diagrams, shear force diagrams and deflected shape of indeterminate structures.	• Moment distribution and slope deflection theorem • Three-moment area equations	• Guide learners through the methods of analysing structures using moment distribution and slope deflection theorem, three-moment area equations to draw bending moment diagram, shear force diagram and deflected shapes of indeterminate structures. Task learners to work out some given examples. • Illustrate with examples analysis of indeterminate structures using moment distribution and slope deflection theorem, three-moment area equations to determine moments and guide learners as they practise.

Assessment Strategy

Task the learners to analyse the rigid frame joint by the moment distribution and slope deflection theorem, three-moment area equations and draw the deflected shape and bending moment diagram.

Teaching/Learning Resource

- Calculators

Sub-module 3: Stiffness and Flexibility Method

Duration: 10 Hours

Competence	Content	Teaching/Learning Strategies
The learner determines reactions, moments, and shear forces by stiffness and flexibility method for continuous beams.	• Truss • Continuous beam and plane frame	• Guide learners through methods of analysing a truss, continuous beam and plane frame using stiffness and flexibility method to determine reactions, moments, and shear forces and task them to workout given examples. • Illustrate with examples the analysis of a truss, continuous beam, plane frame using stiffness and flexibility method to determine moments and shear forces and guide learners as they practise.

Assessment Strategy

Task the learners to analyse a truss, continuous beam and plane frame by stiffness and flexibility method and determine the moments and shear forces.

Teaching/Learning Resource

- Calculators

Sub-module 4: Analysis of Bridges (Arches and Cables)

Duration: 09 Hours

Competence	Content	Teaching/Learning Strategies
The learner determines reactions at the supports and bending moments at any point in the span by analysis with static loads, analytically and graphically and column analogy method.	• Analysis with static loads, analytically and graphically, column analogy method	• Demonstrate the procedure of analysing arches and cables using static loads, analytically and graphically and column analogy method to determine reactions and bending moments and guide the learners as they practise. • Illustrate with examples analysis of cables and arches using static loads, analytically and graphically, column analogy method to determine bending moments and reactions at supports and task learners to workout given examples.

Assessment Strategy

Task the learners to determine reactions at the supports and bending moments at any point in the span.

Teaching/Learning Resource

- Calculators

Sub-module 5: Introduction to Finite-Elements Method

Duration: 06 Hours

Competence	Content	Teaching/Learning Strategies
The learner solves stress problems, draws and assesses meshes.	• Types of elements, stress problems, drawing and assessing meshes	• Lead a guided discussion on types of elements, stress problems, drawing and assessing meshes. • Illustrate with examples analysis of stress problems, drawing and assessing meshes and task learners to workout given examples.

Assessment Strategy

Task the learners to solve stress problems, draw and assess meshes.

Teaching/Learning Resource

- Calculators

Bibliography

Beer, F. P. and Johnston , E. R. (1988). *Vector Mechanics for Engineers: Statics and Dynamics.* Tata McGraw Hill Publishing Co

Cain, I. J. and Hulse, R. (1997). *Structural Mechanics.* 2nd Edition, Macmillan

Durka, A. and Morgan, W. (1998*). Structural Mechanics 2nd Edition*, Palgrave Macmillan

French, S.E. (1995). *Fundamentals of Structural Analysis*. West Publishing Company. New York

HDCE 122: Soil Mechanics

Duration: 45 Hours

Module Overview

This module equips the learner with knowledge and skills of soil investigation, improvement of properties and guidance in selection of foundation type and installation of boreholes.

Learning Outcomes

By the end of this module, the learner should be able to:

- stabilise the soil.
- investigate soil properties.

Preparatory Assignment

Group and task learners to carry out sampling of different soil types, determine bearing capacity, write a report and present in class.

Results

Learners present test results and select right values for determining bearing capacity.

Sub-module 1: Introduction to Soil Mechanics

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • identifies soils for engineering purposes by its properties. • grades and classifies soils for design purposes. • draws soil analytical	• Nature of soils, for engineering purposes • Physical properties of soils • Grading (size distribution • Soil classification	• Lead a guided discussion on nature of soils and the physical properties of soil. • Guide learners to tour the institutes neighbourhood and task them to collect soil samples for comparison, write a report and

Competences	Content	Teaching/Learning Strategies
curves.		present in class. • Group learners to grade and classify the soil and task them to write a group report and make class presentations. • Guide the learners through the processes of grading and classifying soils.

Assessment Strategy

Task the learners to:

- grade soils and draw analytical curves.
- classify soils.

Teaching/Learning Resources

- Grading sieves
- Soil samples
- Graph paper
- Water containers

Sub-module 2: Improvement of Soil Properties

Duration: 09 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • stabilises soils by mechanical, chemical and polymer. • carries out standard proctor compaction tests on soils.	• Soil stabilisation and compaction • Theory of compaction • Standard soil tests • Field control of	• Guide the learners through soil stabilisation processes and ingredients used and task them to stabilise soil samples. • Group learners to carry out standard proctor compaction test on soil and task them to discuss

Competences	Content	Teaching/Learning Strategies
• applies synthetic materials to improve soil properties.	compaction • Use of synthetic materials to improve soil properties	the findings, write a group report and make class presentations. • Guide learners to discuss the theory of compaction, equipment used, the favourable conditions and field control of compaction. • Demonstrate the application of synthetic materials to improve soil properties and guide learners as they practise.

Assessment Strategy

Task the learners to:

- carry standard tests on soil.
- stabilise the soil.

Teaching/Learning Resources

- Synthetic materials
- Soil
- Test tubes

Teaching/Learning Resources

Barnes, G.E. (1995). *Soil Mechanics*. MacMillan, London.

Scott, C.R. (1980). *Introduction to Soil Mechanics and Foundations*. 3rd Ed. Applied Science, Essex.

Sutton, B.H.C. (1983). *Solutions of Problems in Soil Mechanics*. Pitman, London

Sub-module 3: Strength Properties of Soil

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • carries out stress analysis of the soil to determine effective stress. • determines the apparent cohesion and the angle of shearing resistance of the soil. • performs shear box test to determine the shearing resistance of a cohesive soil.	• Stress analysis in soil and rocks • Internal and external stress in soils • The principle of effective stress • Shear strength of soils • Strength tests • Introduction to stress paths	• Illustrate the methods used to carry out stress analysis of the soil so as to determine effective stress and task learners to workout given examples. • Guide learners to discuss the apparent cohesion and the angle of shearing resistance of the soil. • Demonstrate the procedure of carrying out the shear box test to determine the shearing resistance of a cohesive soil and guide the learners as they practise. • Task learners to discuss, write a report and make class presentations on the safety measures to be observed while conducting soil tests.

Assessment Strategy

Task the learners to:

- determine the bearing capacity and shear resistance of a cohesion soil.
- determine effective stress at the footings.

Teaching/Learning Resources

- Shear box
- Soil sample
- Graph paper

Sub-module 4: Consolidation and Settlement

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • carries out consolidated undrained and drained test. • plots consolidation curves. • constructs embankments.	• Consolidation test • Consolidation curves • Pre-consolidation • Settlement computation • Embankment construction	• Guide the learners through consolidated drained and undrained tests and task them to develop consolidation curves and present in class. • group learners to discuss pre-consolidation and settlement computation and present their solutions to class. • Lead a guided discussion on the construction of embankment and task learners to identify the safety measures to be observed during the execution of work. • Demonstrate the methods of constructing embankment and guide learners as they practise.

Assessment Strategy

Task the learners to:

- test and plot consolidation curves.
- construct embankment.

Teaching/Learning Resources

- Shear box
- Soil sample
- Graph paper

Bibliography

Barnes, G.E. (1995). *Soil Mechanics*. MacMillan, London.

Bowels J. E. (2000). *Physical and Geotechnical Properties of Soils*. ISE

Scott, C.R. (1980). *Introduction to Soil Mechanics and Foundations*. 3rd Ed. Applied Science, Essex.

Sutton, B.H.C. (1983). *Solutions of Problems in Soil Mechanics*. Pitman, London

Sub-module 5: Filtration and Drainage of Water through Soils; Groundwater Issues

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • applies permeability in considering seepage under dam, land drainage and water lowering. • constructs earth dams. • uses Darcy law to determine the coefficient of permeability of the soil. • computes total flows and pore water pressure. • carries out piping.	• Permeability • Total and effective stress • Capillarity • Darcy and Bernoulli laws • Seepage flow through soils • Flow nets for sheet-pile, cut-off walls and earth dams • Total flow computations • Pore water pressure calculations • Uplift pressure • Piping and control of piping	• Lead a guided discussion on the importance of permeability to engineers. • Group learners to brainstorm the tasks of total and effective stress and capillarity. • Illustrate with examples the application of Darcy and Bernoulli laws and task learners to practise working out given examples. • Lead a class discussion on flow nets for sheet piles, cut-off walls and earth dams. • Group learners to discuss tasks on total flow computations and pore water pressure calculations. • Lead a guided discussion on uplift pressure, piping and control piping.

Assessment Strategy

Task the learners to:

- determine coefficient of permeability.
- compute total flows and pore water pressure.
- perform fine grained soil method for determining coefficient of permeability.

Teaching/Learning Resources

- Measuring cylinder
- Stop cock
- Stand pipe
- Head permeameter
- Soil sample container

Sub-module 6: Stability of Slopes

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • sketches types of slope failures. • investigates slope stability. • analyses the stability of embankment using total stress and slices method to determine factor of safety of slope. • determines factor of safety of slope using Fellenius and Bishop methods.	• Introduction to slopes stability, granular materials • Infinite slopes • Total stress, effective stress and planar failure analysis • Slope analysis by method of slices • Fellenius and Bishop methods • Slope stability charts	• Lead a guided discussion on slope failure and the possible remedies to overcome such failures. • Group learners to brainstorm the tasks on infinite slopes and granular materials. Task them to write a group report and make presentations. • Illustrate with examples the application of total stress, effective stress and planar failure analysis and guide learners as they practise. • Lead a discussion on total stress and slope analysis by method of slices to determine factor of safety of slope. • Group learners to discuss tasks on determining factors of safety of slope using Fellenius and Bishop methods. • Lead a guided discussion on slope stability charts. Task learners to make illustrations of stability charts.

Assessment Strategy

Task the learners to:

- sketch the three types of slope failure.
- determine factor of safety of slope using method of slices.

Teaching/Learning Resources

- Calculator
- Charts
- Real life project

Bibliography

Barnes, G.E. (1995). *Soil Mechanics*. MacMillan, London.

Bowels, J. E. (2000). *Physical and Geotechnical Properties of Soils*. ISE

Scott, C.R. (1980). *Introduction to Soil Mechanics and Foundations*. 3rd Ed. Applied Science, Essex.

Sutton, B.H.C. (1983). *Solutions of Problems in Soil Mechanics*. Pitman, London

HDCE 123: Construction Technology IV

Duration: 60 Hours

Module Overview

This module equips the learner with knowledge and skills of constructing storeyed structures as well as making and fixing doors and windows. It also involves practice in building requirements and regulations.

Learning Outcome

By the end of this module, the learner should be able to build and supervise super structures and floors of storey buildings.

Preparatory Assignment

Task learners to group building components by trade and make sketches of a roof truss and suspended floor slab formwork.

Results

Learners present their group sketches of roofs truss and slab formwork.

Sub-module 1: Superstructure

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • constructs single and multi-storey of timber, frames steel and reinforced concrete. • sketches and details frame layout, beams,	• Single storey construction in timber, steel and reinforced concrete • Multi-storey structural frames of steel and reinforced concrete • Frame layout, beams, columns, grid,	• Lead a guided tour to sites with single and multi-storey construction of timber, frames steel and reinforced concrete for the learners to observe, inquire of the steps involved in construction, write a report and present in class. • Illustrate with examples sketches and details of frame layout, beams, columns, grid and continuity and guide the learners as they practise. • Guide the learners through

Competences	Content	Teaching/Learning Strategies
columns, grid and continuity. • constructs and applies thermal and sound insulation to load bearing construction in brick, stone, concrete, stressed skin construction, composite and prefabricated units.	continuity • Load bearing wall construction in brick, block, stone, concrete, cross walls, box frames, wind bracing • Stressed skin construction; composite construction, prefabricated units • Thermal and sound insulation	construction and application of thermal and sound insulation to load bearing construction in brick, stone, concrete, stressed skin construction, composite and prefabricated units. • Lead a guided tour to a site for the learners to observe and inquire about the construction and application of thermal and sound insulation to stressed skin construction, composite and prefabricated units. Task them to write a report and make presentations in class.

Assessment Strategy

Assign the learners to:

- sketch, detail and construct frame layout, beams, columns and grid.
- construct and apply thermal and sound insulation to load bearing construction in brick, stone, concrete, stressed skin, composite and prefabricated units.

Teaching/Learning Resources

- Bricklayer tool kit
- Bricks, stone, concrete, timber, steel and blocks
- Prefabricated units
- Thermal and sound insulation materials

Sub-module 2: Formwork Design

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • sketches and draws various formworks to scale. • fabricates and carries out formwork shuttering.	• Foundation • Walls • Beams, columns and slabs • Stairs • Drainage channels, end structures in culverts and bridges	• Lead a guided discussion on various formworks, their construction and maintenance. • Demonstrate the techniques of sketching and drawing formwork to scale and guide the learners as they practise. • Guide learners through the methods of fabricating and carrying out formwork shuttering. • Lead a guided tour to a site with formwork fabrication and shuttering for learners to observe and inquire how they are done. Task them to write reports and make presentations in class.

Assessment Strategy

Assign the learners to:

- sketch and draw formwork to scale.
- fabricate formworks.
- carryout formwork shuttering.

Teaching/Learning Resources

- Carpenter's tool kit
- Timber
- Steel
- Nails
- Poles
- Moulds

Sub-module 3: Floor Structures

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • sketches solid ground floor, suspended timber ground floor; reinforced concrete and steel upper floor. • constructs solid ground floor; suspended timber ground floor; reinforced concrete and steel upper floor and applies anti-vibration base for machines and floor finishes.	• Functional requirements of floors • Types of floors • Structure and construction of floor • Factors for the choice of floor structure • Solid ground floor, suspended ground floor in timber • Reinforced concrete and steel upper floor • Anti-vibration bases for machines • Floor finishes	• Lead a guided discussion on functional requirements, choice of floor for structure and sketching solid ground floor, suspended timber ground floor, reinforced concrete and steel upper floor. • Guide learners to tour a site with solid ground floor, suspended timber ground floor, reinforced concrete and steel upper floor construction and application of anti-vibration base for machines and floor finishes for the learners to observe and inquire how they are done, task them to write reports and present in class. • Together with learners, illustrate with sketches the structure of: solid ground floor, suspended timber ground floor, reinforced concrete and steel upper floor. • Guide learners to brainstorm construction and application of anti-vibration base for machines and floor finishes.

Assessment Strategy

Task the learners to:

- identify the requirements of floor and sketch solid ground floors, suspended timber ground floors and reinforced concrete floors.
- construct solid ground floors, suspended timber ground floors and reinforced concrete floors.

Teaching/Learning Resources

- Carpenter's tool kit
- Timber
- Steel
- Nails
- Cement
- Aggregate
- Hardcore
- Mixer

Sub-module 4: Roof Structures

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • selects appropriate roof for a structure. • sketches and draws details of a truss to scale. • constructs roofs, provides openings and fixes coverings. • installs insulation, solar protection units and rainwater disposal system.	• Functional requirements, types and construction • Choice of roof structure; flat roofs (single and double flat roofs in timber, reinforced concrete flat roofs), pitched roofs (single pitched roofs in timber, double/purlin roofs, triple/trussed roofs) • Openings in timber roofs, steel roof trusses and rigid frames. • Roof coverings	• Lead a guided discussion on functional requirements and choice of roof structure. • Illustrate the techniques of sketching different types of roofs and task learners to practise making sketches in their notebooks. • Display different joints of the truss and task the learners to identify and draw its detail. • Guide learners through roof truss construction, provision of openings and fixing covering materials. • Lead a guided tour to a site with roof work for the learners to observe and inquire stages of truss construction, task them to write a report and present. • Demonstrate the methods

Competences	Content	Teaching/Learning Strategies
	and methods of fixing • Insulation, condensation and solar protection • Rainwater disposal	of installing insulation, solar protection units and rainwater disposal system and guide the learners as they practise.

Assessment Strategy

Task the learners to:

- sketch and draw details of roof trusses.
- construct roofs, provide openings, fix covering, install insulation and fix rainwater disposal system.

Teaching/Learning Resources

- Carpenter's tool kit
- Timber
- Steel
- Nails
- Cement
- Aggregate
- Iron sheets, tiles
- Hoop iron
- Mixer
- Gutters

Sub-module 5: Doors and Windows

Duration: 14 Hours

Competence	Content	Teaching/Learning Strategies
The learner sketches, fabricates and fixes double glazing, roller shutters, folding,	• Double glazing, folding and sliding doors, roller shutters, swing and	• Lead a guided discussion on operational system of double glazing, roller shutters, folding, sliding and swing and revolving doors

sliding, swing and revolving doors, large timber and metal window frames and sashes of various types.	revolving doors • Large timber and metal window frames and sashes of various types	and their application. • Guide learners through sketching and fabricating double glazing, roller shutters and folding, sliding, swing and revolving doors; large timber and metal window frames; sashes of various types. Task them to fabricate and fix a metal window. • Guide learners in a discussion to compare timber, metal, aluminium doors and windows and methods of fixing them.

Assessment Strategy

Task the learners to fix double glazing, roller shutters; folding, sliding, swing, revolving doors; large timber and metal window frames; sashes of various types.

Teaching/Learning Resources

- Models of doors and windows
- Timber
- Steel
- Nails
- Cement
- Aluminium sheets
- Iron mongary
- Gear
- Mixer
- Gutters

Bibliography

Chudley, R. (1987). *Building Superstructure*. 2nd Edition, Longman Scientific and Technical

Chudley, R. and Greeno, R. (1999). *Building Construction Handbook*. 3rd Ed. Butterworth-Heinemann, London.
Hall, F. (1990). *Building Services and Equipment.* Volumes 1 &2, 9th Edition, Longman Scientific & Technical
Mckay, W. B. (2000). *Building Construction. Vols 1 to 4* Longman
Mitchells (2003). *Building Construction Series.* B. T. Batsford Ltd
Nash, G.W. 1990. *Brickwork*. Stanley Thornes Publishers, London
Rheid, E. (2000). *Understanding Building; A Multi-displinary Approach.* E & FN Spon
Roberts, K. (1981). *Construction Technology Levels 1 -3.* Nelson TEC Books

HDCE 124: Estimating and Tendering

Duration: 45 Hours

Module Overview

This module introduces the learner to the process of expressing interest in response to an invitation for tender with an appropriate estimate. It equips the learner with the skills and knowledge of organisation of construction firms and costing of construction works.

Learning Outcomes

By the end of this module, the learner should be able to:

- build unit rates for a project.
- prepare a tender document.

Preparatory Assignment

Lead a guided tour to a construction material hardware and sites to establish the cost of materials and task them to calculate the following in groups:

i) cost of constructing a plinth wall up to floor slab.
ii) cost of building walls of a room of 6m long by 4m wide by 3m high and thickness 225mm in header bond from DPC up to rendering, plastering and painting processes.
iii) cost of making a complete standard panelled door.

Result

Learners present their developed unit rates in the class.

Sub-module 1: Tendering

Duration: 15 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • prepares a tender and bid document. • bids for work under any method of tendering. • negotiates for construction work. • observes construction firm regulations and organisational structure.	• Prequalification • Open tendering • Selective tendering • Negotiated contracts • Construction firm's organisation • Departments involved in tender preparation	• Group learners and guide them to discuss and prepare a tender and bid document for construction work. • Lead a guided discussion on how to bid for work under open domestic biding. • Give a sample of an invitation to bid for works under open domestic biding and task learners to conceptualise and respond. • Group learners to brainstorm how to negotiate for construction work and task them to write a group report and make class presentations. • Lead a guided discussion on a construction firm's organisational structure and task learners to identify the roles for different personnel involved.

Assessment Strategy

Task the learners to:

- prepare a tender document.
- prepare a bid document.

Teaching/Learning Resources

- Sample of biding document
- Public Procurement and Disposal of Public Assets (PPDA) Act
- Sample of tender document

Sub-module 2: Estimation

Duration: 30 Hours

Competences	Content	Teaching/ Learning Strategies
The learner: • builds up unit rates for labour and materials. • identifies sources of information for pricing and labour constants. • prices and matches constructio n plants. • carries out evaluation of work. • presents estimates for estimate adjudicatio n and tender submission. • reconciles site cost information with tender rates.	• Basic wage rate, labour rate build-up, allowance for non-productive time and wastage on materials • Analysis of work items on bills of quantities for resource cost components • Sources of cost information for use in pricing, labour constants, considerations in deciding costs and output constants to use in unit rate build-up, use of checklist for collecting project information and use of published codes for estimating • Synthesis of unit rates for common work items, earthworks, concrete work, block/brickwork, formwork, carpentry and joinery, roof coverings, finishing, electrical installation, plumbing and painting • Pricing, matching and unit rates of construction plant • Net and gross pricing, pricing for profit and attendance, preliminaries, day works, deemed-to-be included items, prime cost sum, pricing spot items, provisional sum, project costs and general overheads allowing for cost fluctuations in fixed price and	• Guide learners to discuss the sources of information used for pricing, labour constants, and constraints. • Lead a guided discussion on techniques of building up unit rates. • Illustrate with examples the pricing, matching and unit rates development of construction plants and task learners to practise using given examples. • Give learners samples of work to carry out evaluation and task them to write a report and present their work in class. • Demonstrate the techniques of presenting estimates for adjudication and tender submission and guide learners

Competences	Content	Teaching/ Learning Strategies
	cost reimbursement contracts • Consideration of construction methods and pretender programmes • Presentation of estimate, estimate adjudication and tender submission • Reconciling site cost information with tender rates	as they practise. • Illustrate the approaches used to reconcile site cost information with tender rates and task learners to practise.

Assessment Strategy

Assign the learners to:

- build up unit rates.
- price and match construction plant.
- present estimates for estimate adjudication and tender submission.

Teaching/Learning Resources

- Drawings
- Calculator

Bibliography

Ashworth, A. (1996). *Pre-contract Studies: Development Economics Estimating and Tendering*, Longman

Ashworth, A. (1996). *SMM7 The Standard Method of Measurement of Building Works.* Longman

CIOB (1994). *Code of Estimating Practice.* 6th Edition. Pearson

McGeorge, D. and Palmer, A. (2002). *Tenders and Contracts for Buildings.* 3rd Edition, Blackwell Science

Schofield, W. (2001*). Computer Aided Estimating, A guide to Good Practice.* Butterworth Heinemann

Seeley, I. (1997). *Building Quantities Explained.* 5th Edition, Longman

Seeley, I. H. (1993). *Civil Engineering Quantities*. 5th Edition, MacMillan, London.

HDCE 125: Water Treatment

Duration: 45 Hours

Module Overview

This module introduces the learner to knowledge and awareness of environmental problems associated with water. It exposes the learner to water treatment methods as well as rural and urban water supply. It equips the learner with skills of treating water.

Learning Outcome

By the end of this module, the learner should be able to:

- assess and treat water.
- protect and preserve water sources.

Preparatory Assignment

Lead a guided tour to a water treatment plant starting from intake to distribution points for learners to observe and make inquiry on treatment processes.

Result

Learners present their observations in the class.

Sub- module 1: Water Quality

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • identifies physical, chemical and biological aspects of water. • tests for microorganism and pathogens in	• Physical aspects; temperature, colour, turbidity, suspended solids, dissolved solids, taste and odour; their effects and testing • Chemical aspects: acidity and alkalinity (pH); hardness; electrical conductivity; chemical	• Lead a guided discussion on physical, chemical, and biological aspects of water. • Guide learners to carry out tests for microorganisms and pathogens in water using

Competences	Content	Teaching/Learning Strategies
water. • applies Uganda Water Quality Guidelines, WHO, and NEMA standards for drinking water supply, industrial, agriculture, irrigation, livestock, and recreational uses. • identifies and protects suitable water sources.	content (iron, manganese, fluoride, chloride, nitrogen, phenols, phosphates, potassium, radioactive substances, silica, sodium, sulphates); their effects and testing • Biological aspects: micro-organisms (classification, identification, effects and testing); pathogenic organisms (types, effects and testing) • Uganda Water Quality Guidelines, WHO and NEMA standards for drinking water supply, industrial, agricultural, irrigation, livestock and recreational uses • Regulations and Water Supply Act and Water Works Act • Consideration of the quality of different water sources: lakes, rivers, wells, protected strings, gravity flow sources, rainwater	different water samples. • Group learners to brainstorm the Uganda Water Quality Guidelines, WHO and NEMA standards for drinking water supply, industrial, agriculture, irrigation, livestock, and recreational uses. • Lead a guided discussion on water supply and water works Acts. • Group learners to discuss quality of different water sources in their areas, task them to write a group report and make presentations. • Lead a guided tour to different water sources for the learners to observe water quality, test the water, write a report and present.

Assessment Strategy

Task the learners to:

- test for microorganisms and pathogens in water.
- identify and protect water sources.

Teaching/Learning Resource

- water
- Uganda Water Quality Guidelines document
- WHO and NEMA standards for drinking water supply, industrial document

Bibliography

Linsley, R. K. et al. (1992). *Water Resources Engineering*. 4th Ed. McGraw Hill, New York.

McGhee, T.J. (1991). *Water Supply and Sewerage*. 4th Ed. McGraw-Hill, New York

Sub-module 2: General Water Treatment

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • carries out water treatment by sand filtration, coagulation, flocculation and disinfection. • constructs simple filter unit.	• Applied environmental / water supply chemistry • Purpose of treatment • Steps in treatment: - storage and settlement (purpose, settling rates, types of settlers and their construction) - flocculation and coagulation (purpose, types of coagulants, their advantages and disadvantages, types of flocculators) - aeration (purpose, types of aerators, advantages and disadvantages) - filtration (purpose, cleaning	• Group learners to brainstorm the stages of water treatment. • Demonstrate the treatment of water by sand filtration, coagulation, flocculation and disinfection and guide the learners as they practise. • Lead a guided tour to a water treatment plant for the learners to observe and inquire stages of water treatment. Task them to write a report and present in class. • Demonstrate the procedure of

Competences	Content	Teaching/Learning Strategies
	/backwashing) - disinfection (purpose, factors affecting disinfection of water, types of disinfectants)	constructing a simple filter unit and guide learners as they practise. • Lead a guided tour to an already built filter unit for the learners to observe its construction, write a report and present.

Assessment Strategy

Task the learners to:

- treat water.
- build filter unit.

Teaching/Learning Resources

- Water
- Disinfectants

Bibliography

Linsley, R. K. et al. (1992). *Water Resources Engineering*. 4th Ed. McGraw Hill, New York.

McGhee, T.J. (1991). *Water Supply and Sewerage*. 4th Ed. McGraw-Hill, New York

Sub-module 3: Rural Water Supply and Treatment

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • recommends appropriate treatment methods for rural areas. • appreciates the purpose of chlorination unit.	• Typical methods of treatment • Construction and use of simple filters and chlorination units	• Lead a guided discussion on typical methods for rural water treatment and the use of simple filters and chlorine units. • Lead a guided tour to a water treatment plant for the learners to observe and analyse construction and use of simple filters and chlorine units. Task learners to write a report and make presentations.

Assessment Strategy

Task the learners to:

- use typical treatment methods for rural area.
- write the purpose of a chlorine unit.

Teaching/Learning Resources

- Water
- Chlorine

Sub-module 4: Treatment Methods for Urban Water Supplies

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses appropriate treatment methods for urban areas. • determines chlorine dose for relevant volume of water based on the method of treatment. • designs a simple water treatment system. • carries out sludge treatment and disposal process.	• Initial preparation (screening, algal control, pre-chlorination) • Aeration • Sedimentation • Mixing and flocculation • Clarification with flocculation • Filtration, disinfection (chlorination and fluoridation) • Water softening (lime, soda ash, ion exchange method) • Turbidity removal • Taste and odour control • Demineralisation / desalination • Sludge treatment and disposal	• Guide learners to treat urban water. • Group learners to brainstorm determination of chlorine dose for relevant volume of water based on the method of treatment. Task them to write a group report and make presentations in class. • Demonstrate the design process of a simple water treatment system and guide the learners as they practise. • Lead a guided discussion on sludge treatment and disposal. • Guide learners through sludge treatment and disposal process and task them to develop the alternative disposal method.

Assessment Strategy

Task the learner to:

- use typical treatment methods for urban areas.

- determine chlorine doses for relevant volume of water based on method of treatment.
- carry out sludge treatment and disposal.

Teaching/Learning Resources

- Water
- Chlorine
- Lime
- Soda ash

Sub-module 5: Treatment Plant Drawing Exercises

Duration: 06 Hours

Competence	Content	Teaching/Learning Strategies
The learner produces the layout of protected springs, gravity floor scheme, rainwater harvesting system and water treatment plant.	• Protected springs • Gravity flow Scheme • Rainwater • Layout of treatment plant for urban water supplies	• Lead a guided tour to protected springs, gravity flow scheme, rainwater harvesting system and water treatment plant for the learners to observe the layouts. Task learners to write a report and make presentations in class. • Guide learners through the techniques of producing layout of protected springs, gravity flow scheme, rainwater harvesting system and water treatment plant and task them to produce gravity flow scheme layouts.

Assessment Strategy

Assign the learner to draw a layout of protected spring, gravity floor scheme, rainwater harvesting system and water treatment plant.

Teaching/Learning Resources

- Drawing paper
- Drawing set

Bibliography

Linsley, R.K. et al. (1992). *Water Resources Engineering*. 4th Ed. McGraw Hill, New York.

McGhee, T.J. (1991). *Water Supply and Sewerage.* 4th Ed. McGraw-Hill, New York

Sub-module 6: Practical / Fieldwork

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • identifies sanitary problems around water source and collects water samples for testing. • carries out a test on water quality.	• Sanitary surveys and water sampling • Testing of water quality	• Lead a guided tour to water sources for learners to carry out sanitary survey and water sampling. Task them to write a report and present in class. • Lead a guided visit to a water treatment plant for the learners to observe water testing process, task learners to collect water samples for testing, write a report and make presentations. • Guide learners through carrying out tests for water quality.

Assessment Strategy

Assign the learner to:

- survey water sources to identify sanitary problems.
- perform water quality tests.

Teaching/Learning Resources

- Books

- Pens
- Documentaries on water sources

Bibliography

Linsley, R.K. et al. (1992). *Water Resources Engineering*. 4th Ed. McGraw Hill, New York.

McGhee, T.J. (1991). *Water Supply and Sewerage.* 4th Ed. McGraw-Hill, New York

HDCE 126: Real Life Project II

Duration: 60 Hours

Module Overview

In this module, the learner constructs a structure of at least two storeys and surface water runoff harvesting system. It involves production of architectural designs, selection of equipment, materials, hands on investigations/tests and report writing.

Learning Outcomes

By the end of this module, the learner should be able to:

- design a two storey structure and surface runoff harvesting system.
- build a two storey structure and surface runoff harvesting system.
- write a report.

Preparatory Assignment

Task learners to move around the college to assess the surface runoff in order to determine the design of surface water collection.

Result

Learners come up with design and present in the class.

Sub-module: Possible Project II in Year 1 Semester 2

Duration: 60 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • generates and sketches drawings. • produces actual architectural	**Proposed projects:** - A staff house accommodating two families - A dormitory accommodating 200	• Lead a guided discussion on sketching and drawing of plans. • Guide the learners in carrying out

Competences	Content	Teaching/Learning Strategies
and detailed structural drawings. • carries out engineering surveying. • clears the site. • carries out geotechnical investigation. • quantifies and costs for materials. • sets out, excavates foundation trench, casts foundation concrete, builds plinth walls, backfills, places and compacts hardcore, blinds, applies DPM, shutters, casts over-site concrete and cures. • takes care of tools and equipment under his/her control. • identifies correct tools, equipment and machines for the project/job.	students - Head of department's offices of a college • Preparing and sketching the plan/drawings • Preparing actual drawings of the plan • Costing and quantifying of materials • Innovation and modification • Setting out the structure • Excavating foundation trench • Casting foundation concrete • Plinth walling • Backfilling • Placing and compacting hardcore • Blinding • Applying DPM • Shuttering • Casting over-site concrete • Curing **Proposed project** Construction of a surface water runoff harvesting system or roof surface rain water harvesting system including installation of sinks, baths, water closets • Surveying • Preparing of drawings • Preparing estimates and bill of quantities • Carrying out material tests	engineering survey work. • Let the learners clear and level the site. • Guide learners in drawing topographical maps. • Guide the learners in carrying out geotechnical Investigation. • Lead a guided discussion on estimation and costing of materials required for the project. • Demonstrate the techniques of setting out, excavating foundation trench, casting foundation concrete, building plinth walling, backfilling, placing and compacting hardcore, blinding, applying DPM, shuttering, casting over-site concrete and curing and guide learners as they practise. • Lead a guided discussion on care of tools and equipment, selection of materials and identification of the

Competences	Content	Teaching/Learning Strategies
• observes safety and health at the sites and workshops. • carries out site fencing/ hoarding.	• Site clearance • Setting out • Carrying out excavation • Constructing or installing	correct tools and machines for the project. • Lead a guided discussion on safety at site and workshop. • Guide learners through site fencing /hoarding.

Assessment Strategy

Task the learners to:

- sort and identify tools and equipment used for engineering survey as well as develop site sketches and working drawings.
- produce topographic map.
- carry out geotechnical investigation.
- carry out estimation and materials costing.
- set out, excavate foundation trench, cast foundation concrete, build plinth walling, backfill, place and compact hardcore, blind, apply DPM, shutter, cast over-site concrete and cure.

Teaching/Learning Resources

- Total station
- Theodolite
- Dumpy level
- Plumb bobs
- Hand saws
- Staff
- Cement
- Gauge box
- Wooden float
- Steel float
- Pick axe
- Stones
- Cement blocks
- Pit and river sand
- Murram
- Coarse aggregates

HDCE 131: Industrial Training

Duration: 480 Hours

Module Overview

This module bridges the gaps between the training institution and the industry as it exposes the learner to various challenges and management approaches, thereby enabling him/her acquire technical work experience.

Learning Outcome

By the end of this module, the learner should be able to apply the acquired skills in building and civil works.

Preparatory Assignment

Task learners to identify places for Industrial Training.

Results

Learners present their identified industries to the Industrial Training coordinator.
Duration: 450Hours

Competences	Content	Teaching/Learning Strategies
The learner: • acquaints with the industry. • relates with workers. • organises, administers and manages materials. • uses tools, equipment and plant as required. • carries out site clearance and earth works.	• Industrial acquaintance • Relationship with fellow workers • Use of tools, equipment and plant • Site clearance and earth works • Design of a structure • Setting out a structure • Excavations • Laying of foundations • Casting of over site concrete	• Lead a guided discussion on industrial acquaintance, organisations and relationships in the industry. • Group learners to discuss management of materials, tools and equipment. • Lead a guided tour to a site and

Competences	Content	Teaching/Learning Strategies
• designs structures. • sets out construction works. • executes construction of structures. • performs laboratory and field tests. • executes finishing works. • supervises works. • prepares bills of quantities. • manufactures construction materials. • observes health, safety and welfare considerations. • writes industrial training report.	• Constructing a structure • Laying columns • Reinforcing columns • Shuttering of columns • Checking the levels of columns • Construction of beams and slabs • Formwork of beams and slabs • Levelling of beams and slabs • Electrical fittings and fixtures • Oiling and placing cover blocks • Concreting, curing and de-shuttering • Carrying out tests • Finishing works • Supervision • Bill of quantities • Manufacture of construction materials • Safety, health and welfare considerations	a material testing laboratory for learners to observe site clearance, earthworks, setting out, construction works and material testing, and let them write a report and present in class. • Lead a guided discussion on supervision of work, preparation of bills of quantities and manufacture of materials. • Group learners to brainstorm the health safety and welfare considerations. • Guide learners through writing reports and making presentations.

Assessment Strategy

Task the learners to:

- design structures.
- set out construction works.
- execute construction of structures.
- carry out laboratory and field tests.

Teaching/Learning Resources

- Total station
- Theodolite
- Dumpy level
- Plumb bobs
- Hand saws
- Staff
- Cement
- Gauge box
- Wooden float
- Brick layer's tool kit
- Machete (panga)
- Hand hoe

Sub-module 3: Entrepreneurship Skills

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • plans for business. • opens up an enterprise. • advertises his/her products.	• Innovation and creativity • Opening up an enterprise • Adverting products • Sale and purchase of products	• Lead a guided discussion on innovation, creativity and opening up of an enterprise. • Guide learners on how to write an advert, sale and purchase products.

Assessment Strategy

Task the learners to:

- open up an enterprise.
- make an advert for his or her products.

Teaching/Learning Resources

- A sample of an advert
- Manufactured concrete products like pavers, culverts, blocks, curves

Description of Year 2 Semester 1

Code	Module Title	L	P	CH	CU
HDCE 211	Design of Structures I	30	30	45	3
HDCE 212 111	Highway Engineering I	30	30	45	3
HDCE 213	Fluid Mechanics	30	30	45	3
HDCE 214	Measurement of Civil and Building Works	30	60	60	4
HDEE 211	Computer Programming	30	30	45	4
HDCE 216	Concrete Technology	30	30	45	3
HDCE 217	Real Life Project	0	120	60	4
Semester Load = 23					

HDCE 211: Design of Structures I

Duration: 45 Hours

Module Overview

This module equips the learner with skills and knowledge of designing and detailing concrete structures.

Learning Outcome

By the end of this module, the learner should be able to:

- investigate loads.
- analyse stress.
- select elements to be designed.
- draw and detail structures.

Preparatory Assignment

Group learners to compute and prepare structural calculations for a selected detailed drawing of a building and let them determine material requirements/schedules.

Result

Learners present their solutions in the class.

Sub-module 1: Introduction to Limit State Design

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • Targets to attain the probability of limit states being reached above the sum of all members in the structure is appropriate to	• Ultimate limit state: considering strength, stability and robustness • Serviceability limit state: deflection, durability (fire and corrosion	• Lead a guided discussion to design a concrete structure using ultimate limit state and check for serviceability limit state. • Group learners to

Competences	Content	Teaching/Learning Strategies
the limit state. • makes sure that the structure is safe to resist forces subjected to it and fulfils its intended purpose during its lifespan. • designs a structure which is economical with regards to its initial and maintenance costs. • applies design standards in design of elements of a structure. • analyses and designs ties. • uses moment distribution and computer application to analyse framed structures.	resistance), vibration • Material properties for steel, concrete and partial safety factor of materials • Design standards: historical review, elastic analysis; CP114, limit state design; CP110, BS 8110, EC. 2 and 3 • Loading: dead imposed (permanent action) and notional loads (variable action), load combinations and partial safety factors for loads • Robustness and design of ties, importance of robustness in explosions and terrorists attack • Analysis of framed structures using moment distribution and computer applications	brainstorm the material properties for steel and concrete for partial safety factor of materials. • Guide learners to interpret design standards clauses. • Lead a guided discussion on imposed loads (variable actions), dead loads (permanent actions), load combinations and partial factor of safety. • Lead a guided discussion on robustness and design of ties. • Illustrate with examples the methods of analysing framed structures using moment distribution and computer application. Task the learners to analyse framed structures using moment distribution and computer application.

Assessment Strategy

Task the learners to:

- categories combined loads.
- analyse a framed structure using moment distribution and computer application.

Teaching/Learning Resources

- Euro Code 2 (2000) Concrete
- Euro Code 3 (2000) Steel
- CP114, Limit State Design; CP110, BS 8110

Sub-module 2: Design of Beams

Duration: 4 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • examines member sizes, estimates loading, moment reinforcement, curtailment and end anchorage, shear, torsional movements, deflection and cracking. • differentiates between balanced, under and over reinforced sections. • designs singly and doubly reinforced, and flanged beams with neutral axis in the web or flange using analytical and design charts.	• Simply supported and continuous beams; (loading, analysis, moment redistribution) • Analysis of beams: assumptions, parabolic and rectangular stress blocks • Singly reinforced beams: moments of resistance, balanced, under and over reinforced sections, design of sections using analytical and design charts • Design of doubly reinforced beams • Design of flanged beams with neutral axis in the web or flange	• Lead a guided discussion on design of simply supported and continuous beams; (loading, analysis, moment redistribution). • Discuss with learners the design approaches of singly and doubly reinforced beams. • Guide learners through interpretation of design charts. • Task learners to design flanged beams with neutral axis in the web or flange.

Assessment Strategy

Task the learners to:

- examine for the size of members, estimate loading, moment reinforcement, curtailment and end anchorage, shear, torsional movements, deflection and cracking.
- differentiate between balanced, under and over reinforced sections.
- design singly reinforced, doubly reinforced and flanged beams with neutral axis in the web or flange using analytical and design charts.

Teaching/Learning Resources

- Euro Code 2 (2000) Concrete
- Euro Code 3 (2000) Steel
- CP114, Limit state Design; CP110, BS 8110

Sub-module 3: Shear, Bond and Torsion

Duration: 3 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • determines the design of shear stress, provides minimum links, anchorage of links, and checks weather the overall dimensions of the sections are adequate. • calculates length of bars required, anchorage bond stress, ultimate anchorage bond length in relation to adhesion, friction and bearing. • determines torsional moment T,	• Shear strength of a reinforced concrete beam without links • Shear resistance of links • Shear resistance of bent up bars • Shear in slabs • Local bond, anchorage bond and length • Hooks, bends, laps, joints	• Group learners and task them to design for shear stress, minimum links, anchorage of links, and check whether the overall dimensions of the section are adequate. • Guide learners on calculation of length of bars required, anchorage bond stress, ultimate anchorage bond length in relation to adhesion, friction and bearing. • demonstrate through the design of torsion to determine torsional moment T, torsional

Competences	Content	Teaching/Learning Strategies
torsional shear, torsional stress, flange section, box section, design torsional reinforcement and structural detailing requirement.	• Torsion analysis, torsion shear stress and reinforcement	shear, torsional stress, flange section, box section, design torsional reinforcement and structural detailing requirement and guide the learners as they practise.

Assessment Strategy

Task the learners to:

- determine the design shear stress, minimum links, anchorage of links, and check whether the overall dimensions of the section are adequate.
- calculate the length of the bar required, anchorage bond stress, ultimate anchorage bond length in relation to adhesion, friction and bearing.
- determine torsional moment T, torsional shear, torsional stress, flange section, box section, design torsional reinforcement and structural detailing requirement.

Teaching/Learning Resources

- Euro Code 2 (2000) Concrete
- Euro Code 3 (2000) Steel
- CP114, Limit state Design; CP110, BS 8110

Sub-module 4: Design of Slabs

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • classifies slabs basing on nature of support, direction of	• Classification of slabs based on: nature of support (simply supported, continuous, flat	• Lead a guided discussion on the classification of slabs basing on nature and direction of support and type of section.

Competences	Content	Teaching/Learning Strategies
support and type of section. • determines the design loads, shear and bending moments diagrams in the slab, design moment of steel, minimum area of reinforcement bars, curtailment of bars, concrete cover and fire resistance. • checks for shear, cracking, deflection and anchorage controls. • details the slab.	slabs); direction of support (one way and two way supporting); type of section (solid, hollow blocks, ribbed slabs) • Design of main and secondary slab reinforcement in one way (solid and ribbed/hollow block) slab, and two way slab • Checking for Shear control in slabs • Checking for Deflection control in slabs • Checking for cracking control in slabs • Anchorage and detailing • Introduction to yield line method • Detailing	• Guide learners on the methods of calculating design loads, shear and bending moment in slab, design of main and secondary slab reinforcement, concrete cover, fire resistance, check for control of shear, cracking, deflection and anchorage control of one way (solid and ribbed/hollow block) and two way slabs. • Demonstrate the techniques of checking for shear, deflection and cracking control in slabs and guide the learners as they practise. • Illustrate the anchorage detailing and yield line and task learners to work out given examples. • Guide learners through detailing of slabs.

Assessment Strategy

Task the learners to:

- classify slabs basing on nature and direction of supports, and type of section.
- determine design loads, shear and bending moments diagrams in the slab, design moment of steel, minimum area of reinforcement bars, curtailment of bars, concrete cover, fire resistance, checks for shear, cracking, deflection and anchorage controls.
- detail the slab.

Teaching/Learning Resources

- Euro Code 2 (2000) Concrete
- Euro Code 3 (2000) Steel
- CP114, Limit state Design; CP110, BS 8110,

Sub-module 5: Design of Staircases: A Special Type of Slopping Slabs

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • classifies stairs into transverse and longitudinal spanning. • analyses the staircase to determine design loads, main and distribution steel, and checks for shear, deflection, cracking, anchorage and details.	• Classification of stairs into transverse and longitudinal spanning • Relevant building regulations • Determination of staircase loading and analysis of staircases • Design of main and provision of distribution steel, checking for shear, deflection, cracks, and anchorage • Detailing	• Lead a guided discussion on the classification of stairs into transverse and longitudinal spanning. • Guide learners through analysis of staircases to determine design loads, main and distribution steel, checking for shear, deflection, cracking, and anchorage. • Task learners to detail a staircase.

Assessment Strategy

Task the learners to:

- classify stairs into transverse and longitudinal spanning.
- analyse the staircase and determine the design loads, distribution steel, checking for shear, deflection, cracking, anchorage and detail.

Teaching/Learning Resources

- Euro Code 2 (2000) Concrete

- Euro Code 3 (2000) Steel
- CP114, Limit state Design; CP110, BS 8110

Sub-module 6: Design of Columns

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • classifies columns. • determines ultimate design loads, area of column, area of minimum reinforcement required, reads steel number from tables and details a column. • designs eccentrically loaded column, short column subjected to axial loads and uni-axial bending using charts, short columns subjected to axial loads and biaxial bending; (analytical use of charts), slender columns. • checks columns for shear strength and details columns.	• Classification: (short and slender columns, braced and unbraced columns) • Section analysis • Design of short columns subjected to only axial loads • Design of eccentrically loaded column • Design of short column subjected to axial loads and uni-axial bending using charts • Design of short columns subjected to axial loads and biaxial bending; (analytical use of charts) • Design of slender columns • Checking columns for shear strength • Detailing	• Group learners to brainstorm the classification of columns considering short, slender, braced and unbraced columns. • Illustrate through the methods of determining ultimate design loads, area of the column, area of the minimum reinforcement required, steel size from tables and detail a column and task learners to workout given examples. • Guide learners on design of eccentrically loaded columns, short columns subjected to axial loads and uni-axial bending using charts, short columns subjected to axial loads and biaxial bending (analytical use of charts) and slender columns. • Guide learners to check for shear strength and detailing columns.

Assessment Strategy

Task the learners to:

- determine ultimate design loads, area of columns, area of minimum reinforcement required, read steel size from tables and detail a column.
- design eccentrically loaded column, short column subjected to axial loads and uni-axial bending using charts, short columns subjected to axial loads and biaxial bending (analytical use of charts) and slender columns.

Teaching/Learning Resources

- Euro Code 2 (2000) Concrete
- Euro Code 3 (2000) Steel
- CP114, Limit state Design; CP110, BS 8110

Sub-module 7: Design of Foundations

Duration: 5 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • determines actions, weight of footing, bearing pressure, pad size, ultimate load, ultimate bearing pressure, design moment, area of steel, main and distribution steel, checks for transverse, vertical and punching shears. • designs raft, strip, and	• Design of axially loaded pad bases, determination of pad size and depth, design for moment steel, checking for transverse, vertical and punching shear • Discussion of eccentrically loaded pad bases • Discussion on design of raft, strip and combined foundations • Discussion of pile foundations	• Illustrate the methods of determining service loads, weight of footing, bearing pressure, pad size, ultimate load, ultimate bearing pressure, design moment, area of steel, main and distribution steel and check for transverse, vertical and punching shears and task learners to work out given examples. • Lead a guided discussion on design of raft, strip, and

Competences	Content	Teaching/Learning Strategies
combined foundations. • details foundations.	• Detailing	combined foundations. • Guide learners through the techniques of detailing foundations, emphasising on the design safety.

Assessment Strategy

Task the learners to:

- determine service loads, weight of footing, bearing pressure, pad size, ultimate load, ultimate bearing pressure, design moment, area of steel, main and distribution steel, and check for vertical and punching shears.
- design and detail raft, strip and combined footings.

Teaching/Learning Resources

- Euro Code 2 (2000) Concrete
- Euro Code 3 (2000) Steel

Sub-module 8: Introduction to Pre-stressed Concrete

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • carries out post tension and pre-tension. • designs pre-stressed beams for serviceability and ultimate	• Advantages of pre-stressed concrete • Pre-tensioning and post-tensioning • Design of pre-stressed beams for serviceability and ultimate limit state • Stress loss and transfer in beams	• Lead a guided tour to a site with pre-tensioning and post-tensioning work for learners to observe their processes, write a report and present. • Guide learners through designing pre-stressed beams for serviceability and ultimate limit state.

Competences	Content	Teaching/Learning Strategies
limit state. • guards against loss of pre-stressing.	• Detailing	• Lead a guided discussion on the causes of loss of pre-stressing. • Illustrate the methods of pre and post tensioning and guide the learners as they practise.

Assessment Strategy

Task the learners to:

- carry out pre-tensioning and post-tensioning.
- design pre-stressed beams for serviceability limit state and ultimate limit state.
- describe causes of loss of pre-stressing.

Teaching/Learning Resources

- Euro Code 2 (2000) Concrete
- Euro Code 3 (2000) Steel
- CP114, Limit state Design; CP110, BS 8110

Bibliography

Dean, Y. (1996). *Structural Engineering Design in Practice*. Pearson

Mosley, W.H. and Bungey, J.H. (1999). *Reinforced Concrete Design.* 5th Ed. MacMillan, London

Rossaw, E. (1993). *Structural Detailing*. 2nd Edition, Palgrave Macmillan

Todd, J.D. (1982). *Structural Theory and Analysis.* 2nd Ed. MacMillan, London

Sub-module 9: Design of Timber Structures

Duration: 5 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • interprets stress grading and strength classifications from tables. • designs flexural members, compression members, timber connections stud walls and storey structures. • distinguishes between principles and application rules.	• Stress grading, grade strength and strength classes • Design to BS (or Euro Codes) of elements (flexural members, compression members, timber connection and stud walls) • Design of a storey structure	• Illustrate with examples interpretation of grading and strength of timber structures and their classification from tables and task learners to design given examples. • demonstrate with examples the methods of designing flexural members, compression members, timber connections, stud walls and storey structure and guide the learners as they practise. • Guide learners to design flexural members, compression members, timber connections, stud walls and storey structures.

Assessment Strategy

Task the learners to:

- interpret stress grading and strength class from tables.
- design flexural members, compression members, timber connections, stud walls and storey structures.

Teaching/Learning Resources

- BS 5268-2:2002
- Euro Code 5 and related Annexes
- Calculator

Sub-module 10: Design of Walls

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • distinguishes between principles and application rules. • designs normalised compressive strength, condition factors, shape factors and characteristic compressive strength of masonry. • considers effective height, effective thickness and capacity reduction factor when designing a wall. • determines characteristic dead (permanent action), imposed (variable action) and applies partial factor for loading. • checks modification factors to obtain characteristic compressive strength. • determines slenderness ratio and eccentricity of loading to	• Functions and types of loads on walls • Design of reinforced concrete walls • Design of plain concrete walls • Design of vertically and laterally loaded wall panels; characteristic flexural strength, orthogonal ratio, support conditions, limiting dimensions, basis of design, bending moment coefficient, partial safety factor for materials and loads, characteristic	• Lead a guided discussion on functions and types of loads on walls. • Illustrate with examples the determination of design strength, characteristic compressive strength of masonry and application of effective height, effective thickness and capacity reduction factor and task learners to workout given examples. • Group learners to determine the characteristic dead, imposed loads and application of partial factor for loading and check modification factors to obtain characteristic compressive strength. Task the learners to write a group report and make presentations in class. • Illustrate with examples the techniques of determining slenderness ratio, eccentricity of loading to determine vertical resistance of the wall and guide learners as they practise. • Guide learners to interpret mortar designations from

Competences	Content	Teaching/Learning Strategies
determine vertical resistance of the wall. • interprets mortar designation from tables. • considers characteristic flexural strength, orthogonal ratio, support conditions and limiting conditions. • determines bending moment coefficient, sectional modulus, moment of resistance and ultimate design moment.	lateral load, ultimate design moment, moment of resistance, design of lateral strength of free standing walls	tables. • Illustrate with examples the determination of characteristic flexural strength, orthogonal ratio, support conditions and limiting conditions and guide the learners as they practise. • Guide learners to determine bending moment coefficient, sectional modulus, moment of resistance and ultimate design moment. • Group learners to determine water absorption and mortar designation. Task them to write a group report and make presentations in class.

Assessment Strategy

Task the learners to:

- determine design strength and characteristic compressive strength of masonry.
- determine the characteristic dead and imposed loads and apply partial factor for loading.
- interpret mortar designation from tables.
- determine bending moment coefficient, sectional modulus, moment of resistance and ultimate design moment.

Teaching/Learning Resources

- BS 5950 (2000) The structural use of steel
- Euro Code 6 and related Annexes
- Calculator
- Todd, J.D. (1982). *Structural Theory and Analysis.* 2nd Ed. MacMillan, London

HDCE 212: Highway Engineering I

Duration: 45 Hours

Module Overview

This module examines the historical development of roads, their elements, materials used as well as the construction and principles of geometric design. It introduces the learner to road engineering, planning and layout of roads, construction techniques, field exercises and environmental considerations. It equips the learner with skills and knowledge of road construction and environmental preservation.

Learning Outcomes

By the end of this module, the learner should be able to:

- construct and supervise road works.
- preserve environment.

Preparatory Assignment

Group learners and task them to discuss steps involved in road construction. Let them carry out a curve ranging exercise on roads within the college.

Result

Learners present their group reports in the class.

Sub-module 1: Introduction to Road Engineering

Duration: 08 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses history and development of roads, transport administration and highway network to design	• History and development of roads • Scope, transport administration • Highway network	• Group learners to brainstorm the history and development of roads, transport administration and highway network.

Competences	Content	Teaching/Learning Strategies
roads. • classifies highways (Uganda case).	• Highway classifications (Uganda case)	• Lead a guided discussion on highway classifications (Uganda case)

Assessment Strategy

Assign the learners to classify highways (Uganda case).

Teaching/Learning Resources

- Road technical manuals
- Documentary on the history of road development
- The Internet
- Charts

Sub-module 2: Planning and Layout of Roads

Duration: 15 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • surveys and selects routes. • carries out site investigations. • constructs roads. • stabilises soil to improve engineering properties.	• Route surveys • Selection of routes • Site investigations • Types of roads: low cost, granite sets, flexible, rigid • Soils technology for roads; soil stabilisation (mechanical, cement, lime-	• Guide learners through route surveys and selection of routes, emphasising safety, environmental and public security. • Group learners to carry out site investigation for the proposed road and task them to write a group report and present in class. • Demonstrate the methods applied in the construction of low cost, granite sets, flexible and rigid roads and guide the learners as they practise. • Lead a guided tour to a road

Competences	Content	Teaching/Learning Strategies
	pozzolana, and bituminous stabilisation)	which is being stabilised for the learners to observe and analyse the methods of stabilisation applied and task them to write a report and make presentations in class.

Assessment Strategy

Task the learners to:

- survey and select routes.
- carry out site investigation.
- stabilise the soil.

Teaching/Learning Resources

- Road technical manuals
- Stabilising material
- The Internet
- Marrum
- Roller

Sub-module 3: Construction Techniques

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • plans for street lighting. • differentiates between rural and urban roads as well as single, double and dual carriage ways. • carries out a geometric design of	• Street lighting; highways, rural roads, urban roads, single, double and dual carriage ways, junctions, intersections, roundabouts, reference traffic flow (RTF) and design reference flow (DRF), road	• Lead a guided discussion on street lighting emphasising the safety and security of the users. • Group learners to discuss rural and urban roads as well as single, double and dual carriage ways. Task them to write a group report and make class presentations. • Illustrate the geometric design of intersections,

Competences	Content	Teaching/Learning Strategies
highways. • maintains roads.	furniture • Maintenance of roads	roundabouts, reference traffic flow (RTF) and reference flow (DRF) and guide the learners as they practise. • Lead a guided discussion on road furniture maintenance.

Assessment Strategy

Task the learner to:

- differentiate between rural and urban roads; single, double and dual carriage ways.
- carry out a geometric design of highways.
- maintain roads and road furniture.

Teaching/Learning Resources

- Road technical manuals
- The Internet
- Stones
- Binders
- Gravel/marrum
- Plant, tools and equipment

Sub-module 4: Field Exercise

Duration: 08 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • interprets available contour map to produce road layout details. • carries out survey on a new road and produces a contour map.	• Planning one layout length of a new road in details using available contoured maps	• Guide learners to interpret available contour map to produce road layout details. • Task learners to carry out engineering survey on a new road and produce a contour map.

Assessment Strategy

Task the learners to interpret an available contour map to produce layout of length of a new road detail.

Teaching/Learning Resources

- Road technical manuals
- The Internet
- Available contour map
- Total station
- Computer
- Staff

Sub-module 5: Environmental Consideration

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • protects the environment against noise and pollution. • considers environmental conservation in road design.	• Noise, pollution • Air quality • Aesthetics • Cemeteries • Cultural resources • Endangered species • Floodplains • Groundwater resources • Hazardous materials and underground storage tanks • Resources - cultural resources - recreational parks - wildlife refuges • Socioeconomic concerns and environmental	• Lead a guided discussion on protection of the environment against noise and pollution, emphasising the possible control measures to be put in place to limit the effect of noise and pollution to the public. • Guide learners through consideration of environmental conservation in road design and task learners to design a road with all the necessary noise and pollution control measures being put in place.

Competences	Content	Teaching/Learning Strategies
	justice: - stream - wetlands	

Assessment Strategy

Task the learners to protect the environment against noise and pollution.

Teaching/Learning Resources

- NEMA related laws
- The Internet
- Computer

Bibliography

AASHTO T 166-00 (2000). *Standard Method of Test for Bulk Specific Gravity of Compacted Bituminous Mixtures using Saturated Surface Dry Conditions.* AASHTO, 20th Edition Washington D.C

AASHTO T 209 (1995). *Standard Method of Test for Maximum Specific Gravity of Bituminous Paving Mixtures*. AASHTO, 20th Edition Washington DC

Ashley, C. (1994). *Traffic and Highway Engineering*. Blackwell Scientific Publications, London.

Salter, R.J. (1983). *Highway Traffic Analysis and Design*. MacMillan, London

HDCE 213: Fluid Mechanics

Duration: 45 Hours

Module Overview

This module equips the learner with concepts and theory of fluid statics, dynamics and flow in pipes. It enhances in the learner the skills and knowledge of fluid flow subjected to different conditions.

Learning Outcome

By the end of this module, the learner should be able to draw a design for flow in pipes and perform pressure test.

Preparatory Assignment

Guide learners in a tutorial involving fluid flow in pipes and flow illustrating hydraulic jump.

Result

Learners present their observations in the class discussion.

Sub-module 1: Introduction to Fluid Mechanics

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • analyses fundamental equilibrium conditions in fluid flows. • applies viscosity principles in designing pipes.	• Definitions and units • Fundamental equilibrium conditions • Viscosity and Newtonian fluids	• Lead a guided discussion on the descriptions and fundamental equilibrium condition units, terms used in fluid mechanics and viscosity and Newtonian fluids. • Group learners and task them to discuss the types of fluids applied in engineering, their properties and let them write a group report and make presentations.

Assessment Strategy

Task the learners to:

- analyse fundamental equilibrium conditions in fluid flows.
- apply viscosity principles in designing pipes.

Teaching/Learning Resource

- The Internet

Sub-module 2: Fluid Statics

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses hydrostatic pressure and theory of manometers to measure pressure difference in pitot or orifices located in airflow in air handling or ventilation systems. • determines static pressure force moments on immersed bodies and confining boundaries.	• Hydrostatic pressure • Theory of manometers and pressure measurement • Static pressure force moments on immersed bodies and confining boundaries • Archimedes principle and floatation	• Lead a guided discussion on hydrostatic pressure, theory of manometers and pressure measurement. • Illustrate with examples the methods of determining static pressure force moments on immersed bodies and confining boundaries and task learners to work out given examples. • Demonstrate and guide in the application of Archimedes principle of floatation.

Assessment Strategy

Task the learners to:

- use hydrostatic pressure and theory of manometers to measure pressure difference in pitot or orifices located in airflow in air handling or ventilation system.

- determine static pressure force moments on immersed bodies and confining boundaries.

Teaching/Learning Resources

- the Internet
- Manometers
- Calculator

Sub-module 3: Fluid Dynamics

Duration: 16 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses behaviour of fluids flow to design and lay pipes. • applies Bernoulli's energy conservation equation in determining discharge, flow measurement in orifices, venturis and pitot tubes. • applies momentum principle to control volume, forces on pipe bends, nozzle contractions, and vanes jets.	• Incompressible motion, streamlines and stream tubes, steady flow, control volume, continuity • Bernoulli's energy conservation equation, flow measurement, orifices, venturis, pitot tube • Momentum principle applied to control volume, forces on pipe bends, nozzle contractions, and vanes jets • Dimensional analysis and similitude	• Lead a guided discussion on incompressible motion, streamlines and stream tubes, steady flow, control volume and continuity flow. • Illustrate the development of Bernoulli's energy conservation equation and application in determining discharge, flow measurement in orifices, venturis, pitot tube and guide the learners as they practise. • Demonstrate with examples the application of momentum principle to control volume, forces on pipe bends, nozzle contractions and vanes jets and guide the learners as they practise. • Group learners to brainstorm dimensional analysis, similitude and task them to write a group report and make presentations.

Assessment Strategy

Assign the learners to apply Bernoulli's energy conservation equation in determining discharge, flow measurement in orifices, venturis and pitot tubes.

Teaching/Learning Resources

- Pipes
- Bends
- Pitot tubes

Sub-module 4: Flow in Pipes

Duration: 13 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • calculates the discharge in pipes. • considers friction factors, head loss coefficients, valves, and bend application in analysing pipe networks and quasi – steady flow in draining and filling problems.	• Flow in pipes: viscosity, dynamic similarity, Reynolds' number, Reynolds' experiment, laminar, transition, turbulent motion, Hagen-poise Uille theory for laminar flow • Friction factors, head loss coefficients, valves, bend application to pipe networks and quasi – steady flow in draining and filling problems	• Illustrate methods of determining discharge in pipes, Reynolds' number and experiment, laminar, transition, turbulent motion, Hagenipoise and Uille theory for laminar flow and guide the learners as they practise. • Lead a guided discussion on approaches used in determining friction factors, head loss coefficients, valves, bend application to pipe networks and quasi – steady flow in draining and filling problems. • Use a documentary and task learners to observe, discuss, write a report and make presentations on fluid flow problems and solutions.

Assessment Strategy

Assign the learners to determine discharge in pipes, Reynolds' number, Reynolds' experiment, laminar, transition, turbulent motion, Hagen-poise and Uille theory for laminar flow, and determine static pressure force moments on immersed bodies and confining boundaries.

Teaching/Learning Resources

- Documentary on fluid flow problems and solutions
- The Internet
- Calculator

Bibliography

Nalluri, C. and Featherstone, R.E. (2001). *Civil Engineering Hydraulics*. 4th Edition. Blackwell Scientific Publications, London

HDCE 214: Measurement of Building and Civil Works

Duration: 45 Hours

Module Overview

This module introduces the learner to approaches to measurement of building and civil works. It equips the learner with principles of measurements.

Learning Outcome

By the end of this module, the learner should be able to measure building and civil works.

Preparatory Assignment

Group learners and task them to measure a classroom to produce unprized bill of quantities.

Result

Learners present their group work in class.

Sub-module 1: Approaches to Measurement

Duration: 02 Hours

Competence	Content	Teaching/Learning Strategies
The learner applies systematic approach to the measurement of an entire building.	• Systematic approach to the measurement of whole buildings • Sub-division of work for measurement purposes	• Lead a guided discussion on systematic approach to measurement of entire buildings and sub-division of work for measurement purposes.

Assessment Strategy

Assign the learners to apply systematic approach to the measurement of an entire building.

Teaching/Learning Resources

- The Internet
- Plan

Sub-module 2: Preliminaries

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses preambles for measuring work. • provides a statement of how and where the work is fixed to the building and what other work is to be fixed thereto; quantity or quantities that indicate the scope and extent of the work; and any specific limitations and the like identified. • values work on the basis of time spent by the contractor's workpeople, the materials used and the plant employed.	• Site preparation and temporary works • Preambles, day works, prime and provisional sums and contingencies, spot items (demolitions, repairs, renovations and alterations) • Deemed to be included items • General and specific attendance	• Lead a guided discussion on site preparation and temporary works, emphasising the safety precautions. • Group learners to brainstorm the preambles, day works, prime and provisional sums, contingencies, spot items, deemed to be included items, general and specific attendance and task them to write a group report and make presentations. • Lead learners to an ongoing construction site, task them to discuss the site progress under implementation, its merits, write a report and make group presentations.

Assessment Strategy

Assign the learners to use preambles, day works, prime and provisional sums, contingencies, spot items, deemed to be included items, general and specific attendance to execute works not included in the bill of quantities.

Teaching/Learning Resources

- Standard method of measurement
- Sample bill of quantities
- The Internet
- Plan

Sub-module 3: Sub-structure

Duration: 08 Hours

Competence	Content	Teaching/Learning Strategies
The learner takes off for sub-structure work.	• Site clearance • Excavation: wide and narrow, deep and shallow foundations (flat and sloping sites) • Timbering to include basement • Placement of: hard core, concrete and reinforcements • Construction of plinth wall • Foundation treatment and ancillaries	• Jointly discuss with learners different categories of site clearance and involve them in an ongoing site clearance works. • Demonstrate the techniques and methods of measuring an excavation, constructing timbering, placing hard core, concrete, reinforcement's plinth wall, foundation treatment and ancillaries and guide the learners as they practise.

Assessment Strategy

Assign the learners to take off for site clearance, excavation, timbering, hard core, concrete, reinforcements, plinth wall, foundation treatment and ancillaries.

Teaching/Learning Resources

- Automatic levels
- The Internet
- Plan
- Measuring tape
- Calculator

Sub-module 4: Super Structure

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner takes off walls, formwork concrete, stairs, reinforcements, damp proof course (DPC) and ant-proof course (APC) works.	• Walls • Formwork • Concrete • Stairs • Reinforcements • DPC and APC	• Provide a detailed plan and guide learners through measurement of walls, formwork, concrete, stairs, reinforcements, DPC and APC. • Illustrate the various approaches used in carrying out measurement of works and task the learners to measure given works.

Assessment Strategy

Task the learners to measure formwork concrete, stairs, reinforcements, DPC and APC works.

Teaching/Learning Resources

- Automatic levels
- The Internet
- Timber
- Measuring tape

Sub-module 5: Roofs

Duration: 08 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • constructs a complete roof of timber and steel, installs rainwater disposal system and measures. • takes off a roof structure and finishes.	• Roof structure in timber and steelwork • Roof covering in sheets, tiles and coatings • Rainwater disposal installation	• Group learners to construct a roof of timber and steel, fix coverings, install rainwater disposal system and measure. • Task learners to take off a roof structure and its components.

Assessment Strategy

Task the learners to:

- construct a roof of timber and steel, fix coverings, install, rainwater disposal system and measure.
- take off a roof structure and finishes.

Teaching/Learning Resources

- Timber
- Steel
- Nails
- Carpenter's tool kit

Sub-module 6: Windows and Doors

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • takes off for windows and doors. • fabricates	• Internal and external doors (timber and steel) • Windows (timber	• Provide detailed plans of windows and doors, and guide learners to take off for doors and

Competences	Content	Teaching/Learning Strategies
internal and external windows and doors.	and steel)	windows. • Group learners and task them to take off and to fabricate internal and external windows and doors.

Assessment Strategy

Task the learners to:

- fabricate internal and external windows and doors.
- takes off for windows and doors.

Teaching/Learning Resources

- Timber
- Steel
- Nails
- Carpenter's tool kit
- Welding kit

Sub-module 7: Finishes

Duration: 04 Hours

Competence	Content	Teaching/Learning Strategies
The learner takes off for finishes.	• Internal and external finishes	• Lead learners to an unfinished building in the college or nearby community and task them to measure and finish one of them.

Assessment Strategy

Task the learners to measure and finish structures.

Teaching/Learning Resources

- Timber
- Cement
- Sand
- Paint
- Terrazzo
- Bricklayer's tool kit

Sub-module 8: Services

Duration: 04 Hours

Competence	Content	Teaching/Learning Strategies
The learner: • takes off and installs electrical and plumbing works.	• Electrical and plumbing installations	• Guide learners through measurement and installation of plumbing and electrical work. • Illustrate the methods of taking off for electrical and plumbing installation including their finishes and guide the learners as they practise.

Assessment Strategy

Assign the learners to measure and install electrical and plumbing work.

Teaching/Learning Resources

- Measuring tape
- Electric cables
- Conduits
- Pipes
- Sanitary appliances

Sub-module 9: Introduction to Civil Works

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses both standard method of measurement (SMM) of building works and civil engineering standard methods of	• Comparison of current building and civil engineering standard methods of measurement. • Sub-division of large projects	• Provide learners with a detailed plan and guide them to use both SMM of building works and CESMM3 to execute the work. • Lead a guided discussion on sub-division of large

Competences	Content	Teaching/Learning Strategies
measurement (CESMM3). • allows for general, fixed and time-related charge items in work measurement.	into building and civil engineering for measurement and billing purposes • General, fixed and time-related charge items	projects into building and civil engineering for measurement and billing purposes. • Group learners to brainstorm the general, fixed and time-related charge items.

Assessment Strategy

Assign the learner to compare current building and civil engineering standard methods of measurement.

Teaching/Learning Resource

- Measuring tape

Sub-module 10: Measurement of Civil Engineering Works

Duration: 16 Hours

Competence	Content	Teaching/Learning Strategies
The learner carries out measurement of civil works.	• Site clearance and earth works • Pavement layers/ embankment • Paving, bridges and tunnels • Mass, reinforced, precast concrete, steel, concrete and steel sheet piles and soil stabilisation • Brickwork,	• Lead a guided tour to an ongoing construction site for the learners to observe and inquire how the measurements of the various civil works are done. Let them write a report and present in class. • Demonstrate the methods of measuring site clearance and earthworks, pavement layers/ embankment, paving, bridges and tunnels and guide the learners as they practise. • Illustrate the techniques of measuring mass, reinforced, precast concrete, steel, concrete

Competence	Content	Teaching/Learning Strategies
	block work, masonry • Timber and metal work structures • Water proofing of underground structures • Sewers and drains, sewage treatment installations • Water and gas lines, water treatment installations and reservoirs • Landscaping	and steel sheet piles and soil stabilisation, brickwork, block work, masonry, timber and metal work structures, water proofing of underground structures and task learners to measure given examples. • Guide learners through the methods of measuring sewers and drain, sewage treatment installations, water and gas lines, water treatment installations, reservoirs and landscaping. Task them to measure given real life examples.

Assessment Strategy

Assign the learners to measure earthworks and sewage treatment installations.

Teaching/Learning Resources

- Civil Engineering Standard method of measurement
- Documentary on civil engineering works
- Automatic levels
- Measuring tape

Bibliography

- Ashworth, A. (1996). *Pre-contract Studies: Development Economics Estimating and Tendering*. Longman
- Ashworth, A. (1996). *SMM7 The Standard Method of Measurement of Building works.* Longman
- Seeley, I. (1997). *Building Quantities Explained*. 5th Edition. Longman
- Seeley, I. H. (1993). Civil Engineering Quantities. 5th Edition.. Macmillan, London.

HDCE 215: Computer Aided Design and Drawing

Duration: 45 Hours

Module Overview

The module equips the learner with the knowledge and skills of using a computer to design and draw construction and civil engineering works, writing of supporting specifications and printing of the drawn work. It enables the learner to interpret given drawings for effective implementation.

Learning Outcomes

By the end of this module, the learner should be able to:

- design, draw and interpret construction and civil engineering plans, sections and details.
- select and write accompanying material specifications.

Preparatory Assignment

Before teaching this module, task the learners to design and develop the sketch of institutional compound landscape and let them make presentations.

Result

Learners design and make a neat sketch of the institutional compound landscape.

Sub-module 1: AutoCAD

Duration: 20 Hours

Competences	Content	Teaching / Learning Strategies
The learner: • installs AutoCAD software into the	• Introduction to computer aided drawing (CAD) • AutoCAD commands	• Lead a guided discussion on CAD applications and types. • Guide learners in a demonstration on the

Competences	Content	Teaching / Learning Strategies
computer. • identifies and uses AutoCAD commands during the development of the drawing. • develops the design perception of some form, makes the sketch and uses AutoCAD to draw it. • draws the ground plan, the correct section and the elevations. • designs and draws the roof details, the door and window elevations. • makes the title block and writes supporting specifications for foundation, neat walls, roof, ceilings and	(lines, offset, trim, extend, erase, mirror, fillet, hatch, scale, dimension, layers, blocks, zoom, chamfer, circle and arcs) • Drawing of structures like house plans, sections and elevations of ventilated improved latrine • Foundations details and specification of materials • Roof truss, wall plate, purlins, rafters, lean to roofs, concrete flat roofs, hipped roof, gable end roof, facias and barge boards and joints used during roof construction • Ramps, Dog leg, Geometrical Stairs • Hard board, soft board, timber and concrete ceilings • Interior design work and finishes for special rooms and structures • Elevations of panelled, framed, brace and ledged, flush doors and windows • Creating and adding	procedure of installing AutoCAD and task them to practise. • With the aid of a projector or computer, guide the learners to open AutoCAD window interface and guide learners through the identification and use of AutoCAD commands such as lines, offset, trim, extend, erase, mirror, fillet, hatch, scale selection, dimensioning, layers selection and application, creation of blocks, zooming in and out, chamfer, circle and arc selections and guide learners as they practise. • Together with learners, go through the steps followed when making a drawing, starting from mind perception, sketch formation and drawing implementation. Prompt the learners to design and draw objects as they have conceived them. • Illustrate with the aid of a projector the drawing of a structure, the plan, sections and elevation development and task learners to draw. • Demonstrate the development of the roof, doors and windows, the relationship of orthographic and AutoCAD

Competences	Content	Teaching / Learning Strategies
schedules. • prints the completes drawing.	data to a surface, contour data, adjusting surfaces through surface properties, surface analysis tools, surface labels, surface volume calculations, break lines and boundaries, surface analysis display and quantity take off/sections	drawings and building plan, the making of title block and the writing of text in AutoCAD and task learners to make the title block for their drawings with the necessary text in it, the procedure followed to print an AutoCAD drawn item and task learners to print their drawings.

Assessment Strategy

Let the learners:

- develop the design of a VIP, make the sketch and use AutoCAD to draw its plan, elevation and section.

Teaching/Learning Resources

- Computers
- Drawing sheets
- Printers
- The Internet
- projector
- AutoCAD software
- Introduction to Autocad 2004
- Introduction to Office 2000

Sub-module 2: Arch CAD and Atlatis

Duration: 11 Hours

Competences	Content	Teaching / Learning Strategies
The learner: • installs Arch CAD into the computer. • identifies and uses Arch CAD commands during the development of the drawing. • develops the design perception of some form, makes the sketch and uses Arch CAD to draw it. • draws the ground plan, the correct section and the elevations. • designs and draws the roof details, the door and window elevations. • makes the title block and writes	• Introduction to computer aided design using (Arch CAD) • Arch CAD commands (lines, offset, trim, extend, erase, mirror, fillet, hatch, scale, dimension, layers, blocks, zoom, chamfer, circle and arcs) • Drawing of structures like plan, section and elevations of ventilated improved latrine • Foundations details and specification of materials • Roof truss, wall plate, purlins, rafters, lean to roofs, concrete flat roofs, hipped roof, gable end roof, Facias and barge boards and joints used during roof construction	• Lead a guided discussion on Arch CAD applications. • Guide learners in a demonstration on the procedure of installing Arch CAD and task them to practise. • With the aid of a projector or computer, guide the learners to open Arch CAD window interface and guide them through the identification and use of Arch CAD commands such as lines, offset, trim, extend, erase, mirror, fillet, hatch, scale selection, dimensioning, layers selection and application, creation of blocks, zooming in and out, chamfer, circle and arc selections. Guide the learners as they practise. • Together with learners, go through the steps followed when making a drawing, starting from mind perception, sketch formation and drawing implementation. Prompt the learners to design and draw objects as they have conceived them. • Illustrate with the aid of a projector drawing of a one room structure, the plan, sections and elevation development. Task the

Competences	Content	Teaching / Learning Strategies
supporting specifications for foundation, neat walls, roof, ceilings and schedules. • prints the complete drawing.	• Hard board, soft board, timber and concrete ceilings • Elevations of panelled, framed, brace and ledged, flush doors and windows • 3D objects, sharing data, data shortcuts for project management. • Rendering images, solid element operations and custom elements profiles, annotations, publishing and data extraction	learners to draw a one room structure using Arch CAD applications. • Demonstrate with the aid of a projector the development of the roof, doors and windows, the relationship of orthographic and Arch CAD drawings and building plan, the making of a title block and the writing of text in Arch CAD and task learners to make the title block for their drawings with the necessary text in it, the procedure followed to print an Arch CAD drawn item and task learners to print their drawings.

Assessment Strategy

Let the learners:

- develop the design of a foundation, make the sketch and use Arch CAD to draw its plan, elevation and section.
- write specifications of the materials and proportions to be used during implementation.

Teaching/Learning Resources

- Computers
- Drawing sheets
- Printers
- The Internet
- Projector
- AutoCAD software
- Introduction to Office 2000

Sub-module 3: Drainage Facilities using AutoCAD and Arch CAD

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • draws the plans, sections and elevations of inspection chambers and manholes, water closets and sinks, septic tanks, soak away pits, and cesspools. • develops the block and drainage site layout plan showing the position of the proposed drainage pipeline in accordance with the existing site conditions and designed gradient.	• Drawing of water supply and drainage facilities on the real designed simple building plan: - inspection chambers and manholes - water closets and sinks - septic tanks - soak away pits - cesspools - open channels to gradient	• Take learners to visit the school toilets or urinals and asses the hygienic conditions, write a report and present in the class. • Lead a guided discussion on the types and principles of drainage. • Illustrate the sketching of the types of drainage facilities and pipe network up to the disposal point and task learners to practise. • Demonstrate with the aid of projector the use of Arch CAD and AutoCAD commands and the techniques of drawing water closets, sinks, manholes, septic tanks, open channels, soak away pits and cesspools and task learners to use CAD commands when drawing drainage facilities. • Guide learners to set out manholes, septic tanks, open channels and benching and task them to set out and draw manholes, open channels and their concrete benching. • Lead a guided demonstration on the dos and don'ts during the development of the block and site layout plan indicating the proposed pipeline network in regard to the site slopes.

Assessment Strategy

Let the learners draw and print the water closets, sinks, manholes, septic tanks and soak away pits in their correct positions in reference to the developed building plan and the site conditions.

Teaching/Learning Resources

- Computer installed with Arch CAD and AutoCAD application
- Printer
- Drawing sheets
- The Internet
- Projector

Sub-module 4: Landscaping using AutoCAD and Arch CAD

Duration: 08 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • plans and designs the site layout in accordance with the site contours, topography and client's interest. • levels the site. • locates the incoming building to a good orientation with a good access route, parking provisions and designated areas for flowers, green grass,	• Block and structural site layout planning and design: - site levelling - orientation of the building - greening provisions (hedges, beauty shrubs, flower patterns, grass and tree planting	• Take learners to visit any nearby building with a modern landscaped homestead and task them to make the sketches, identify the types of materials used and discuss the importance of landscaping. Let the learners make group presentations on return into the class. • Lead a guided discussion on selection of materials and equipment used for landscaping homesteads and other recreational grounds. • Demonstrate the use of commands and the techniques of designing and drawing the landscape finish on surfaces and guide learners as they practise. • Guide learners to carry out

Competences	Content	Teaching/Learning Strategies
trees, hedges and beauty shrubs. • designs and draws boundary walls, giving provisions of draining off the surface water from the compound. • plants flowers, green grass, trees, hedges and beauty shrubs as per agreed design.	logic) - parking provisions - open water runway channels and drainage - boundary walls - access roads	landscaping compounds using hand tools and equipment, planting and maintaining the modified homestead. • Task learners to design, draw and format a section of the compound landscape using hand tools. • Divide learners into groups and task them to landscape independent portions of the institutional or staff or neighbourhood compound. • Emphasise the safety regulations to be followed during the landscaping exercise.

Assessment Strategy

Let the learners design part of the institutional compound and plant flowering plants, green grass, trees, hedges and beauty shrubs.

Teaching/Learning Resources

- Computer installed with Arch CAD and AutoCAD application
- Printer and drawing sheets
- The Internet
- Hand tools and equipment
- Watering cans
- Projector

HDCE 216: Concrete Technology

Duration: 45 Hours

Module Overview

This module introduces the learner to concrete materials, mix design, concrete products and sprayed application of concrete. It equips the learner with skills and knowledge of quality control and protection of concrete as well as manufacture of concrete products.

Learning Outcomes

By the end of this module, the learner should be able to:

- closely quality control batching which reduces the variability of the desired properties of hardened concrete.
- use agitator trucks to ensure care in transportation thus prevention of segregation and maintaining workability
- see that the placing is proceeding correctly by ensuring that lighting is available for large deep sections as well as for thin walls and columns.
- fully compact concrete to produce dense, strong and durable concrete.

Preparatory Assignment

Group learners to perform different concrete mixes in the college workshop and to carry out slump tests.

Result

Each group presents their concrete workability.

Sub-module 1: Basics of Concrete Technology

Duration: 04 Hours

Competence	Content	Teaching/Learning Strategies
The learner selects concrete class based on the required strength.	• Properties of concrete • Types of concrete	• Lead a guided discussion on the properties and types of concrete. • Task learners to research, write a report and make presentations on the commonly used type of concrete in Uganda and find out the reasons why.

Assessment Strategy

Assign the learners to select concrete class based on the strength required.

Teaching/Learning Resources

- Cement
- Sand
- Aggregates
- Mixer
- Vibrator
- Gauge box

Sub-module 2: Materials for Concrete

Duration: 07 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • selects and grades aggregate. • uses correct type of cement, admixture and water to cement ratio. • performs tests on workability.	• Aggregates: choice, types, production and grading • Cements: types and manufacture of cements, admixtures and additives • Water: water/ cement ratio and workability	• Demonstrate the grading of aggregates using sieve mesh and guide the learners as they practise. • Group learners to brainstorm the types and manufacture of cements and admixtures. • Lead a guided tour to a cement factory for the learners to observe and inquire about the manufacturing process of cement, write a report and present in class. • Guide learners through carrying out a slump test.

Assessment Strategy

Task the learners to:

- select and grade aggregate.
- use the correct type of cement, admixture and water cement ratio.
- perform test on workability.

Teaching/Learning Resources

- Cement
- Sand
- Aggregates
- Admixtures
- Mesh sieves

Sub-module 3: Concrete Mix Design

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • batches, and mixes concrete materials. • transports, places, compacts and cures concrete. • carries out formwork shuttering, steel bending, tying and fixing. • casts and tests concrete cubes. • details columns, slabs, walls and beams.	• Batching of aggregates, cement and water; mixing and transporting concrete; preparation and joints: placement of concrete, compaction of concrete, curing of concrete, surface finishing • Formwork, reinforcement, concrete mixing plant • Quality control inspection and testing • Detailing	• Demonstrate batching and mixing of concrete and guide learners as they practise. • Guide learners in transporting concrete, preparation joints, placement of concrete, compaction, curing and surface finishing of concrete. • Group learners to carry out formwork shuttering, steel bending, tying and fixing, emphasising the safety precautions to be observed during the erection. • Lead a guided discussion on concrete mixing plant and task learners to search for modern concrete mixing plants on the Internet. Let them write a report and make presentations. • Guide learners through the procedure of casting concrete cubes and testing thereafter. • Illustrate with examples detailing of columns, slabs, walls and beams and task learners to produce the details in their notebooks.

Assessment Strategy

Task the learners to:

- batch and mix concrete materials.
- transport, place, compact and cure concrete.
- cast and test concrete cubes.

Teaching/Learning Resources

- Cement
- Sand
- Aggregates
- Admixtures
- Reinforcement
- Timber
- Mixer
- Gauge box
- Wheelbarrow

Sub-module 4: Protecting Concrete

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • protects concrete in hot, cold and wet weather conditions. • creates joints in concrete.	• Concreting in hot weather • Concreting in cold weather • Concreting in wet conditions • Shrinkage, cracking creep and joints	• Lead a guided discussion on concreting in hot, cold and wet weather conditions as well as on shrinkage, cracking and creep. Task learners to search for solutions taken to produce sound concrete under such hash conditions, write a report and make presentations in class. • Demonstrate the procedure of creating joints in concrete and guide the learners as they practise.

Assessment Strategy

Task the learners to:

- protect concrete in hot and cold weather conditions.
- create joints in concrete.

Teaching/Learning Resources

- Cement
- Sand
- Aggregates
- Admixtures
- Reinforcement
- Timber
- Mixer
- Gauge box
- Wheelbarrow
- Joint sealer

Sub-module 5: Concrete Products and Sprayed Application of Concrete

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • constructs concrete structures. • repairs and renovates concrete structures. • produces sprayed concrete. • applies sprayed concrete.	• Concrete for road construction • Concrete structures: piles, water retaining structures such as dams and tunnels; pre-cast concrete products, floors and floor surfaces • Durability of concrete • Repairs and renovations of concrete structures • Definition of sprayed concrete • Reasons for sprayed concrete • Types of sprayed concrete • Properties of sprayed concrete	• Guide learners to select and material for making concrete. • Task learners to mix concrete for road construction, piles, water retaining wall, dams, tunnels, pre-cast concrete products, floors, floor surfaces and including concrete curing. • Group learners to discuss durability of concrete as well as repairs and renovation of concrete structures. • Group learners to discuss types, properties, repairs, admixtures and additives, recommended range of dosage requirement, main

Competences	Content	Teaching/Learning Strategies
	• Sprayed concrete repairs • Sprayed concrete admixtures • Recommended range of dosage requirement • Main benefits of sprayed concrete • Application	benefits of sprayed concrete and application. Task them to write a group report and make presentations. • Guide learners on a tour to a site where sprayed application of concrete is done for them to observe and inquire about its application.

Assessment Strategy

Task the learners to:

- construct concrete structures.
- repair and renovate concrete structures.

Teaching/Learning Resources

- Cement
- Sand
- Aggregates
- Admixtures
- Reinforcement
- Timber
- Mixer
- Gauge box
- Wheelbarrow
- Joint sealer

Sub-module 6: Practical (Laboratory)

Duration: 12 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • mixes, places, compacts and cures concrete.	• Concrete mix • Concrete curing • Fresh concrete tests	• Lead a guided tour to a construction site for the learners to observe mixing, placing, compaction, curing,

Competences	Content	Teaching/Learning Strategies
• carries out compaction factor test and slump test. • writes specifications for concrete. • configures reinforcement and fixes.	• Concrete cube test • Testing of dry samples • Writing concrete specifications • Reinforcement configurations and placement	compaction factor test, slump test, configuring reinforcement and fixing. Task them to write a report and present. • Demonstrate the methods of mixing, placing, compaction, curing, compaction factor test, slump test, writing specifications, configuring reinforcement and fixing and guide the learners as they practise.

Assessment Strategy

Task the learners to:

- mix, place, compact and cure concrete.
- carry compaction factor test, slump test and cube test.
- write specifications for concrete.

Teaching/Learning Resources

- Cement
- Sand
- Aggregates
- Admixtures
- Reinforcement
- Timber
- Mixer
- Gauge box
- Wheel barrow
- Joint sealer

Bibliography

- Mosley, W. H. and Bungey, J. H. (1999). *Reinforced Concrete Design.* 5th Edition. Macmillan, London.
- Murdock, L .J. and Brook, K. M. (1990). *Concrete Materials and Practice.* Edward Arnold, London.
- Neville (2000). *Properties of Concrete*. Pitman

HDCE 217: Real Life Project

Duration: 60 Hours

Module Overview

In this module, the learner carries out a task of erecting structures and manufacturing concrete products.

Learning Outcomes

By the end of this module, the learner should be able to:

- erect at least a two storey structure.
- construct a roof structure (steel or timber) up to finishes.
- manufacture concrete products.

Preparatory Assignment

Display a sketch of a roof truss and task learners to draw details of joints at eaves, ridges, struts and ties.

Result

Learners present drawings for marking.

Sub-module: Possible Projects in Year 2 Semester 1

Duration: 60 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • prepares and sketches drawings. • produces actual architectural and structural drawings. • carries out engineering surveying. • clears the site. • carries out	**Proposed project**: **Designing and constructing a labour based road** (at least 10m per learner) • Surveying • Designing road details • Quantifying the materials and labour • Testing soil	• Lead a guided discussion on sketches and drawings. • Guide learners in carrying out engineering surveying work. • Task learners to clear and level the site to determine formation level.

Competences	Content	Teaching/Learning Strategies
geotechnical investigation. • quantifies and costs materials. • sets out, excavates foundation trenches, casts foundation concrete, builds plinth walling, backfills, places and compacts hard core, blinds, applies DPM, shutters, casts over-site concrete and cures. • prepares trusses. • positions trusses, purlins, fascia boards and fixes coverings. • fabricates moulds. • tests materials. • casts, compacts and cures units. • takes care of the tools and equipment under his/her control. • identifies correct tools, equipment and machines for the project/job. • observes safety, welfare and health at sites and workshops. • carries out site fencing/ hoarding.	• Setting out **Proposed project: Construction of a roof structure (steel or timber) up to finishes** • Interpretation of existing drawings • Specifications, prepare estimates and bill of quantities (BoQs) for roof structure • Prepare trusses • Position trusses • Position purlins • Fix fascia board • Lay roof coverings **Proposed project**: **Manufacture of building materials** such as Culverts, Stair case, Concrete poles, Kerbs, Balustrades, Lintels, Columns, pavers, vents, VIP slabs and copings • Tools and equipment • Preparation of drawings • Specifications • Fabricate moulds • Material tests • Cast the units • Compact • Curing	• Guide learners in production of topographical maps. • Guide learners in carrying out geotechnical investigation. • Lead a guided discussion on estimation and costing of materials required for the project. • Guide learners through setting out, excavating foundation trench, casting foundation concrete, building plinth wall, backfilling, placing and compacting hard core, blinding, applying DPM, shuttering, casting over-site concrete and curing. • Lead a guided discussion on care of tools and equipment, selection of materials and identification of the correct tools and machines for the project. • Lead a guided discussion on safety, health and welfare considerations at site and workshop. • Guide learners through site fencing /hoarding.

Assessment Strategy

Task the learners to:

- sort and identify the tools and equipment used for engineering survey.
- develop site sketches and working drawings.
- produce topographic maps.
- carry geotechnical investigation.
- carry out estimation and materials costing.
- set out, excavate foundation trench, cast foundation concrete, build plinth walling, backfill, place and compact hardcore, blind, apply DPM, shutter, cast over-site concrete and cure.
- prepare and positions trusses, purlins, fascia boards and fixe coverings.
- fabricate mould, test materials, cast, compact and cure the concrete.

Teaching/Learning Resources

- Total station
- Theodolite
- Dumpy level
- Plumb bobs
- Hand saws
- Staff
- Cement
- Gauge box
- Wooden float
- Steel float
- Machete (panga)
- Hand hoe
- Pick axe
- Stones
- Cement blocks
- Pit and river sand
- Murram/ gravel
- Aggregates
- Hard core
- Timber
- Steel
- Moulds

Detailed Module Description for Year 2 Semester 2

Code	Module Title	L	P	CH	CU
HDCE 221	Design of Structures II	30	30	45	3
HDCE 222	Hydraulics and Hydrology	45	30	60	4
HDCE 223	Highway Engineering II	30	30	45	3
HDCE 224	Construction Management	30	30	45	3
HDEE 225	Engineering Geology	30	30	45	3
HDCE 226	Sanitation and Drainage	30	60	60	4
HDCE 227	Real Life Project	0	60	60	4
Semester Load = 23					
Total Second Year Credits = 42					

HDCE 221: Design of Structures II

Duration: 45 Hours

Module Overview

This module equips the learner with the skills and knowledge of examining the behaviour of the structure, determining internal resultant action, identifying possible causes and modes of failure as well as determining design loads and design structures.

Learning Outcome

By the end of this module, the learner should be able to design steel, timber and wall structures.

Preparatory Assignment

Task the learners to discuss the methods of joining steel, timber members and masonry units.

Result

Learners present results of their discussion for marking.

Sub-module 1: General Principles

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • applies design requirement, forms of bracing and movement joints. • determines load combinations. • designs a structure that is safe, so as to fulfil intended purpose during	• Design requirements, forms of bracing, movement joints • Loading: dead /imposed (permanent action), wind and notional loading (variable action), load combinations and partial safety	• Lead a guided discussion on design requirements, forms of bracing and movement joints. • Illustrate with examples determination of load combination and task learners to work out given examples. • Group learners to determine load combinations and task

Competences	Content	Teaching/Learning Strategies
its intended life span. • considers partial factor of safety, design strength, modulus of elasticity and coefficient of linear expansion.	factors for loads • Ultimate limit state: strength, stability and robustness • Serviceability limit states: deflection, durability (fire resistance, corrosion, wear and tear) • Material properties and consideration of different sections	them to write a group report and make presentations. • Lead a guided discussion on ultimate and serviceability limit states. • Group learners to brainstorm the material considerations and different sections. • Lead a guided discussion on the classification of sections.

Assessment Strategy

Assign the learners to:

- determine load combinations.
- consider different sections.

Teaching/Learning Resources

- BS 5950
- Euro Code and related Annexes
- Calculator

Sub-module 2: Design of Steel Beams

Duration: 09 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • designs shear force and bending moment. • selects the	• Conditions of lateral restraints and loading • Classification of steel sections in terms of strength and plasticity	• Illustrate with examples determination of design shear force, bending moment,

Competences	Content	Teaching/Learning Strategies
universal beams/ columns and classifies them. • checks for shear strength, moment capacity, deflection, web bearing, web buckling, web stiffness and lateral torsion buckling.	• Choice of section: prevention of local and shear buckling • Checking for shear strength • Checking for moment capacity • Checking for deflection • Checking for web bearing • Checking for web buckling • Design of web stiffeners • Checking for lateral torsion buckling	selection of universal beams/ columns and classify them, check for shear strength, moment capacity, deflection, web bearing, web buckling, web stiffness and lateral torsion buckling and task learners to workout given examples. • Guide learners through the procedure of selecting universal beams and columns. • Illustrate the design of web stiffness, check for deflection and task learners to practise on given examples.

Assessment Strategy

Task the learners to:

- design shear force and bending moment.
- select universal beams and columns.
- check for shear strength, moment capacity, deflection, web bearing, web buckling, web stiffness and lateral torsion buckling.

Teaching/Learning Resources

- BS 5950
- Euro Code 3, 4 and related Annexes
- Calculator

Sub-module 3: Design of Steel Compression Members

Duration: 09 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • selects sections by trial and error method, and calculates for effective length. • calculates radius of gyration, compressive strength and short strut capacity of the section. • checks for local capacity, overall and lateral torsion buckling.	• Cased and uncased columns • Design of axially loaded compression members • Design of columns with bending moments • Plain battened lattice columns	• Illustrate with examples the selection of section by trial and error method, calculation of effective length, radius of gyration, compressive strength, short strut capacity of the section and check for local capacity overall and lateral torsion buckling. Task learners to workout given examples. • Group leaner's to brainstorm the plain battened lattice columns and present their solutions. • Guide learners through the techniques of determining the radius of gyration and task them to work out given examples.

Assessment Strategy

Task the learners to:

- select section by trial and error method, and calculate for effective length.
- calculate for the radius of gyration, compressive strength and short strut capacity of the section.
- check for local capacity and overall and lateral torsion buckling.

Teaching/Learning Resources

- BS 5950
- Euro Code 3, 4 and related Annexes
- Calculator

Sub-module 4: Design of Steel Connections: Bolted and Welded

Duration: 13 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • calculates design load, moment, eccentric loadings, bending strength and checks for overall buckling. • checks for fasteners spacing and edge distance, strength of bolts connecting cleats supporting the column, shears capacity and bearing capacity. • checks for strength of group bolts connecting cleat to support the beam. • checks for slip resistance, bearing resistance and long joint slip resistance.	• Design of base plates • Design of beam to column connections • Design of beam to beam connections • Design of column to column connections • Design of connections for truss members	• Illustrate with examples the determination of design load, moment, eccentric loading, bending strength and check for overall buckling, fasteners spacing and edge distance, strength of bolts connecting cleats supporting the column, shear and bearing capacity. • Guide learners to check for strength of groups of bolts connecting cleat to support the beam, slip resistance, bearing resistance and long joint slip resistance. • Group learners to design connections for truss members and task them to write a group report and make presentations.

Assessment Strategy

Task the learners to:

- calculate for design load, moment, load eccentricity from beams, bending strength and checks for overall buckling.
- check for fasteners spacing and edge distance, strength of bolts connecting cleats supporting the column, shears capacity and bearing capacity.

- check for strength of group bolts connecting cleat to support the beam.
- check for slip resistance, bearing resistance and long joint slip resistance.

Teaching/Learning Resources

- BS 5950
- Euro Code 3, 4 and related Annexes
- Calculator

Sub-module 5: Design of Steel Tension Members

Duration: 08 Hours

Competence	Content	Teaching/Learning Strategies
The learner designs for ties, purlins and side rails	• Ties • Purlins • Side rails	• Guide learners to discuss the considerations taken when designing ties, purlins and side rails for structures. • Illustrate with examples the design of ties, purlins and side rails and task learners to workout given examples. • Group learners to design ties, purlins and side rails and task them to write a group report and make presentations.

Assessment Strategy

Assign the learners to design ties, purlins and side rails.

Teaching/Learning Resources

- BS 5950
- Euro Code 3 ,4 and related Annexes
- Calculator

HDCE 222: Hydraulics and Hydrology

Duration: 45 Hours

Module Overview

This module introduces the learner to conveyance of liquids through pipes, channels as well as the movement and distribution of water on earth. It equips the learner with knowledge and skills of flow of liquids, rainfall analysis and water harvesting.

Learning Outcomes

By the end of this module, the learner should be able to:

- design pipe network.
- estimate rainfall distribution.
- forecast drought.

Preparatory Assignment

Task learners to search on the forces acting in pipes when the pide sizes increase or reduce

Result

Learners present the solutions in the class.

Sub-module 1: Hydraulics

Duration: 05 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • applies concepts of static and dynamics fluids in pipes, channels, dams and streams.	• Introduction to hydraulics • Hydrostatics • Hydrodynamics • Hydraulic resistance • Head loss	• Lead a guided discussion on concepts of static fluids and dynamics of fluids. • Group learners to determine hydraulic resistance and head loss

Competences	Content	Teaching/Learning Strategies
• determines hydraulic resistance and head loss during the flow of liquids.	during the flow of liquids	during the flow of liquids and task them to write a group report and make presentations. • Illustrate the head loss during the flow of liquids and guide the learners as they practise.

Assessment Strategy

Assign the learners to:

- apply concepts of statics and dynamics fluids in pipes.
- determine hydraulic resistance and head loss during the flow of liquids.

Teaching/Learning Resources

- Calculators

Sub-module 2: Equation of Continuity

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • applies Bernoulli's equation of continuity to determine flows in pipes. • applies steady and unsteady flows principles for selecting pipes. • determines the discharge in pipes.	• Bernoulli's theorem and equation of continuity • Steady flow of liquids in pressure pipes • Unsteady flow of liquids in pressure pipes	• Lead a guided discussion on derivation and application of Bernoulli's equation of continuity in flows. • Group learners to discuss differences between steady and unsteady flows. • Guide learners in manipulating Bernoulli's theorem and equation of continuity and task them to write a group report and make presentations through calculation of discharge in pipes.

Assessment Strategy

Task the learners to:

- apply Bernoulli's equation of continuity.
- differentiate between steady and unsteady flows.
- determine the discharge in pipes.

Teaching/Learning Resources

- Calculators

Sub-module 3: Flow Characteristics

Duration: 14 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • determines discharge and flow in small openings, orifice, jet and flow under constant head. • applies Chezy and Manning equations in determining discharges and flows in pipes. • designs channels of most economical cross sections. • determines specific	• Flow through small openings • Orifices • Characteristics of water jet • Flow under constant head • Flow in open channels • Steady and unsteady flow • The Chezy and Manning equations • Channels of most economical cross sections • Specific energy • Critical depth • Hydraulic	• Demonstrate the determination of discharge and flow in small openings, orifice, jet and flow under constant head and guide the learners as they practise. • Group learners to discuss determination of discharge and flow in small openings, orifice, jet and flow under constant head. • Illustrate the development and application of Chezy and Manning equations in determining discharges and flows in pipes and guide the learners as they practise. • Group learners to design channels of most economical cross sections and task learners to write a group report and make presentations. • Illustrate with examples the methods of determining specific energy, critical depth, hydraulic

Competences	Content	Teaching/Learning Strategies
energy, critical depth, hydraulic jumps and energy losses. • determines discharge in surge tanks. • determines discharge and flow in laminar and turbulent flow. • estimates friction losses in pipes. • applies hydraulic and energy grade line concept to determine total head. • designs pipe network. • identifies and selects hydraulic machines.	jumps and energy losses • Pressure transients • Surge tanks • Pipe flow: understand concepts of laminar and turbulent flow • Energy equations • Estimation of friction losses • Hydraulic and energy grade line concept • Pipe network design; series, parallels, branched and loop pipe networks • Description of different hydraulic machines	jumps and energy losses and guide learners as they practise. • Group learners to brainstorm on pressure transients, surge tanks and task them to write a group report and make presentations. • Lead a guided discussion on determination of discharge and flow in laminar and turbulent flow. • Group learners to estimate friction losses and task them to determine the flow in pipes • Illustrate with examples the application of hydraulic and energy grade line concept and task learners to work out given examples. • Guide learners through design of pipe network and task them to design one from a given town map. • Lead a guided tour to National Water and Sewerage Corporation for the learners to observe pipe network, write a report and make presentations. • Lead a guided discussion on the description of different hydraulic machines.

Assessment Strategy

Task the learner to determine discharge and flow in small openings, orifice, jet and flow under constant head.

Teaching/Learning Resources

- Calculators

Sub-module 4: Hydrology

Duration: 20 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses hydrological cycle to plan for rainfall distribution. • carries out flood estimation, control and routing. • determines rate of evaporation, precipitation, infiltration and soil moisture. • carries out stream gauging. • analyses surface runoff mass curve, flow duration curves, frequency analysis and rainfall runoff relationships. • uses Darcy's law to determine ground water. • carries out rural water supply.	• Hydrological cycle • Hydrometeorology rainfall • Drought forecast • Flood estimation, control and routing • Evaporation • Infiltration • Soil moisture • Hygrometry and stream flow measurement • Rainfall curves and analysis: surface runoff mass curve, flow duration curves, frequency analysis • Rainfall runoff relationships • Storage, bondage and flow duration curves • Hydrographs • Ground water hydraulics; Darcy's law, pumping tests analysis, aquifers • Rural water supply and water resources in Uganda	• Lead a guided discussion on hydrological cycle and types of rainfall. • Guide learners through flood estimation, control and routing. • Illustrate with examples determination of rate of evaporation, infiltration and soil moisture. • Guide learners through stream gauging. • Group learners to analyse surface runoff mass curve, flow duration curves, frequency analysis and rainfall runoff relationships. • Group learners to brainstorm the storage, bondage and flow duration curves, and hydrographs. • Illustrate with examples uses of Darcy's law to determine groundwater. • Lead a guided discussion on pumping tests analysis, aquifers, rural water supply and water resources in Uganda.

Assessment Strategy

Task the learner to:

- carry out flood estimation, control and routing.
- determine rate of evaporation, precipitation, infiltration and soil moisture.
- carry out stream gauging.
- analyse surface runoff, mass curve, flow duration curves, frequency analysis and rainfall runoff relationships.
- use Darcy's law to determine ground water.

Teaching/Learning Resources

- Rain gauge
- Documentary on rainfall
- Calculators

Bibliography

Nalluri, C. and Featherstone, R. E. (2001). *Civil Engineering Hydraulics*. 4th Edition. Blackwell Scientific

Viessman, W. and Lewis, G. L. (1996). *Introduction to Hydrology.* 4th Edition. Hasper Collins College Publishers

HDCE 223: Highway Engineering II

Duration: 45 Hours

Module Overview

This module equips the learner with the knowledge and skills applied in design and construction, roads, traffic regulation and control.

Learning Outcome

By the end of this module, the learner should be able to design, supervise and construct roads.

Preparatory Assignment

Learners visit several busy traffic junctions with problems of traffic jams and come up with possible solutions to the traffic jam.

Result

Learners present group findings and possible solutions in class.

Sub-module 1: Road Construction

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • applies appropriate methods of constructing a road. • uses the American Association of State Highways and Transportation Officials (AASHTO) and Transport Research Laboratory (TRL) approaches to pavement design. • correctly uses road construction plants.	• Construction methods • AASHTO and TRL approaches to pavement design • Road construction plant	• Lead a guided discussion on methods of constructing a road, issues to avoid and consider during planning and designing. • Guide learners through AASHTO and TRL approaches to pavement design. • Lead a guided tour to any road under construction for learners to observe and inquire the uses of various road construction plants. Task them to write a report and make presentations in class.

Assessment Strategy

Assign the learners to:

- apply AASHTO and TRL approaches in design pavement.
- correctly use road construction plants.

Teaching/Learning Resources

- Calculators
- Charts
- Documentary on road construction
- Documentary on highway analysis

Sub-module 2: Road Drainage

Duration: 06 Hours

Competence	Content	Teaching/Learning Strategies
The learner designs and constructs road drainage systems.	• Construction of road drainage • Surface and sub-surface drainage	• Lead a guided discussion on surface and sub-surface drainage. • Illustrate the techniques applied in the construction of road drainage in the college compound and guide learners as they practise.

Assessment Strategy

Assign the learners to design and construct road drainage.

Teaching/Learning Resources

- Calculators
- Cement
- Stones
- Brick layer's tool kit
- Culverts
- Documentary on highway analysis

Sub-module 3: Earth Movement

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • clears a site. • determines cut and fill.	• Site stripping • Cuttings and filings • Calculations of volumes of cut and fill • Mass haul diagram	• Lead a guided tour to any site where cut and fill are carried out for the learners to observe, write a report and make presentations. • Guide learners through the determination of cut and fill using mass haul diagram and task learners to work out given examples.

Assessment Strategy

Task the learner to:

- clear the site.
- determine cut and fill using mass haul diagram.

Teaching/Learning Resources

- Calculators
- Excavator
- Trucks
- Documentary on highway analysis

Sub-module 4: Road Materials

Duration: 09 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • selects and categories road materials. • consolidates, compacts	• Sub-grade, sub-base and base materials, compaction and soil consolidation	• Lead a guided discussion on the considerations taken when selecting and categorising materials used for road construction. • Group learners to discuss

Competences	Content	Teaching/Learning Strategies
and stabilises the soil. • performs surface dressing operations. • erects road drainage structures.	• Soil stabilisation: stabilisation materials, pavement materials, geotextile materials, rigid pavements and materials, flexible pavements and materials, bridge construction and culverts	differences between consolidation, compaction and stabilisation. • Lead a guided tour to a road under construction for learners to observe compaction, consolidation and stabilisation of the soil. Task them to write reports and make presentations. • Guide learners to a nearby site with surface dressing and drainage works in progress and task them to identify the materials used and the ratios. Let them write a report and make presentations.

Assessment Strategy

Task the learners to:

- select and categorise road materials.
- compact, consolidate and stabilise the soil.
- perform surface dressing operations.
- erect road drainage structures.

Teaching/Learning Resources

- Cement
- Stones
- Stabilisation materials
- Documentary on highway analysis

Sub-module 5: Elements of Traffic Engineering and Management

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • marks carriage ways. • classifies roads. • carries out traffic survey. • analyses highway traffic. • plans for ground transport and urban traffic network. • maintains traffic element systems. • determines signal timing plan for vehicles and pedestrians.	• Carriageway markings, road classification, road capacity • Traffic survey, elements of ground circulation and planning, vehicular, driver and road characteristics • Highway traffic analysis (capacity, flow, volume, speed, density, intersections, driver-vehicle relationship, parking, queuing processes in traffic flow) • Planning of ground transportation control, public transport planning and management • Urban traffic network management, traffic safety • Maintenance of traffic system elements	• Lead a guided discussion on carriageway markings, road classification and road capacity. • Group learners to carry out traffic survey and analyse highway traffic, task them to write a group report and make presentations. • Lead a guided discussion on planning of ground transportation and control public transport and management • Lead a guided discussion on urban traffic network management and traffic safety. Task learners to search for current information on traffic safety, write a report and make class presentations. • Group learners to carry out traffic survey and analyse highway traffic, maintenance of traffic system elements and controls.

Assessment Strategy

Task the learners to:

- mark carriage ways.
- classify roads.
- carry out traffic survey.
- analyse highway traffic.
- determine signal timing plan for vehicles and pedestrians.

Teaching/Learning Resource

- Documentary on highway analysis

Bibliography

Salter, R. J. (1983). *Highway Traffic Analysis and Design.* Macmillan, London

Sub-module 6: Traffic Regulation and Control

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • plans for urban traffic control. • designs intersections, roundabouts and flyovers. • assesses causes of accidents on roads.	• Rural and urban traffic control • Design: priority intersections, right of way, rotary intersections (roundabout), at grade and grade-separated intersections, capacity of T-junction central reservation (median) strip, signalised intersections, considerations for pedestrians at signalised intersections • Flyover-bridge across highways	• Lead a guided discussion on rural and urban traffic control. • Group learners to design priority intersections, rotary intersections, grade-separated intersections and flyover-bridge across highways. Task them to write a group report and make presentations. • Lead a guided discussion on accident control,

Competences	Content	Teaching/Learning Strategies
	• Accident control (causes of accidents, traffic restrictions including pedestrians only areas, use of traffic control elements)	causes of accidents, traffic restrictions including pedestrians only area and use of traffic control elements.

Assessment Strategy

Task the learners to:

- design intersections, roundabouts and flyovers.
- assess causes of accidents on roads.

Teaching/Learning Resources

- Documentary on highway analysis

Bibliography

Salter, R. J. (1983). *Highway Traffic Analysis and Design.* MacMillan, London

NEMA and related Laws

AASHTO T 166-00 (2000). *Standard Method of Test for Bulk Specific Gravity of Compacted Bituminous Mixtures using Saturated Surface Dry Conditions.* 20th Edition. Washington D.C

AASHTO T 209 (1995). *Standard Method of Test for Maximum Specific Gravity of Bituminous Paving Mixtures* . 20th Edition Washington DC.

HDCE 224: Construction Management

Duration: 45 Hours

Module Overview

This module equips the learner with knowledge and skills of organising sites; maintaining construction plants; observing safety, health and welfare considerations; developing best methods of work; contract law.

Learning Outcomes

By the end of this module, the learner should be able to:

- organise and manage sites.
- service and maintain plants and equipment.
- develop best work methods.
- interpret conditions of contract.

Preparatory Assignment

Group learners and task them to prepare:

i) various conditions of contract for construction works.
ii) advertisements for bids as per PPDA guidelines.

Result

Learners present their findings.

Sub-module 1: Introduction to Construction Management

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • produces construction plans. • applies the principles of management in managing	• Principles and functions of management; (planning, organising, staffing, commanding, coordinating, controlling,	• Lead a guided discussion on the principles and functions of management, organisation structures and

Competences	Content	Teaching/Learning Strategies
sites. • develops and observes hierarchy of organisationa l structure.	communicating and motivating) • Organisation structures and relationships in the construction industry (line/direct; line and staff relationship; staff relationship)	relationships in the construction industry. • Illustrate with examples the different organisational structures. Task learners to develop an organisational structure.

Assessment Strategy

Task the learners to:

- produce construction plan.
- apply the principles of management in managing sites.
- develop and observe hierarchy of organisational structures.

Teaching/Learning Resources

- Charts

Sub-module 2: Site Organisation and Administration

Duration: 09 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • draws a site layout. • identifies and uses correct technical control methods. • prepares, interprets and	• Site lay-out • Technical control (elimination of construction hazards) • Site documents • Resource scheduling • Allocation and	• Guide learners to draw a site lay-out. • Group learners to discuss technical control and elimination of construction hazards. • Group learners to brainstorm the types of documents used on site by

Competences	Content	Teaching/Learning Strategies
keeps site documents/ records. • communicates effectively in the site and prepares site reports.	control, storage and control of construction materials • Site communication • Effective site control • Site record keeping • Report writing	use of examples. Task them to write a group report and make presentations. • Lead a guided discussion on resource scheduling, allocation and control, storage and control of construction materials. • Guide learners through site communication, effective site control site record keeping and report writing.

Assessment Strategy

Task the learners to:

- draw a site layout.
- identify and use correct technical control methods.
- prepare, interpret and keep site documents/records.
- prepare site reports.

Teaching/Learning Resources

- Charts
- Samples of site documents
- Drawing of site layout
- Samples of reports

Sub-module 3: Construction Plant and Equipment

Duration: 08 Hours

Competences	Content	Teaching/learning strategies
The learner: • controls and maintains site plant, equipment and tools. • determines the machine output and matches.	• Planning, organisation and control • Application of correct plant, tools and equipment on construction site • Maintenance and servicing • Productivity and plant matching	• Lead a guided discussion on planning, organisation and control, and task learners to plan for a given organisation. • Group learners to brainstorm the application of various plants on the construction site and task them to make neat sketches in their notebooks. • Lead a guided discussion on maintenance and servicing the plant. • Guide learners through productivity and plant matching for a particular task.

Assessment Strategy

Assign the learners to:

- control and maintain site plant, equipment and tools.
- determine the machine output and matches.

Teaching/Learning Resources

- Charts
- Calculator

Sub-module 4: Safety, Health and Welfare

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • holds safety lectures and appoints an accident prevention officer. • displays eye catching posters. • maintains records and management considerations of regular reports on accidents. • provides for cleanliness, prevention of overcrowding in factories, ventilation, lighting, drainage of floors and lavatories. • takes into consideration the health, safety and security issues hence reducing on absenteeism owing to sickness. • recruits staff and improves the morale of workers. • encourages performance of more and better work and acts as incentive to staff to take a greater	• Safety: importance of safety in industries, industrial safety, factors that undermine industrial safety, safety wear, warning signage • Health: hazards in industries, nature of industrial hazards, causes of industrial fire, emergency procedures and application of protective measures associated with industrial hazards, fire extinguishers, and hazards of compressed gases • Welfare: employment legislation and construction regulations, incentive schemes and	• Lead a guided discussion on safety: importance of safety in industries, industrial safety, factors that undermine industrial safety, safety wear and warning signage. • Group learners to brainstorm the health hazards in industries, nature of industrial hazards, causes of industrial fire, emergency procedures and application of protective measures associated with industrial hazards, fire extinguishers, and hazards of compressed gases. Task each group to write a report and make presentations. • Lead a guided discussion on welfare: employment legislation and construction regulations,

Competences	Content	Teaching/Learning Strategies
interest in the work and in the business.	their application in the construction industry	incentive schemes and their application in the construction industry.

Assessment Strategy

Assign the learners to identify, write and display eye catching posters on safety, security and health promotion.

Teaching/Learning Resources

- Posters
- Safety wear
- Fire extinguishers

Sub-module 5: Work Study

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • evaluates and improves performance in production using aspects of work study. • examines methods of work study. • establishes good systems of recruitment of staff, coupled with good methods of reviewing staff performance subsequently.	• Introduction to work study • Methods of work study: method study, time study, motion study and work measurement • Project investment appraisal	• Lead a guided discussion on evaluation and improvement of performance in production using aspects of work study. • Group learners to brainstorm the need for work study. • Group learners to examine all stages of methods of work study. • Lead a guided discussion on project investment appraisal.

Assessment Strategy

Assign the learners to:

- evaluate performance in production using aspects of work study
- examine all stages of methods of work study.

Teaching/Learning Resources

- Charts
- Internet

Sub-module 6: Basic Construction Law

Duration: 10 Hours

Competence	Content	Teaching/Learning Strategies
The learner interprets legal responsibility of parties in construction; legal responsibility of local authority, insurance and the law of torts; labour laws; environment laws; PPDA/ International Federation of Consulting Engineers (FIDIC) conditions of contract.	• Legal responsibility of parties in construction • Legal responsibility of local authority, insurance and the law of torts • Labour laws: workman's compensation, construction contracts • Environment laws: public utilities, urban planning and legal framework • Contract procurement: PPDA/FIDIC conditions of contract • Engineering ethics and professionalism: professional responsibility, risk and moral responsibility, corruption in society and ways to fight it • Gender issues in engineering, codes of ethics, international issues • Case study	• Lead a guided discussion on legal responsibility of parties in construction, legal responsibility of local authority and insurance companies. • Group learners to discuss the law of torts, labour laws, environment law and legal framework. Task each group to write a report and make presentations. • Lead a guided discussion on contract procurement: PPDA Act, conditions of contract and other legal matters.

Assessment Strategy

Assign the learners to interpret legal responsibility of parties in construction, legal responsibility of local authority, insurance and the law

of torts, labour laws, environment laws and PPDA/FIDIC conditions of contract.

Teaching/Learning Resources

- PPDA/FIDIC

Bibliography

Cooke, B. and Williams, P. (1997). *Construction Planning, Programming and Control.* Macmillan

Fryer, B. (1997). *The Practice of Construction Management.* Macmillan

Harris, F. and Mc Caffer, R. (2001). *Modern Construction Management.* 2nd Edition. Blackwell Science, London.

Illston, J. (2001). *Building Control: A Guide to Law.* Longman

McGeorge, D. and Palmer, A. (2002). *Tenders and Contracts for Buildings.* 3rd Edition, Blackwell Science

Owen, S. (1998). *Law for the Construction Industry.* Longman

Oxley, R. and Poskitt, J. (1997). *Management Techniques Applied to Construction Industry.* Blackwell

HDCE 225: Engineering Geology

Duration: 45 Hours

Module Overview

This module introduces the learner to application of geologic sciences to engineering study for the purpose of assuring the geologic factors regarding the location, design, construction, operation and maintenance of engineering works. It equips the learner with knowledge and skills of complex geological processes, tests, ground water occurrences and construction materials.

Learning Outcome

By the end of this module, the learner should be able to examine geological linkage with civil and water engineering constructions and select the appropriate construction materials.

Preparatory Assignment

- Task learners to visit a quarry to identify different types of rocks and grading of aggregates.
- Group learners to brainstorm the formation of different types of rocks and their characteristics.

Result

Each group writes a report and presents.

Sub-module 1: Elements of Earth and Historical Perspective

Duration: 04 Hours

Competence	Content	Teaching/Learning Strategies
The learner considers elements of earth and its history in designing	• Introduction, the surface of the earth, the interior of the earth, continental drift, plate tectonic, earth age and origin	• Lead a guided discussion on the surface of the earth, the interior of the earth, continental drift, plate tectonic, earth age and origin and stratigraphical

Competence	Content	Teaching/Learning Strategies
structures.	and stratigraphical representation, Precambrian, Phanerozoic, Mesozoic and Cenozoic eras.	representation, Precambrian, Phanerozoic, Mesozoic and Cenozoic eras. • Illustrate the continental drift and guide learners as they practise.

Assessment Strategy

Task the learners to consider elements of earth and its history in designing structures.

Teaching/Learning Resources

- The Internet
- Documentary on earth formation
- Chart

Sub-module 2: Structural Geology

Duration: 5 hours

Competence	Content	Teaching/Learning Strategies
The learner identifies and classifies folds, faults and joints.	• General introduction, attitude and beds • Folds: terminologies, classification, types, causes and engineering considerations involved when dealing with folded rocks, fold geometry • Faults: terminologies, types and classifications, recognition of faulting in the field, causes,	• Lead a guided discussion on folds: terminologies, classification, types, causes and engineering considerations involved when dealing with folded rocks, fold geometry. • Group learners to discuss faults: terminologies, types and classifications, recognition of faulting in the field, causes,

Competence	Content	Teaching/Learning Strategies
	effects and engineering considerations involved when dealing with the faulted rocks • Joints: nature and attitude, classifications, types, in different rocks and engineering considerations involved when dealing with the jointed rocks and unconformities	effects and engineering considerations involved when dealing with the faulted rocks. Task each group to write a report and make presentations. • Lead a guided tour to any nearby rock for the learners to identify folds, faults and joints and task them to write group reports and make presentations.

Assessment Strategy

Assign the learners to identify and classify folds, faults and joints.

Teaching/Learning Resources

- The Internet
- Documentary on earth formation
- Chart

Sub-module 3: Minerals and Strength of Geological Materials

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • describes and identifies different types of rocks in	• Introduction to rocks and minerals, elements and compounds and their definitions, identification and	• Lead a guided tour to nearby rocks for learners to observe and identify the different types of rocks and their order of formation. Task them to

Competences	Content	Teaching/Learning Strategies
order of formation and their physical properties. • selects, classifies and uses minerals basing on their properties. • investigates drainage and behaviour of rock, soil and failures of rocks.	classification, their uses and properties: physical properties, microscopic optical properties of minerals, chemical properties of minerals • Rock forming minerals and their importance, clay and non-silicate minerals, mineral accumulation, influence of geological history, importance of drainage and behaviour of rocks, soil and failures of rocks	write group reports and present in class. • Group learners to discuss minerals, elements and compounds and their definitions, identification and classification, their uses and properties: physical, microscopic optical, and chemical properties of minerals. • Lead a guided discussion on rock forming minerals and their importance, clay and non-silicate minerals, mineral accumulation, influence of geological history, importance of drainage and behaviour of rock, soil and failures of rocks.

Assessment Strategy

Assign the learners to:

- identify different types of rocks in order of formation and their physical properties.
- select, classify and use minerals basing on their properties.

Teaching/Learning Resources

- The Internet
- Stones from different rocks

Sub-module 4: Process of Weathering and Denudation

Duration: 02 Hours

Competence	Content	Teaching/Learning Strategies
The learner controls causes, mechanisms/types and processes of weathering.	• Introduction, causes, mechanisms/ types of weathering and products of weathering; processes of weathering, wind and water erosion, deposition and geological work associated with them	• Lead a guided discussion on the causes, mechanisms/types, processes and products of weathering. • Demonstrate the processes involved in weathering, wind and water erosion, deposition and geological work and guide the learners as they practise.

Assessment Strategy

Assign the learners to control the causes, mechanisms/types and processes of weathering.

Teaching/Learning Resource

- The Internet

Sub-module 5: Tunnels and Tunnelling

Duration: 02 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • designs and draws cross-sections of tunnels • applies geological considerations required for successful tunnelling operations in consolidated and unconsolidated rocks.	• Definitions, merits and demerits, tunnel approaches, shape and size of tunnel cross-sections, types, geological considerations required for successful tunnelling operations in consolidated and unconsolidated rocks	• Lead a guided discussion on the merits and demerits of tunnels, tunnel approaches, shape, type and size of tunnel cross-sections. • Illustrate the representative design of tunnels, shapes and guide the learners as they practise designing of tunnel shapes and sizes. • Group learners to discuss geological considerations required for successful tunnelling operations in consolidated and unconsolidated rocks and task each group to write a report and make presentations.

Assessment Strategy

Assign the learners to design and draw cross-sections of tunnels.

Teaching/Learning Resource

- The Internet

Sub-module 6: Geological Aspects of Building Stones and Aggregates

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • classifies rocks. • seasons stones. • carries out tests for stones. • quarries stones.	• Introduction: formation of rocks and soils, classification of rocks, types of fractured rocks /aggregates and their uses, seasoning of stones, characteristics and their qualities, tests for stones/aggregates for constructions, decay or deteriorations to stones/aggregates • Quarrying: selection, methods – excavation, heating, wedging, blasting, use of channelling machines; precautions taken while quarrying and dressing of stones	• Lead a guided discussion on the formation of rocks and soils; classification of rocks; types of fractured rocks /aggregates and their uses • Group learners to discuss seasoning of stones; characteristics and their qualities; tests for stones/aggregates for construction; decay or deteriorations of stones/aggregates. Task them to write group reports and make presentations. • Lead a guided tour to a quarry for learners to observe and inquire about the methods of quarrying, precautions taken while quarrying and dressing stones. Task them to write group reports and present.

Assessment Strategy

Task the learners to:

- classify rocks.
- season stones.
- carry out tests for stones.
- quarry stones.

Teaching/Learning Resources

- The Internet

- Stones
- Quarrying tools
- Blasting equipment

Sub-module 7: Geotechnical Methods of Site Investigation

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • carries out desk study. • performs boring and drilling. • writes site investigation reports, profiling data and borehole records.	• introduction • Techniques employed: desk study, types of samples and reasons • Organising effective site investigations: boring, drilling and site investigation reports, profiling data, borehole records and interpretations	• Lead a guided discussion on the desk study, types of samples and reasons for site investigation. • Guide learners through boring and drilling practices. • Guide learners to carry out site investigations, emphasising on safety. • Group learners to discuss site investigation reports, profiling data, borehole records and interpretations.

Assessment Strategy

Task the learners to:

- carry out desk study.
- perform boring and drilling.
- write site investigation reports and profiling data for borehole drilling.

Teaching/Learning Resources

- The Internet
- Sample of desk study report

Sub-module 8: Geo-hydrology

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • identifies ground water sources and occurrence. • uses knowledge of aquifers formation and wells while drilling boreholes and protecting wells. • applies Darcy's law in determining flows. • carries out tests on ground water.	• Introduction to groundwater: groundwater source, occurrence, stratigraphy, utilisation and vulnerability • Aquifers and wells: different types, confinement, isotropy and anisotropy, hydrological boundaries, springs and artesian wells, identification, potentially different rock aquifers, groundwater prospecting, borehole and logs data, groundwater flow • Darcy's law, all its assumptions and characters e.g. seepage force, storage, specific yield, coefficient of storage, conductivities, character of groundwater: chemical and physical, hydro geological investigations	• Lead a guided discussion on groundwater source, occurrence, stratigraphy, utilisation and vulnerability. • Lead a guided discussion on types, confinement, isotropy and anisotropy, hydrological boundaries, springs and artesian wells, identification, potentially different rock aquifers, groundwater prospecting, borehole logs data, and groundwater flow. • With examples, illustrate the application of Darcy's law in determining flows of liquids. • Group learners to discuss Darcy's law, assumptions, characters, chemical and physical, and hydro geological investigations. Task them to write group reports and make presentations.

Assessment Strategy

Task the learners to:

- identify ground water sources and occurrence.
- apply Darcy's law in determining flows.
- test for characteristics of ground water.

Teaching/Learning Resources

- The Internet
- Calculator
- Auger
- Documentary on geo- hydrology

Bibliography

Blyth, F.G.H. and de Freitas, M. H. (1987). *A Geology for Engineers*. 7th Edition. Edward Arnold, London

Sub-module 9: Earthquakes

Duration: 02 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • designs structures basing on types, earthquake mechanism and causes. • predicts earthquake occurrence.	• Introduction, types of earthquakes, earthquake mechanisms, causes, waves, travel time and location of epicentre, intensity and magnitude, seismic zones and the engineering considerations including safety measures • Prediction of earthquake occurrence	• Lead a guided discussion on types of earthquakes, earthquake mechanisms, causes, waves, travel time, location of epicentre, intensity and magnitude, seismic zones and the engineering considerations including safety measures. • Group learners to discuss prediction of earthquake occurrence and task each group to write a report and make presentations.

Assessment Strategy

Task the learners to describe the types, earthquake mechanisms and causes of earthquakes.

Teaching/Learning Resource

- The Internet

Sub-module 10: Geological Maps

Duration: 04 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • uses scales for mapping. • interprets maps of subsurface geology and resources. • carries out field mapping. • uses age relationship, unconformities, outliers and inliers, structural relationships and shape of outcrop boundaries for interpreting geological maps.	• Introduction, commonly used scales, types: solid and drift editions, exposure and outcrop, thickness of strata • Maps of subsurface geology: Isochore, horizontal-plane, structural, geophysical • Maps of resources: derived, geomorphological, geotechnical • Field mapping: equipment used – clinometer, traverse surveys, measurement of dip and strike • Map interpretation: age relationship, unconformities, outliers and inliers,	• Lead a guided discussion on solid and drift editions, exposure, outcrop and thickness of strata. • Group learners to interpret maps of subsurface geology, and task them to write a group report and make presentations geomorphologic, and geotechnical aspects • Guide learners through field mapping. • Group learners to discuss age relationship, unconformities, outliers and inliers, structural relationships and shape of outcrop

Competences	Content	Teaching/Learning Strategies
	structural relationships and shape of outcrop boundaries	boundaries. Task them to write group reports and make presentations.

Assessment Strategy

Task the learners to:

- use scales for mapping.
- interpret maps of subsurface geology and resources.
- carry out field mapping.

Teaching/Learning Resources

- The Internet
- Scales
- Samples of subsurface geology and resources maps
- Equipment for fieldwork

Sub-module 11: Practical and Fieldwork

Duration: 06 Hours

Competence	Content	Teaching/Learning Strategies
The learner carries out field investigation tests.	• Tests to be carried out: - Sample and sampling - Tests for composition - Tests for structure: whole fabric, porosity, particle size distribution - Test for strength: elastic moduli, consolidation characters, tensile, uniaxial, tri-axial and shear strengths - Hydraulic properties: permeability, effective porosity, specific yield - Index tests: rock and soil indices, identification of minerals (rock forming) - Identification of rocks: sedimentary, metamorphic and igneous, chemical properties and microscopic optical properties	• Guide learners through sample and sampling, tests for composition, structure and strength of soils. • Group learners to discuss hydraulic properties of subsoil water and soil strata. • Guide learners to carry out index tests and identification of rocks.

Assessment Strategy

Task the learners to carry out field tests.

Teaching/Learning Resources

- The Internet
- Soil
- Stones

Bibliography

Blyth, F. G. H. and de Freitas, M. H. (1987). *A Geology for Engineers*. 7th Edition. Edward Arnold, London.

Bowels J. E. (2000). *Physical and Geotechnical Properties of Soils*. ISE

HDCE 226: Sanitation and Drainage

Duration: 60 Hours

Module Overview

This module introduces the learner to hygienic means of promoting health through prevention of human contact with the hazards of wastes as well as the treatment and proper disposal of sewage or waste water. It equips the learner with knowledge and skills of drainage issues, waste water treatment and solid waste management.

Learning Outcomes

By the end of this module, the learner should be able to:

- design public and domestic excreta systems.
- educate the public on good health practices and build drains.

Preparatory Assignment

Group learners to study:

i) excreta disposal on a college campus, explain limitations and observe challenges and appropriate solutions for improvement.
ii) solid waste management at campus or nearby community.

Result

Groups write reports and present through a guided discussion.

Sub-module 1: Health Issues

Duration: 04 Hours

Competence	Content	Teaching/Learning Strategies
The learner sensitizes the public on the appropriate methods of hygiene and sanitation system.	• Public health concerns • Sanitation related illnesses and diseases such as cholera, typhoid fever, dysentery, infant diarrhoeas,	• lead a guided discussion on public health concerns, sanitation related illnesses and diseases such as cholera, typhoid fever, dysentery, infant

Competence	Content	Teaching/Learning Strategies
	hookworm, ascariasis, bilharziasis • Transmission of disease and prevention method	diarrhoea, hookworm, ascariasis, and bilharziasis. • Group learners to discuss the transmission of disease and sustainable preventive methods.

Assessment Strategy

Task the learners to maintain good hygiene and sanitation system in the college or community.

Teaching/Learning Resources

- Documentary on health issues
- Lagoon
- Septic tanks
- Chemicals
- Rubbish pits

Sub-module 2: Microbiology

Duration: 04 Hours

Competence	Content	Teaching/Learning Strategies
The learner identifies and describes the effects of micro-organisms present in water.	• Micro-organisms present in water including classification and effects: microbes, plants and animals, protozoa, algae, bacteria, fungi	• Lead a guided discussion on micro-organisms present in water including classification and their effects. Task learners to identify the possible solutions to such issues.

Assessment Strategy

Task the learners to identify the effects of micro-organisms present in water and suggest the possible solutions.

Teaching/Learning Resources

- Algae
- Fungi

Sub-module 3: Rural Sanitation and Drainage

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • designs and constructs excreta disposal systems. • manages human and solid waste in society.	• Methods of disposal of excreta • Design considerations • Construction, operation and maintenance of pit latrines, ecosan toilets, VIP latrines, bucket latrines, water seal latrines, cesspool, septic tank, soak pits and leaching fields • Household sanitation (wash water sumps, soak pit, soakage trench) • Solid waste management (generation, sorting, collection, transportation, disposal, recycling, composting)	• Guide learners through design considerations in the construction, operation and maintenance of pit latrines, ecosan toilets, VIP latrines, bucket latrines, water seal latrines, cesspool, septic tank, soak pits and leaching fields. Guide the learners as they practise. • Lead a guided discussion on household sanitation (wash water sumps), soak pit, soakage trench. • Group learners to manage solid waste (generation, sorting, collection, transportation, disposal, recycling, composting) around the college. Task them to write group reports and make presentations.

Assessment Strategy

Task the learners to:

- design and construct excreta disposal systems.
- manage human and solid waste in society.

Teaching/Learning Resources

- Drawings
- Toilet slabs
- Bricks
- Blocks
- Iron sheets

Sub-module 4: Urban Drainage

Duration: 10 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • designs and lays sewers for drainage systems. • maintains sewerage systems and estimates runoffs.	• Types of sewage/drainage systems: separate, combined or partial • Storm drainage systems: - Hydrological consideration - Design flow - Procedures for estimating runoff: rational method - Storm water inlets - Pipes and material - System layout	• Lead a guided discussion on types of sewage/drainage and storm drainage systems. • Demonstrate the design process and layout of sewage drainage systems and guide the learners as they practise. • Illustrate with examples the estimation of runoff by rational method and task learners to practise on given examples.

Assessment Strategy

Assign the learners to:

- design and lay sewers for drainage systems.
- maintain sewerage system.
- estimate runoffs.

Teaching/Learning Resources

- Calculator
- Charts

Sub-module 5: Waste Water Collection

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • connects a building waste water collection system. • identifies and constructs site for waste water pumping stations and treatment plant.	• Building connections • Collecting and intercepting sewers • Pipes and materials • System layout • Sewer maintenance • Protection of sewerage system against flood waters • Inverted siphons • Waste water pumping stations • Location of treatment plants	• Group learners to discuss: building connections, collecting and intercepting sewers, pipes and materials, system layout, sewer maintenance, protection of sewerage system against flood waters and inverted siphons. Task them to develop design sketches, write group reports and make presentations. • Guide learners on the connection of sewage collection system. • Task learners to visit waste water pumping stations and treatment plant for them to observe and inquire about the processes involved. Task them to write group reports and make presentation.

Assessment Strategy

Task the learners to:

- connect a building waste water collection system.
- identify a site and construct a waste water pumping station and treatment plant.

Teaching/Learning Resources

- Intercepting sewers
- Pipes
- Charts
- Pumping station
- Treatment plant

Bibliography

McGhee, T.J. 1991. *Water Supply and Sewerage*. 4th Edition. McGraw-Hill, New York.

Sub-module 6: Waste Water Quality Characteristics

Duration: 06 Hours

Competence	Content	Teaching/Learning Strategies
The learner treats waste water by applying biochemical oxygen demand and chemical oxygen demand.	• Dissolved oxygen • Biochemical oxygen demand • Relative stability • Chemical oxygen demand • Chlorine demand • Grease and volatile acids • Suspended solids • Microorganisms • Typical domestic waste characteristics	• Group learners to treat waste water and guide them as they practise. • Lead a guided discussion on: suspended solids, microorganisms and typical domestic waste characteristics, emphasising on the safest way of handling waste.

Assessment Strategy

Task the learners to treat waste water by applying biochemical and chemical oxygen demand.

Teaching/Learning Resources

- Chlorine
- Grease and volatile acids
- Biochemical oxygen demand and chemical oxygen demand

Bibliography

McGhee, T. J. (1991). *Water Supply and Sewerage.* 4th Edition. McGraw-Hill, New York.

Sub-module 7: Waste Water Treatment

Duration: 08 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • treats waste water. • designs and constructs stabilisation ponds, lagoon and septic tanks.	• Reasons for treatment • Biological and physical treatment • Waste water quality standards • Conventional treatment plant methods: including screening, grit removal, sedimentation • Sludge disposal • Design, construction, operation and maintenance of stabilisation ponds, and septic tanks	• Lead a guided tour to a waste water treatment plant for them to observe and inquire about the waste water treatment process. Task the learners to write group reports and present. • Guide learners through the design, construction, operation and maintenance of stabilisation ponds and septic tanks.

Assessment Strategy

Task the learner to:

- treat waste water.
- design and construct stabilisation ponds, lagoons and septic tanks.

Sub-module 8: Solid Waste Management

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • manages solid waste. • constructs a leachate	• Generation • Sorting and separation • Recycling	• Lead a guided discussion on solid waste management process. • Group learners to manage

Competences	Content	Teaching/Learning Strategies
evaporation pond.	• Collection • Transportation • Treatment • Disposal • Treatment of leachates	waste in their respective hostels, discuss the challenges met, write a group report and make presentation. • Guide the learners to construct a leachate evaporation pond and task them to design it.

Assessment Strategy

Task the learners to:

- manage solid waste in their respective hostels.
- construct a leachate evaporation pond.

Teaching/Learning Resources

- The Internet
- Chemicals
- Protective gears
- Respirators

Sub-module 9: Treatment of Industrial Wastes

Duration: 06 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • differentiates industrial wastes from agricultural wastes. • carries out pre-treatment of industrial waste.	• Characteristics of industrial wastes and their effects on water bodies • Characteristics of agricultural wastes and their effect on water bodies • Dilution	• Lead a guided discussion on the characteristics of industrial and agricultural wastes and their effect on water bodies. • Demonstrate the procedure carried out in dilution purification and pre-treatment of

Competences	Content	Teaching/Learning Strategies
	purification • Pre-treatment of industrial waste	industrial wastes processes and guide the learners as they practise.

Assessment Strategy

Task the learners to carry out pre-treatment of industrial waste.

Teaching/Learning Resources

- Documentary of industrial waste
- The Internet
- Chemicals
- Protective gears

Sub-module 10: Special Problems

Duration: 04 Hours

Competence	Content	Teaching/Learning Strategies
The learner controls pollution by encouraging collection of polythene bags and plastic bottles.	• Low-lying water logged areas (wetlands) destruction and pollution • Poor urban areas: slums and their sanitation problems • Pollution by polythene bags, plastic bottles and their control • Sanitation and water supply on islands	• Lead a guided discussion on low-lying water logged areas (wetlands) destruction, pollution and poor urban areas. • Group learners to collect polythene bags, plastic bottles in the college compound and dispose of appropriately. • Guide learners to discuss sanitation and water supply on islands and task them to search for information on the best ways of managing water and sanitation in the islands.

Assessment Strategy

Task the learners to collect polythene bags and plastic bottles around the college compound and dispose them of appropriately.

Teaching/Learning Resources

- The Internet
- Chemicals
- Protective gear

Bibliography

BS5572, Soil and Waste systems

Burberry, P. (1984). *Mitchell's Environment & Services.* Batsford Academic and Educational Ltd, London

CP 302 Small Sewerage Treatment Works

CP8301 Building Drainage

McGhee, T. J. (1991). *Water Supply and Sewerage.* 4th Edition. McGraw-Hill, New York.

NEMA and related laws

HDCE 227: Real Life Project IV

Duration: 60 Hours

Module Overview

In this module, the learner is tasked to design and construct a paved /tarmac road, a lagoon, a biogas production system or an eco-san toilet. It involves hands on training.

Learning Outcome

By the end of this module, the learner should be able to design and construct a paved/tarmac road, a biogas production system **OR** an eco-san toilet system.

Preparatory Assignment

Group learners to compute quantity of gravel required on a road of 100m length having a width of 6.5m, 150mm thick and determine the spacing using $4m^3$ track capacity based on side slopes of 1:2.

Result

Groups present their computation in class discussion.

Sub-module: Possible Projects in Year 2 Semester

Duration: 60 Hours

Competences	Content	Teaching/Learning Strategies
The learner: • generates and sketches drawings. • produces actual architectural and structural drawings. • carries out	Proposed project: Identify a road to be rehabilitated within or outside the college • Carry out survey • Carry out soil test • Prepare drawings • Prepare estimates and BoQs • Set out a road (vertical and horizontal alignment)	• Guide learners to generate sketches and drawings. • Task learners to carry out engineering surveying work. • Let the learners clear and level

Competences	Content	Teaching/Learning Strategies
engineering surveying. • clears the site. • carries out geotechnical investigation. • excavates to level (ETL). • forms a road to the required gradients. • gravels, and surfaces a road. • builds drainage, wing and head walls. • constructs grouted stone masonry. • quantifies and costs materials. • determines road geometry. • carries out inspection to determine performance of the road by identifying corrugation formation, gravel loss, erosion, pot-holes, blockage of	• Site clearance (grubbing and stripping) • Excavate to level (ETL) • Form a road • Gravel • Surface • Drainage • Wing and head walls (stone finish) • Stone pitching OR • Determine the road geometry by taking measurements and levels to produce drawings of the cross-section and longitudinal profile • Carry out inspection to determine performance of the road by identifying corrugation formation, gravel loss, erosion, pot-holes, blockage of drainage structures or where they are needed but lacking and produce a report with drawings/photographs showing the performance of the existing road. • Carry out traffic studies namely: classified traffic counts, determine origin and destination of the road and establish the traffic that may use the road when completed including estimates of traffic that may be attracted due to good ridding surface • Establish utility services	the site. • Guide learners in drawing topographical maps. • Guide the learners in carrying out geotechnical investigation. • Lead a guided discussion on estimation and costing of materials required for the project. • Task the learners to excavate to level. • Guide learners to form a road to required gradient, gravel and surface. • Lead guided tours to a road with drainage work for the learners to observe and inquire drainage construction, write a report and present. • Illustrate the techniques of determining the road geometry and guide learners as they

Competences	Content	Teaching/Learning Strategies
drainage structures. • carries out traffic studies. • establishes utility services along and across the road and historical date. • establishes drainage pattern by taking levels alongside drains, streams, culverts and drainage channel perpendicular to the road. • designs lagoon considering water consumption per capita, waste water production, population forecast and sewage tests from existing systems. • constructs base and chambers, pad fabrication, super	along and across the road and historical date when last maintained, traffic flow records, where and when accidents occur (black spot) and maintenance policy • Establish the drainage pattern by taking levels alongside drains, taking levels along streams/ culverts/drainage channel perpendicular to the road, inspecting the road when raining to determine the preferred running water flow and produce a report and working drawings showing the drainage pattern, the profile for streams and drainage channels. Proposed project: Construction of a lagoon • Surveying • Soil investigation • Design consideration: - water consumption per capita - waste water production - population forecast - sewage tests from existing systems. • Preparation of drawings • Preparation of estimates and bill of quantities • Construction base and chambers • Construction of pad fabrication • Construction of super	practice. • Task learners to carry out inspection to determine performance of the road by identifying corrugation formation, rutting, gravel loss, erosion, pot-holes, blockage of drainage structures • Guide learners through carrying out traffic studies, establishing utility services along and across the road, historical data, establishing drainage pattern by taking levels alongside drains, streams, culverts and drainage channel perpendicular to the road • Task learners to design a lagoon considering, water consumption per

Competences	Content	Teaching/Learning Strategies
structure and finishing. • tests quality of effluent from existing systems. • establishes water consumption and resulting per capita waste water production and population forecast. • makes reports and prepares drawings. • constructs base and vaults. • carries out monitoring and evaluation of the project.	structure • Finishing • Monitoring and evaluation Proposed project: Biogas production system • Surveying • Preparation of drawings • Preparation of estimates and bill of quantities • Construction Proposed project : Eco-san • Carry out inception and field investigation • Test quality of effluent from existing systems • Establish water consumption and resulting per capita waste water production and population forecast • Make report and prepare drawings • Construction base and vaults • Construction of pad fabrication/ concrete pads • Construction of super structure • Finishing • Disposal of waste • Monitoring and evaluation	capita, waste water production, population forecast and sewage tests from existing systems • Lead a guided discussion on construction of base, chambers, pad fabrication, super structure and finishing • Group learners to test quality of effluent from existing systems, establish water consumption and resulting per capita waste water production, population forecast and make reports. • Demonstrate the construction of bases and vaults and guide learners as they practise. • Lead a guided discussion on monitoring and evaluation of the project.

Assessment Strategy

Task the learners to:

- sort and identify tools and equipment used for engineering survey and survey a proposed site.
- develop site sketches and working drawings.
- produce topographic maps.
- carry out geotechnical investigation.
- carry out estimation and materials costing.
- excavate to level, form a road gravel, surface and builds drainage.
- determine road geometry.
- carry out inspection to determine performance of the road by identifying corrugation formation, rutting, gravel loss, erosion, pot-holes and blockage of drainage structures.
- carry out traffic studies.
- establish utility services along and across the road and historical data.
- establish the drainage pattern by taking levels alongside drains, along streams/ culverts/drainage channel perpendicular to the road.
- design lagoon considering water consumption per capita, waste water production, population forecast and sewage tests from existing systems.
- construct base and chambers, pad fabrication, super structure and finishing.
- test quality of effluent from existing systems.
- establish water consumption and resulting per capita waste water production and population forecast.
- make reports.
- construction base and vaults.
- carry out monitoring and evaluation of the project.

Teaching/Learning Resources

- Aggregates
- Cement
- Cement blocks
- Dumpy level
- Gauge box
- Gravel (murram)
- Hand hoe
- Hand saws
- Hard core
- Moulds
- Panga
- Pick axe
- Pit and river sand
- Plumb bobs
- Staff
- Steel

- Steel float
- Stones
- Theodolite
- Timber
- Total station
- Wooden float

Appendix: Software

- Arch CAD
- Autocad
- C++
- CS Project Professional
- Job Master
- Master Bill
- Microsoft Access
- Microsoft Project
- Ms Word
- PowerPoint
- Spreadsheets
- Visual Basic 8.0 and above
- Wessex Accounts
- Win QS

Bibliography

AASHTO T 166-00 (2000). *Standard Method of Test for Bulk Specific Gravity of Compacted Bituminous Mixtures using Saturated Surface Dry Conditions.* AASHTO, 20th Edition. Washington D.C

AASHTO T 209 (1995). *Standard Method of Test for Maximum Specific Gravity of Bituminous Paving Mixtures.* AASHTO, 20th Edition. Washington D.C

Ashley, C. (1994). *Traffic and Highway Engineering*. Blackwell Scientific Publications, London.

Ashworth, A. (1996). *Pre-contract Studies: Development Economics Estimating and Tendering*. Longman

Ashworth, A. (1996). *SMM7 The Standard Method of Measurement of Building Works.* Longman

Bannister, A. and Baker, R. (1999). *Surveying*. 2nd Edition. Longman, London.

Barnes, G.E. (1995). *Soil Mechanics*. Macmillan, London.

Barry, R. (2001), *The Construction of Buildings*. Crosby Lockwood & Sons Ltd

Beer, F. P. and Johnston, E. R. (1988). *Vector Mechanics for Engineers: Statics and Dynamics.* Tata McGraw Hill Publishing Co

Blyth, F.G.H. and de Freitas, M.H. (1987). *A Geology for Engineers*. 7th Edition. Edward Arnold, London.

Bolton, W. (1997). *Essential Mathematics for Engineering.* Butterworth-Heinemann, London.

Booth, D. L. and Hanner, L. D. (2000). Poverty and Transport: The World Bank Transport and Poverty Alleviation Workshop. June 13th 2000 Washington DC

Bowels, J. E. (2000). *Physical and Geotechnical Properties of Soils*. ISE

Breck, W. G. et al. (1988). *Chemistry for Science and Engineering*. 2nd Edition. McGraw-Hill Ryerson Ltd, Singapore.

BS 5950 (2000) *The Structural Use of Steel*

BS 8110(2000) *The Structural Use of Concrete,* Parts 1, 2 and 3

BS5572, *Soil and Waste Systems*
BS6700, *Water Supply*

Bueche, J. F. (1980). *Introduction to Physics for Scientists and Engineers*. McGraw-Hill, New York.

Building Regulations (1985) HMSO

Burberry, P. (1984). *Mitchell's Environment & Services.* Batsford Academic & Educational Ltd, London

Butler, J.T. (1983). *Elements of Administration for Building Students*. 3rd Edition. Hutchison & Co., London.

Cain, I. J. and Hulse, R. (1997). *Structural Mechanics*. 2nd Edition, Macmillan

Callister, D.W. (2000). *Materials Science and Engineering: An Introduction.* 5th Edition. John Willy and Sons. New York.

Case, J. and Chilver, A.H. (1986). *Strength of Materials and Structures*. 2nd Edition. Edward Arnold, London.

Chudley, R. (1987). *Building Superstructure.* 2nd Edition. Longman Scientific and Technical

Chudley, R. and Greeno, R. (1999). *Building Construction Handbook*. 3rd Edition. Butterworth-Heinemann, London.

Chudley, R. and Greeno, R. (1999). *Building Construction Handbook*. 3rd Edition. Butterworth-Heinemann, London.

CIOB (1994). *Code of Estimating Practice.* 6th Edition. Pearson

Clarke, H. (2000). *Economics for the Construction Industry.* 3rd Edition. Blackwell Science

Cooke, B. and Williams, P. (1997). *Construction Planning, Programming and Control.* Macmillan

Couzeus, E. and Yarsley (1993). *Concrete, Timber and Metals.* E and FN Spon

CP 2005 *Sewerage*
CP 302 *Small Sewerage Treatment Works*
CP3 Ch VII *Engineering & Utility Services*
CP342, *Centralized Hot Water Supply*
CP352 *Mechanical Ventilation*
CP8301 *Building Drainage*

Dean, Y. (1996). *Structural Engineering Design in Practice*. Pearson

Dinwoodie, J. M. (1981). *Timber, its Nature and Behaviour*. Reinhold Company, Van Nostrand.

Durka, A. Morgan, W. (1998*). Structural Mechanics.* 2nd Edition. Palgrave Macmillan

Euro Code 2 (2000) *Concrete*

Eurocode 3 (2000) *Steel*

Everett, A. (1999). *Materials.* 5thEdition. Longman

Foster, G. 1981. *Construction Site Studies – Production, Administration and Personnel*. Longman, London.

Foster, J. S. (1979). *Structure and Fabric Part 1*. Batsford Limited

Foster, J.S. and Harington, R. (1983). *Structure and Fabric*. Batsford Academic and Educational, London.

French, S.E. (1995). *Fundamentals of Structural Analysis*. West Publishing Company. New York.

Fryer, B. (1997). *The Practice of Construction Management.* Macmillan

Gauld, B. (1996). *Building Regulations Explained.* 6th Edition. Longman

Greenberg, D.M. (1998). *Advanced Engineering Mathematics*. 2nd Edition. Prentice-Hall International Inc., New Jersey.

Greer and Taylor (2000). *Mathematics for Technicians*. Stanley Thomas

Hall, F. (1990). *Building Services and Equipment, Volumes 1 &2.* 9th Edition. Longman Scientific & Technical

Harris, F. and McCaffer, R. (2001). *Modern Construction Management*. 2nd Edition. Blackwell Science, London.

Health and Safety Commission (1996). *Management of Health and Safety at Work*. Blackwell Science

Hughes, E. (1998). *Electrical Technology.* 7th Edition. Longman, London.

Illston, J, DinwioalieJ et al (1995). *Construction Materials.* Longman Scientific Technical

Illston, J. (2001) *Building Control: A Guide to Law*. Longman

Irvine, W. (1995). *Cost Studies of Buildings.* 3rd Edition. McGraw Hill

Jackson, N. & Dhir, R. K. (1988). *Civil Engineering Materials*. Macmillan, Hampshire.

Jensen, C. and Helsen, J.D. (1995). *Engineering Drawing and Design*. 4th Edition. McGraw-Hill, New York.

Linsley, R.K. et al. (1992). *Water Resources Engineering*. 4th Edition. McGraw Hill, New York.

McGeorge, D. and Palmer, A. (2002). *Tenders and Contracts for Buildings.* 3rd Edition. Blackwell Science

McGhee, T. J. (1991). *Water Supply and Sewerage*. 4th Edition. McGraw-Hill, New York.

Mckay, W. B. (2000). *Building Construction, Vols 1 to 4.* Longman

McMullan, R. (2001). *Environmental Science in Building*. 5th Edition, Palgrave

Meriam, J. L. and Kraig, L.G. (1992). *Engineering Mechanics*. 3rd Edition. John Willy & Sons, Inc., New York.

Meriam, J.L. and Kraig, L.G. (1992). Engineering Mechanics. 3rd Edition. John Willy & Sons, Inc., New York

Mitchells, R. (2003). *Building Construction Series.* B. T. Batsford Ltd

Mosley, W. H. and Bungey, J. H. (1999). *Reinforced Concrete Design*. 5th Edition. MacMillan, London.

Murdock, L. J. and Brook, K. M. (1990). *Concrete Materials and Practice*. Edward Arnold, London.

Nalluri, C. and Featherstone, R. E. (2001). *Civil Engineering Hydraulics*. 4th Edition. Blackwell Scientific Publications, London.

Nash, G.W. (1990). *Brickwork*. Stanley Thornes Publishers, London.

Neville (2000). *Properties of Concrete.* Pitman

Noy (2000) "*Plastics in the Modern World*" Pearson

Nutt, B. (1968). Adapting *Buildings for Changing Uses.* Penguin Pelican

Oliver, J. G. and Clendiinning, J. (1984). *Principles of Surveying.* Van Nostrand Reinhold (UK)

Owen, S. (1998). *Law for the Construction Industry*, Longman

Oxley, R. And Poskitt, J. (1997). *Management Techniques Applied to Construction Industry.* Blackwell

Panshin, A. J. & de Zeeuw, C. (1970). *Textbook of Wood Technology*. McGraw-Hill, New York.

Peter, B. (1984). *Mitchell's Environment and Services*. Batsford Academic and Educational Ltd, London

Rajasekaran, S. and Sankarra, S. G. (2000). *Engineering Mechanics - Short Questions and Answers.* Vikas Publishing House Pvt Ltd

Rheid, E. (2000). *Understanding Building; A Multi-disciplinary Approach.* E& FN Spon

Roberts, K. (1981). *Construction Technology Levels 1 -3.* Nelson TEC books

Rogers, G. F. C. and Mayhew, Y. R. (1996). *Engineering Thermodynamics*. 4th Edition.. Longman, London.

Rossaw, E. (1993). *Structural Detailing.* 2nd Edition. Palgrave Macmillan

Salter, R. J. (1983). *Highway Traffic Analysis and Design*. Macmillan, London.

Schofield, W. (2001*). Computer Aided Estimating, A Guide to Good Practice.* Butter worth Heinemann

Scott, C. R. (1980). *Introduction to Soil Mechanics and Foundations*. 3rd ed. Applied Science, Essex.

Seeley, I. (1997). *Building Quantities Explained.* 5th Edition. Longman

Seeley, I. (1997). *Civil Engineering Quantities.* 5th Edition

Seeley, I.H. (1993). *Civil Engineering Quantities*. 5th ed. MacMillan, London.

Sher, W. (1986). *Writing for Excellence.* Longman

Stephenson, J. (1996). *Practical Buildability.* Prentice Hall

Stroud, K. A. (1991). *Engineering Mathematics*. 4th Edition. Macmillan

Sutton, B. H. C. (1983). *Solutions of Problems in Soil Mechanics*. Pitman, London.

Tack, C. H. (1969). *Uganda Timbers*. Publication by Authority, Kampala.

The Aqua Group (2000). *Contractual Procedures in the Construction Industry* E & F N Spon

The Aqua Group, (2002). *Setting Out, A Guide for Site Engineers.* 2nd Edition, Blackwell Science

Todd, J.D. (1982). *Structural Theory and Analysis*. 2nd Edition. Macmillan, London.

Uren, J. and Price, W. F. (1994). *Surveying for Engineers*. 3rd Edition. MacMillan, London.

Viessman, W. and Lewis, G. L. (1996). *Introduction to Hydrology*. 4th Edition. Hasper Collins College Publishers, New York.

Walton, J. A. (1970). *Woodwork in Theory and Practice*. Australasian Publishing Company, Kuala Lumpur.

National Curriculum Development Centre
Ministry of Education and Sports
P.O. Box 7002, Kampala
UGANDA

www.ncdc.go.ug