



# NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

Yearbook  
2018/19

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## FACULTY OF ENGINEERING

### ***Dean***

*Dr William M Goriwondo*, (PhD, F'ZwIE, Pr Eng.) PhD (BA) NUST Z'bwe, MSc. Manufacturing Systems and Operations Management (UZ), BEng. (Hons) Industrial Engineering, NUST Z'bwe, Post Graduate Diploma in Higher Education, NUST Z'bwe

### ***Senior Assistant Registrar***

*Gladys Tshuma*, FETC, Bulawayo Polytechnic, BEd (UZ-CDE), MBA (ZOU)

### ***Senior Technician***

*Thomas Taapatsa*, (BTech (Hons) Information Technology, Harare Institute of Technology, HND, Computer Studies (HEXCO)

### ***Chief Secretary***

*Eliza Mapungwana*, ND Secretarial Studies, Certificate of Personnel Management, IPMZ

### ***Secretary***

*Lydia Nyathi*, HND Secretarial Studies, Bcom Human Resources

# FACULTY REGULATIONS FOR UNDERGRADUATE AND POSTGRADUATE DEGREE PROGRAMMES

## 1.0 PREAMBLE

1.1 The Faculty of Engineering was established to provide undergraduate teaching in the following :-

- Bachelor of Engineering – Chemical Engineering
- Bachelor of Engineering – Civil and Water Engineering
- Bachelor of Engineering – Electronic Engineering
- Bachelor of Engineering – Industrial and Manufacturing Engineering
- Bachelor of Engineering – Fibre and Polymer Materials Engineering

1.2 The Bachelor of Engineering degree is a five year full time honours degree programme. The programmes are designed to cater for the requirements of those wishing to pursue a career in Engineering with a strong practical orientation.

## 2.0 REGULATIONS

*(Applicable to those who entered the Faculty in July 2017 or after)*

### 2.1 GENERAL REGULATIONS

These regulations should be read in conjunction with the General Academic Regulations for undergraduate degrees.

### 2.2 ENTRY REGULATIONS

To be admitted to any of the Programmes in the Faculty, a candidate must have satisfied the minimum conditions for entry prescribed under the General Regulations. In addition he\she must satisfy the following entry requirements:

#### 2.2.1 For admission to the Programme in Chemical Engineering

*(Conventional and Parallel)*

##### NORMAL ENTRY

- a) At least 3 'A' level passes in Pure Mathematics, Physics and Chemistry  
Or

- b) At least 3 'A' level passes in Additional Mathematics, Chemistry and a third approved subject such as Physics, or Biology with an 'O' level passes in Chemistry and Physics with 'C' grade or better.  
Or
- c) At least 3 'A' level passes in Pure Mathematics, Mechanical Mathematics, Chemistry and a third approved subject such as Physics, or Biology with 'O' level passes in Chemistry and Physics with 'C' grade or better.

**SPECIAL ENTRY**

- a) ND in Chemical Engineering, Chemical Technology, Metallurgy, Mineral Processing and Metallurgy and any other equivalent qualification plus 2 years post ND working experience  
Or
- b) HND in Chemical Engineering, Chemical Technology, Metallurgy, Mineral Processing and Metallurgy plus 1 year post HND working experience.

**MATURE ENTRY**

Candidates should be at least 25 years of age with relevant work experience or other attainments.

**2.2.2 For admission to the Programme in Civil and Water Engineering**

*(Conventional and Parallel)*

**NORMAL ENTRY**

At least three 'A' level passes in Pure/Additional/Mechanical Mathematics, Physics and Chemistry with either Computer Science or Engineering Drawing.

**SPECIAL ENTRY**

- a) ND in Civil Engineering or ND Water resources Engineering plus 2 years post ND working experience  
Or
- b) HND in Civil Engineering or Water resources engineering plus 1 year post HND working Experience.

**MATURE ENTRY**

Candidates should be at least 25 years of age with relevant work experience or other attainments.

**2.2.3 For admission to the Programme in Electronic Engineering**

*(Conventional and Parallel)*

**NORMAL ENTRY**

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At least three `A' level passes in Pure/Additional/Mechanical Mathematics, Physics and Chemistry.

**SPECIAL ENTRY**

- a) National Diploma in Electronic Engineering **or** Telecommunication Engineering **or** Instrumentation and Control **or** Computer Engineering plus 2 years post ND working experience.
- b) Higher National Diploma in Electronic Engineering **or** Telecommunication Engineering **or** Instrumentation and Control **or** **Computer** Engineering plus 1 year post HND working experience.

**MATURE ENTRY**

Candidates should be at least 25 years of age with relevant work experience or other attainments.

**2.2.4 For admission to the Programme in Fibre and Polymer Materials Engineering**  
(*Conventional and Parallel*)

**NORMAL ENTRY**

At least three `A' passes in Chemistry, Pure/Additional/Mechanical Mathematics and Physics.

**SPECIAL ENTRY**

- a) ND in Materials Engineering (Polymer, Chemical & other relevant Materials) plus 2 years post ND working experience  
Or
- b) HND in Materials Engineering (Polymer, Chemical & other relevant Materials) plus 1 year post HND working experience.

**MATURE ENTRY**

Candidates should be at least 25 years of age with relevant work experience or other attainments.

**2.2.5 For admission to the Programme in Industrial and Manufacturing Engineering**  
(*Conventional and Parallel*)

**NORMAL ENTRY**

At least three 'A' level passes in Pure/Additional/Mechanical Mathematics and Physics plus Chemistry/Computer Science/Engineering Drawing, Design Technology, with 'O' level pass in Chemistry.

#### **SPECIAL ENTRY**

- a) ND in Mechanical, Production, Plant Engineering, Draughting & Design and Refrigeration plus 2 years post ND working experience  
Or
- b) HND in Mechanical, Production, Plant Engineering, Draughting & Design and Refrigeration plus 1 year post HND working experience.

#### **MATURE ENTRY**

Candidates should be at least 25 years of age with relevant work experience or other attainments.

### **3.0 STRUCTURE OF THE PROGRAMMES**

- 3.1 The programmes constitute five academic years on full-time basis, each academic year representing a part of the degree Programme. Part IV shall be spent on industrial training attachment with an appropriate organisation.
- 3.2 A student may be exempted, with the approval of the Senate, from a part or parts of the Programme if his/her qualifications are found adequate by the individual Departments and the Faculty.

### **4.0 FINAL YEAR PROJECTS PART V**

- 4.1 Project/Design must be undertaken by all candidates. The Project will involve a major investigation, design or development which will normally contain a significant proportion of laboratory or practical work.
- 4.2 The original and one copy of the project report will be submitted for assessment on or before the date specified by the Chairman of Department. The examiners may penalize candidates for late submission of the Project Report.

### **5.0 SCHEME OF EXAMINATION AND ASSESSMENT**

#### **5.1 Date of Examinations**

Final and supplementary examinations will take place in each semester for each course in a Part, at dates to be specified.

#### **5.2 Mode of course Assessment**

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The assessment of a course may contain contributions due to formal examinations, continuous assessment and coursework. Unless otherwise specified, the formal examination will contribute 75% and continuous assessment/coursework will contribute 25% for the final marks. Where appropriate, continuous assessment/coursework may contribute either (a) 50% or (b) 100% of the final mark. With the approval of the Faculty Board, students may be required to pass separately the coursework and examination components. Before the commencement of each academic year, Departments will submit to the Faculty Board for approval lists of courses to be examined under either option (a) or option (b).

## **6.0 MINIMUM PASS MARK AND AGGREGATE MARKS**

- 6.1 The minimum pass mark for a course is 50% as prescribed in General Regulations.
- 6.2 The aggregate mark of a Part is the weighted average of aggregate marks for the parts constituting the programme of study.
- 6.3 The overall aggregate mark is the weighted average of aggregate marks for the parts constituting the programme of study.

## **7.0 PROCEEDING TO THE NEXT PART**

- 7.1 A student may proceed to the next Part on satisfying the examiners in all the courses for the Part.
- 7.2 Subject to the provisions of Section 8.5 a student may proceed to the next Part provided that he/she gets an aggregate of 50% or more.

## **8.0 CARRY OVER**

- 8.1 On the recommendation of the Faculty Board of Examiners a student may be permitted to proceed to the next Part and carry over up to 25% of courses including any supplementary examination failures.
- 8.2 For Part I examinations the number of carry over courses shall be limited 25% of the courses including examination failures.
- 8.3 A student carrying over some courses, as above, will be re-examined in these modules at the next regularly scheduled examinations in the following year.

## **9.0 REPEATING COURSES**

- 9.1 A student whose aggregate mark for a Part is 50% or more than 25% of the courses, must repeat the Part.
- 9.2 A student whose aggregate mark for a Part is 45% or more, but who after supplementary examinations fails to get minimum pass marks in more than 25% of the courses, must repeat the Part.

## **10.0 DISCONTINUING**

A student whose aggregate is less than 35% should discontinue the programme.

## **11.0 INDUSTRIAL ATTACHMENT**

During industrial attachment the student will be governed by the general Regulations for Industrial Attachment.

## **12.0 FINAL YEAR PROJECT ASSESSMENT**

### **12.1 Marks Allocation**

Assessment during the course of the Project shall constitute 25% of the final mark while the final Report and oral examination will account for 75%.

### **12.2 Overall Pass**

For each project course, the appropriate Departmental Panel of Examiners shall determine, for each student, an overall mark.

### **12.3 Re-submitting / Repeating**

12.3.1 A student who fails a project shall normally be allowed to re-submit a report and be re-examined within a period to be specified by the appropriate Department.

12.3.2 A student required to re-submit a report but fails the assessment again will have to do a different project. A project course can be repeated only once.

## **13.0 AWARDING OF A DEGREE AND CLASSIFICATION**

In determining a candidate's degree classification, the parts of the degree programme will be weighted as follows:-

Part I	5%
Part II	10%
Part III	15%
Part IV	20%
Part V	50%

### **13.1 AWARD OF THE DEGREE**

13.1.1 Students are required to satisfy the examiners in all the courses before being awarded the degree.

13.1.2 The Bachelor of Engineering Honours Degree under the Seal of the University will be awarded to every successful candidate. The successful candidates will have their degree annotated as being in the respective field of:- Chemical Engineering, Civil and Water Engineering,



Electronic Engineering, Industrial and Manufacturing Engineering or Fibre and Polymer Materials Engineering.

## DEPARTMENT OF CHEMICAL ENGINEERING

### ***Lecturer and Chairperson***

*Ms Siboniwe Bhebhe*, M.Sc. Chemical Engineering, University of the Witwatersrand, Johannesburg, RSA. BEng. (Hons) Chemical Engineering, NUST, Bulawayo, Zimbabwe. PGDHE, NUST, Bulawayo, Zimbabwe. Membership - AICHE

### ***Secretary***

*Helga Nyamweda*, Advanced Pitman Certificate, BBA UNISA

### ***ACADEMIC STAFF***

#### ***Senior Lecturers***

*Dr Joel Tshuma*, PhD Metallurgy and Materials Sciences, Mexico City, DF, Mexico. M.Sc. Chemical Engineering, Havana, Cuba. Membership - AICHE, ACS, NUSESA

*Dr Nkosikhona Hlabangana*, PhD Chemical Engineering, University of Witwatersrand, Johannesburg, RSA. M.Sc. Chemical Engineering (Converted to PhD), University of Witwatersrand, Johannesburg, RSA. Certificate in Project Management, University of Witwatersrand, Johannesburg, RSA. BEng. (Hons) Chemical Engineering, NUST, Bulawayo, Zimbabwe. Membership – SAICHE, SAIMM

#### ***Lecturer***

*Eng. Stanford Mudono*, MEng. Chemical Engineering, Tsinghua University, Beijing, (China). BSc. (Hons) Chemical Engineering, University of Oriente, Santiago de Cuba, Cuba. PGDHE (NUST), PGDMC (China), Membership - ZIE

*Mr Liberty. L. Mguni*, M.Tech. (Chemical Engineering), University of Johannesburg, Johannesburg, RSA BEng (Hons) Chemical Engineering, NUST, Bulawayo, Zimbabwe.

*Ms Nonhlanhla G. Mguni*, M.Sc. Chemical Engineering, University of the Witwatersrand, Johannesburg, RSA. BEng. (Hons) Chemical Engineering, NUST, Bulawayo, Zimbabwe. PGDHE, NUST, Bulawayo, Zimbabwe. Membership - ICHOME, SAICHE, FFF.

*Eng. Cledwyn T. Mangunda*, M.Eng. Manufacturing Systems and Operations Management, NUST, Bulawayo, Zimbabwe. B. Eng (Hons) Chemical Engineering, NUST, Bulawayo, Zimbabwe. PGDHE NUST, Bulawayo, Zimbabwe. Membership - AMIChemE, AMSAICHe, ZIE

*Ms Tariro Tecla Manhongo*, M.Eng. Manufacturing Systems and Operations Management, NUST, Bulawayo, Zimbabwe. BEng (Hons) Chemical Engineering, NUST, Bulawayo, Zimbabwe.

*Mrs Olga Kuipa*, M.Sc. Eng. Ivanovo Inst. USSR

### ***Temporary Full-time Lecturers***

*Dr E. Mtetwa*, PhD Chemistry, Robert Gordon's University, Aberdeen, UK. M.Sc. Chemical Engineering and Technology, VSCHT, Czechoslovakia.

*Mr L.B. Moyo*, M.Sc. Chemical Engineering, University of the Witwatersrand, Johannesburg, RSA. BSc (Hons) (Chemical Engineering), University of the Witwatersrand, JHB, RSA. Membership - ECSA

*Mr S. Ncube*, M.Sc. Chemical/Process Engineering, Erlangen-Nuremberg, Germany. BEng (Hons) Chemical Engineering, NUST, Bulawayo, Zimbabwe.

### ***Engineering Instructor***

*Ms Lawrencia Tshuma*, BEng (Hons) Chemical Engineering NUST, Bulawayo, Zimbabwe. National Diploma in Chemical Technology, Bulawayo Polytechnic, Bulawayo, Zimbabwe

### ***Staff Development Fellow***

*Ms Ivonne Tshuma*, BEng (Hons) Chemical Engineering NUST, Bulawayo, Zimbabwe.

# BACHELOR OF ENGINEERING HONOURS DEGREE IN CHEMICAL ENGINEERING

*The department offers both conventional and parallel programmes.*

## PROGRAMME SUMMARY

### PART I

#### Semester I

Module Code	Module Description	Hours	Credits
TCE 1101	Chemical Engineering Calculations	48	4
TCE 1102	Materials and Containment IA	48	4
TCE 1103	Professional Engineering Skills I	24	2
TIE 1101	Engineering Drawing I	48	4
SCH 1120	Physical Chemistry for Engineers	48	4
SCS 1101	Introduction to Computer Science I	48	4
SMA 1116	Engineering Mathematics IA	48	4

#### Semester II

TCE 1202	Materials and Containment IB	48	4
TCE 1204	Engineering Thermodynamics	48	4
TIE 1101	Engineering Drawing I	48	4
TEE 2292	Principles of Electrical Engineering	48	4
SCH 1221	Organic Chemistry for Engineers	48	4

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SCS 1206	Visual Programming Concepts and Development	48	4
SMA 1216	Engineering Mathematics IB	48	4
CTL 1101	Conflict Transformation and Leadership	24	2

## **PART II**

### **Semester I**

TCE 2101	Transport Phenomena	48	4
TCE 2102	Professional Engineering Skills II	24	2
TCE 2103	Mass Transfer Processes IA	48	4
TCE 2104	Chemical Engineering Thermodynamics IA	48	4
TCE 2105	Fluid Flow I	48	4
TCE 2108	Chemical Reaction Engineering IA	48	4
TCE 2109	Chemical Engineering Laboratory IA	24	2
SMA 2116	Engineering Mathematics II	48	4

### **Semester II**

TCE 2203	Mass Transfer Processes IB	48	4
TCE 2204	Chemical Engineering Thermodynamics II	48	4
TCE 2206	Heat Transfer	48	4
TCE 2207	Process Dynamics and Control	48	4
TCE 2208	Chemical Reaction Engineering IB	48	4
TCE 2209	Chemical Engineering Laboratory IB	24	2
SMA 2217	Engineering Mathematics III	48	4

## **PART III**

### **Semester I**

TCE 3101	Plant and Equipment Design	48	4
TCE 3102	Chemical Reaction Engineering II	48	4
TCE 3103	Minerals Engineering IA	48	4
TCE 3104	Separation Processes IA	48	4
TCE 3105	Fluid-Solid Systems IA	48	4
TCE 3108	Research Methodology	48	4
TCE 3010	Chemical Engineering Laboratory Project	24	2
SMA 3116	Engineering Mathematics IV	48	4

### **Semester II**

TCE 3203	Minerals Engineering IB	48	4
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TCE 3204	Separation Processes IB	48	4
TCE 3205	Fluid-Solid Systems IB	48	4
TCE 3206	Fluid Flow II	48	4
TCE 3207	Biochemical Engineering I	48	4
TCE 3209	Health and Safety in Industrial Plants	48	4
TCE 3010	Chemical Engineering Laboratory Project	24	2

#### **PART IV**

TCE 4000	Industrial Training Attachment		
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#### **PART V**

##### **Semester I**

TCE 5101	Process Management, Economics and Optimisation I	48	4
TCE 5102	Process Dynamics, Modelling and Control IIA	48	4
TCE 5103	Chemical Engineering Software Packages	24	2
TCE 5104	Environmental Process Engineering IA	48	4
TCE 5005	Chemical Engineering Design Project		
TCE 5006	Research and Development Project		
TCE 5107	Advanced Mineral Engineering IA	48	4
TCE *	Option	48	4

##### **Semester II**

TCE 5202	Process Dynamics, Modelling and Control IIB	48	4
TCE 5204	Environmental Process Engineering IB	48	4
TCE 5005	Chemical Engineering Design Project	38	
TCE 5006	Research and Development Project		4
TCE 5207	Advanced Mineral Engineering IB	48	4
TCE *	Option	48	4

##### **OPTIONS\***

TCE 5108	Biochemical Engineering II		
TCE 5109	Technology of Processes		
TCE 5211	Food Process Engineering		
TCE 5212	Advanced Separation Processes		
TCE 5113	Process Modelling and Simulation		
TCE 5214	Liquid/Solid Wastes Management, Remediation		
TCE 5115	Process Quality Management		

TCE 5116  
TCE 5217

Product Planning and Control  
Industrial Energy Management

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## MODULE SYNOPSES

### PART I

#### **TCE 1101 Chemical Engineering Calculations**

**4 Credits**

The module focuses on dimensional analysis and units; Material Balances; Material Balance Calculations, Balance on Multiple Unit Processes, Recycle and Bypass, Balances on Reactive Systems, Combustion Reactions; Energy Balances Energy Balances on Closed Systems, Energy Balances on Open Systems at a Steady State, Tables of thermodynamic data, Energy Balance procedures, Balances on non-reactive processes, Balances on reactive processes; Material and energy balances on transient processes and an introduction to computer aided balance calculations.

#### **TCE 1102 - Materials And Containment IA**

**4 Credits**

The module looks at materials Engineering: Basic physical metallurgy, Phase diagrams, Microstructures and mechanical properties of materials, Relationship between structure and properties Stress and strain Fracture and creep selection criteria for materials.

#### **TCE 1202 - Materials And Containment IB**

**4 Credits**

This module explores corrosion engineering: fundamentals of corrosion and oxidation of metals, Localised corrosion, Pitting and environmental cracking, Degradation in flowing media; Erosion-corrosion and erosion-oxidation, Corrosion protection strategies, Inhibition and water treatment design, Cathode-based and anode-based protection, Ceramics properties and uses, Plastic properties and uses as well as rubber properties and uses.

#### **TCE 1103 - Professional Engineering Skills I**

**2 Credits**

This module examines study methods; Communication principles; Technical definitions; Descriptions and instructions; Tables and graphs; Letters Memoranda and curricula vitae; Written reports; Word processing and computer jargon; Interview technique; Running a meeting; Reading, understanding and summarising technical articles as well as group dynamics.

#### **TCE 1204 - Engineering Thermodynamics**

**4 Credits**

The module is an introduction to thermodynamics - scope of thermodynamics; First Law of thermodynamics; Volumetric properties of pure fluids; Heat effects and the second law of thermodynamics.

## **PART II**

### **TCE 2101 Transport Phenomena**

**4 Credits**

This module offers a basic Introduction to mass transfer, Estimation of diffusion coefficients, Diffusion processes, Diffusion in laminar flow, Diffusion in turbulent flow; transport process analogies, Mass transfer in flow past miscellaneous shapes, Mass transfer to single spheres, Unsteady-state diffusion; interphase mass transfer theories and mass transfer coefficients.

### **TCE 2102 Professional Engineering Skills II**

**2 Credits**

The module gives an introduction and overview on types of skills, organization, management, human skills, conceptual skills, time management and stress management.

### **TCE 2103 Mass Transfer Processes IA**

**4 Credits**

This module outlines principles of mass transfer; Maxwell Stefan model; Stage wise operations; Binary distillation processes; Distillation with reflux; Distillation equipment; McCabe-Thiele method; Lewis-Sorel method and the Ponchon Savarit method.

### **TCE 2203 Mass Transfer Processes IB**

**4 Credits**

The module looks at gas absorption, Liquid/liquid extraction, Leaching, Humidification, Cooling towers and drying.

### **TCE 2104 Chemical Engineering Thermodynamics 1A**

**4 Credits**

The module examines thermodynamic Properties of Fluids; Thermodynamics of flow processes; Production of power from heat and refrigeration.

### **TCE 2204 Chemical Engineering Thermodynamics 1B**

**4 Credits**

The module focuses on solution Thermodynamics Theory; Solution Thermodynamics Applications; Vapour Liquid Equilibrium (VLE) at Low to Moderate Pressures; Phase Equilibria as well as Chemical Reaction Equilibria.

### **TCE 2105 Fluid Flow I**

**4 Credits**

The module explores fluid mechanics and properties - Properties of Fluids; Viscosity; Newtonian Fluids, Statics - Hydrostatic pressure; Manometry/pressure measurement, Dynamics - The continuity equation; The Bernoulli Equation; Applications of the Bernoulli equation; The momentum equation; Application of the momentum equation; Real Fluids - Boundary layer; Laminar flow in pipes; Transportation of fluids and flow measurement.

### **TCE 2206 Heat Transfer**

**4 Credits**

The module looks at steady State Conduction, Forced and Natural Convection, Reynolds Analogy, Heat Transfer Film Coefficient Correlations, LMTD Heat Transfer Design, Fouling Factors,



Radiation; Unsteady State Conduction, 2-D Conduction, E-NTU Heat Exchanger Design, Correction Factors for LMTD Heat Exchanger Design, Condensers, Boilers and Evaporators.

**TCE 2207 Process Dynamics, Modelling And Control I**

**4 Credits**

The module is an introduction to process control; Introduction to feedback control: the dynamic behaviour of feedback controlled processes; Introduction to Feed-forward control: the dynamic behaviour of the feed-forward controlled processes; Introduction to process systems dynamics and cascade control system.

**TCE 2108 Chemical Reaction Engineering IA**

**4 Credits**

The module is an introduction to Chemical Kinetics, Mole Balances, Conversion and Reactor Sizing, Rate Laws and Stoichiometry, Concentration versus Time Equations for Single, Irreversible Reactions; Concentration versus Time Equations for Reversible Reactions; Isothermal Reactor Design - Design of the Ideal PFR, CSTR, Batch and Semi-Batch Reactors and CSTRs in Series.

**TCE 2208 Chemical Reaction Engineering IB**

**4 Credits**

The module looks at collection and Analysis of Rate Data, Multiple Reactions; Series, Parallel, Complex and Independent, Algorithm for Solution of Complex Reactions, Multiple Reactions in PFRs/PBRs and CSTRs, Non-Isothermal Ideal Reactors; Packed Bed Reactors and Residence Time Distribution Functions for Non Ideal Flow Reactors.

**TCE 2109 Chemical Engineering Laboratory IA**

**2 Credits**

This is an introduction to laboratory practise; safety in the laboratory, relevant analytical equipment and techniques, handling of wastes and a series of practicals based on Part I and Part II modules.

**TCE 2209 Chemical Engineering Laboratory IB**

**2 Credits**

This is a series of practicals based on Part I and Part II modules.

## **PART III**

**TCE 3101 Plant And Equipment Design And Selection**

**4 Credits**

The module covers the design, selection considerations and specifications of chemical process industry (CPI) plant and equipment. The range of equipment treated is, to the greatest possible extent, the pieces of equipment that are found in the process flow sheet of an industrial manufacturing plant: storage and reaction vessels, pumps, compressors, process plant piping, valves and other fittings for process control. Considerations used in the Selections of materials of construction are dealt with comprehensively such as process Integration and Pinch Technology;

Computer based process design techniques. The module also includes basic precepts of Engineering Economics: business cash flows; time value of money; capital budgeting; methods of budget and investment evaluation.

**TCE 3102 Chemical Reaction Engineering II**

**4 Credits**

The module explores fluid reactions: - kinetics and mass transfer, rate equations, design for reaction towers; Fluid - Particle reactions, reaction models for non-catalytic reactions, Uniform conversion, shrinking core and shrinking particle models; Consideration of controlling mechanism, Design analysis; Catalytic fluid-solid reactions: catalyst types, kinetics and LHHW; Catalytic reactors (packed bed, CSTR and FB); Intrapellet and external heat and mass transfer, Reactor design especially of single or staged packed bed reactors and interstage heat transfer; optimum temperature profiles, reactor choices and operating choices.

**TCE 3103 Minerals Engineering IA**

**4 Credits**

The module is an introduction to mineral geology, rock formation, exploration, mining and economics of ore extraction; Principles of mineral ore processing with emphasis on ore handling, ore crushing and grinding, screening, classification and the design of comminution circuits.

**TCE3203 Minerals Engineering IB**

**4 Credits**

The module explores the principles of mineral concentration, separation of values from waste, process recoveries, gravity concentration, dense medium separation, froth flotation, magnetic and electrostatic separation, dewatering, tailings disposal and management, design of mineral processing circuits.

**TCE 3104 Separation Processes IA**

**4 Credits**

The module gives an introduction to separation processes; UNIFAC and UNIQUAC methods; Staged column design; Absorption and stripping; Azeotropic and extractive distillation; Liquid-liquid extraction and supercritical fluid extraction.

**TCE 3204 Separation Processes IB**

**4 Credits**

The module looks at evaporation; Adsorption and ion exchange; Membrane processes; Crystallisation; Mixing; Chromatography and Bio separations.

**TCE 3105 Fluid-Solid Systems IA**

**4 Credits**

The module examines solids; Introduction to powder technology; Particulate systems; Particle characterization; Particle size measurement; Particle size distribution; Sampling; Particle size reduction; Solids storage, handling and transportation as well as mixing and agitation.

**TCE 3205 Fluid-Solid Systems IB**

**4 Credits**

The module focuses on fluidisation and fluidized beds; Liquid/solid separations: Filtration,

Sedimentation, Centrifuges; Gas/solid separation: Cyclones, Electrostatic precipitators and (Hot) Gas filtration.

**TCE 3206 Fluid Flow II**

**4 Credits**

The module covers fundamental concepts: The continuum hypothesis and mathematical implications; Analytical Classification of Flow Phenomena; Lagrangian & Eulerian Systems; the Substantial Derivative; Equations of particle paths, The Equations of Fluid Motion: Conservation of Mass—the continuity equation, Momentum Balance—the Navier–Stokes Equations; Analysis of the Navier–Stokes Equations; Applications of the Navier–Stokes Equations: Fluid Statics, Bernoulli’s Equation, Control-Volume Momentum Equation, Classical Exact Solutions to Navier–Stokes Equations, Approximate Solutions of the Navier-Stokes Equation Potential Flow, Laminar and Turbulent flows and boundary layer analysis.

**TCE3207 Biochemical Engineering I**

**4 Credits**

The module gives an introduction to microbiology, Classification and composition of cells, Microbial classification, Microbial Systems; Bio kinetic, thermodynamic and stoichiometric preliminaries- Enzyme and Cell kinetics Thermodynamics, Stoichiometry and Metabolical pathways; Bioreactor design and operation- Design, scale up, configuration and construction, Ideal reactor operation: sterilization, control, optimisation and downstream processing.

**TCE3108 Research Methodology**

**4 Credits**

The module offers an introduction and overview of problem assortment; literature review; hypotheses and postulation; data accumulation; data processing and scientific writing skills.

**TCE3209 Health And Safety In Industrial Plants**

**4 Credits**

The module teaches the fact that every industrial company ought to propagate a corporate policy that lets it be understood by the workforce; that safety considerations override all preoccupations on company premises, including production; Industrial operations are operated subject to the provisions of the law: the Factories and Works Act (1976, with amendments that followed); The Boiler and Pressure Vessel Regulations contained in the Factories and Works Act are special areas of focus; Engineering codes used in the fabrication and inspection of boilers and pressure vessels that are acceptable to the Chief Inspector of Factories in Zimbabwe, notably the ASME Code, Section VIII, Division 1; Non-destructive testing ( NDT) methods used for crack detection in pressure vessels are covered; Plant and process designs for the following: material hazards - mainly attributed to chemicals (toxicity, carcinogenicity, mutagenicity, flammability, etc.); process hazards – mainly attributed to overpressure, temperature deviations, loss of containment, fires and sources of ignition, explosions, human error; Study the methods of hazard identification, and risk evaluation used in the chemical process industry (CPI); process safety and environmental issues in chemical process design including waste minimization and life cycle analysis, HAZOP.

**TCE 3010 Chemical Engineering Research Project****2 Credits**

The purpose of the project is to develop the students' research skills and analytical skills, with a strong emphasis on research skills.

**PART 1V Industrial Attachment****PART V****TCE5101 Management, Economics and Optimisation****4 Credits**

The module is an introduction to Analytical and Numerical Optimisation Techniques; La-Grangian multipliers; Sequential Search; Simplex acceleration; Linear programming; Network analysis, Introduction to Project Planning; Forecasting; Budgeting; Probability Theory for Decision Making and entrepreneurship.

**TCE5102 Process Dynamics, Modelling and Control IIA****4 Credits**

The module explores applications of Laplace and Z transforms to process control systems; The Routh - Hurwitz test; Root locus analysis; Design of feedback controllers; Frequency response techniques; Control systems design techniques and dead -time compensation.

**TCE5202 Process Dynamics, Modelling And Control IIB****4 Credits**

The module focuses on advanced design techniques of control systems; Complex processes with Multivariable control systems; Multiple - Input Multiple- Output systems; Introduction to artificial intelligence control systems; Process control using digital systems: Real time optimisation and an introduction to PLC.

**TCE 5103 Chemical Engineering Packages****2 Credits**

These are selected from available packages in the department.

**TCE 5104 Environmental Process Engineering IA****4 Credits**

The module gives an introduction and Overview on Laws and governmental policies on industrial waste management; Industrial waste classification; Industrial Solid and liquid (effluent) waste management; Characteristics of industrial waste (solid waste/liquid waste industrial effluent); Identification of pollutants (solid waste) in a production line; Technologies for industrial solid/liquid waste treatment and disposal; Waste solid/water minimization; Selection criteria for solid/liquid waste treatment and disposal technologies; Design of solid/liquid waste treatment and disposal technologies; Impact of industrial solid/liquid waste on the environment as well as sewerage works and health.

**TCE 5204 - Environmental Process Engineering IB****4 Credits**

The module has an introduction and Overview on Industrial gaseous waste management; Pollution Cycle, Identification of gaseous pollutants in a production line; Characterization of industrial gaseous waste, Impact of industrial gaseous waste on the environment and health; Technologies for control of air discharges; Design of equipment and plants for air pollution control; Environmental Impact Assessment (EIA) and Life Cycle Analysis.

**TCE 5005 Chemical Engineering Design Project****38 Credits**

This is project work which will involve; Mass and energy balances of the process; Alternative flow sheeting schemes; The sociological and environmental impact; Hazard analysis of process and plant safety; Detail design of specific units and The economic viability of the process.

**TCE 5006 Research And Development Project****4 Credits**

At this advanced stage of research, students are expected to identify possible areas of research and apply all the knowledge gained in the programme to come up with possible solutions and recommendations;

**TCE 5107 Advanced Minerals Engineering IA****4 Credits**

The module looks at pyrometallurgy; Unit operations in pyrometallurgy; Fuels, coke making; fluxes; Concentrate pre-treatment processes and equipment, smelting furnaces and reactions, refining processes and uses for selected minerals.

**TCE 5207 Advanced Minerals Engineering IB****4 Credits**

The module explores hydrometallurgy and electrometallurgy, principles of hydrometallurgy and electrometallurgy, unit processes in hydrometallurgy; Leaching, leaching techniques, leaching processes; Solution purification and enrichment techniques; Metal recovery; Process routes for selected minerals; Halide extraction, chlorination processes and reduction of halides.

**OPTIONS****TCE 5108 - Biochemical Engineering II****4 Credits****TCE 5109 Technology Of Processes****4 Credits**

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*Think in other terms*

**TCE 5211 Food Process Engineering (48 Hours) 4 Credits**

**TCE 5212 - Advanced Separation Processes (48 Hours) 4 Credits**

**TCE 5213 - Process Modelling And Simulation (48 Hours) 4 Credits**

**TCE 5214 - Liquids/Solids Waste Management, Remediation 4 Credits**  
The module looks at the regulations on the disposal of solid and liquid wastes, waste and health, waste water and sewage treatment, sludge treatment, disposal and re-use, product life cycle assessment, resource recovery, soil and ground water remediation.

**TCE 5115 - Process Quality Management 4 Credits**

**TCE 5116 - Product Planning And Control 4 Credits**  
The module explores product portfolio models; Role of new products; Separating winners from losers; The new product development process; Product idea selection; Market research and analysis; Product launching; Project management in product launching and product life cycles.

**TCE 5217 - Industrial Energy Management 4 Credits**  
The module is an introduction to Energy Management; Energy Data Recording & Processing; Plant Survey; Electrical metering and tariffs; Demand Management; Electric Motors; Lighting Systems; Insulation; Fans; Pumps; Compressed Air Systems; Refrigeration; Fuel Fired Equipment; Steam Generation and Distribution; Heat Recovery Systems and financial Analysis;

## DEPARTMENT OF CIVIL AND WATER ENGINEERING

### ***Lecturer and Chairperson***

*Dr Annatoria Chinyama*, BSc Civ Eng (UZ), MSc IWRM (UZ), D-Tech Civ Eng (TUT), MZwIE

### ***Secretary***

*Mrs T. Ronney*, ND Secretarial Studies, BCom. Bus. Mgt. (MSU),

## ACADEMIC STAFF

### ***Lecturers***

*Mr Pascal Kamwemba*, MSc Mine Survey (Moscow)

*Dr Eugene Makaya*, BScEd Physics&Maths (BUCSE), MSc WREM (UZ), PhD. Water Eng. (Germany)

*D.E. Makweche*, BEng Civ & Water Eng. (NUST), MSc Civil. Eng (UCT)

*S. Ndlovu*, BSc Geology (UZ) PgD Geo-Info. Sc WR (Netherlands), MSc Hydrology & Water Res. (UNESCO-IHE), MSc in Eng. Geology (University of Leeds, UK)

*Eng. K. Mushunje*, BSc Civ Eng. (UZ), MSc Civil. Eng (Witwatersrand), MZwIE

*Eng. Sheilla Nhandara*, BEng Civ & Water Eng. (NUST); MEng Geotech Eng (UCT), MZwIE

*Mr P. Chiradza*, MSc Hydrualic Eng. (Moscow)

### ***Staff Development Fellows***

*Mr Jeremiah Chimhundi*, BEng Civ & Water Eng. (NUST)

### ***Senior technician***

*D.C Jecha*, BTechEd. Civ & Con (NUST), MSc Con Proj. Mgt. (NUST), TechZwIE

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*Think in other terms*

# BACHELOR OF ENGINEERING HONOURS DEGREE IN CIVIL AND WATER ENGINEERING

*The department offers both conventional and parallel programmes.*

## PROGRAMME SUMMARY

### PART I

#### Semester I

Module Code	Module Description	Credits
SCS 1101	Introduction to Computer Science	10
SMA 1116	Engineering Mathematics 1A	10
TCW 1102	Engineering Drawing	10
TCW 1103	Engineering Communication Skills	10
TCW 1104	Principles of Electrical Engineering	10
TCW1105	Material Science	10

#### Semester II

CTL1101	Leadership and Transformation Management	10
SMA 1216	Engineering Mathematics 1B	10
SCS 1206	Visual Programming Concepts & Development	10
TCW 1203	Civil Engineering Drawing	10
TCW 1204	Engineering Mechanics	10
TCW 1205	Occupational Health, Safety and Environment	10

### PART II

#### Semester I

TCW 2101	Fluid Mechanics	10
TCW 2102	Engineering Surveying I	10
TCW 2105	Engineering Geology	10
SMA 2116	Engineering Mathematics	10

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*Think in other terms*



TCW 2106	Structural Mechanics	10
TCW 2107	Civil Engineering Materials	10
<b>Semester II</b>		
TCW 2201	Soil Mechanics	10
TCW 2202	Engineering Hydrology	10
TCW 2204	Engineering Surveying II	10
SMA 2217	Engineering Mathematics III	10
TCW 2206	Structural Analysis I	10
TCW 2207	Construction Technology	10
<b>PART III</b>		
<b>Semester</b>		
TCW 3103	Design of Structures I	10
TCW 3104	Wastewater Engineering	10
TCW 3107	Hydraulic Design	10
TCW 3108	Structural Analysis II	10
TCW 3109	Transportation Engineering I	10
TCW 3110	Business Management for Civil Engineers	10
<b>Semester II</b>		
TCW 3204	Irrigation Systems Design	10
TCW 3208	Transportation Engineering II	10
TCW 3209	Research Methods	10
TCW 3210	Geotechnical Engineering	10
TCW 3211	Construction Management & Ethics	10
TCW 3212	Design of Structures II	10
<b>PART IV</b>		
TCW 4000	Industrial Attachment	120
<b>PART V</b>		
<b>Semester I</b>		
TCW 5101	Water Quality and Treatment	12
TCW 5099	Final Year Project	12

Elective I		12
TCW 5104	Civil Engineering Business Studies	12
TCW 5105	Design of Structures III	12

### **Semester II**

TCW 5099	Final Year Project	12
Elective II		12
TCW 5204	Dam Engineering	12
TCW 5205	Water Resources Management	12

### **ELECTIVES FOR PART V**

TCW 5001	Groundwater Hydraulics and Modelling	12
TCW 5002	Pipe Network Analysis	12
TCW 5003	Liquid Retaining Structures	12
TCW 5004	Finite Element Method in Civil Engineering	12
TCW 5005	Traffic and Airport studies	12
TCW 5006	Solid Waste Management	12
TCW 5007	Wastewater Technology	12
TCW 5008	Bitumen Technology	12
TCW 5009	Computer Aided Design in Civil Engineering	12
TCW 5010	Computational Techniques in Civil Eng.	12
TCW 5011	Dynamic Analysis of Structures	12
TCW 5012	Elastic Analysis of Structures	12

### **TOTAL CREDITS FOR THE PROGRAMME**

Part I	120
Part II	120
Part III	120
Part IV	120
Part V	108
<b>Total minimum credits:</b>	<b>588</b>

## MODULE SYNOPSES

### **PART I**

#### **TCW 1102 Engineering Drawing**

**10 Credits**

The module gives an introduction to Phase geometry; First and third angle projection; Dimensioning; Pictorial views; Freehand sketching, Drawing of common objects; Sectioning; Intersections; Developments; Conventions and Assembly drawings. It also covers an introduction to the basic concepts of the graphic language as a tool for communicating design related information; Introduction to orthographic projections, flow sheeting, and isometric through a series of graded exercises and introduction to technical drawing, simple geometric constructions.

#### **TCW 1103 Engineering Communication Skills**

**10 Credits**

This module aims to equip students with skills necessary for writing, editing, gathering, organizing, and presenting information effectively according to audience and purpose. Topics to be covered include technical documentation, oral and written technical reports, designing principles of technical and professional communication, policy making and leadership skills, teamwork, conflict management styles, public speaking skills, participation in group meetings, interview types and skills, critical thinking and audience analysis as well as study skills.

#### **TCW 1104 Principles of Electrical Engineering**

**10 Credits**

The module is an introduction to general concepts of current, voltage, resistance and circuits (dc and ac), elements of loop and nodal analysis, basic networks and theorems, Delta-Wye conversions and network theorems, Capacitor and inductor circuits; Transient analysis; DC and AC power; Forced response; Sinusoidal steady-state response; Frequency response; P-n junction behaviour and rectifier modelling and elementary power supplies.

#### **TCW 1204 Engineering Mechanics**

**10 Credits**

The module explores an introduction to Engineering Mechanics: Statics & Dynamics; Introduction to Solid Mechanics; Statics: Systems of forces; Equilibrium; Geometric characteristics of sections; Kinematics; Types of motion; Distance, linear displacement, speed, relative and linear velocity; Linear acceleration; Equations of motion; Kinetics: - Force-mass acceleration method, Work-energy method Conservation of energy; Impulse-momentum method; Conservation of linear momentum, collision, inelastic and collision; Angular momentum; Solid Mechanics: Stress-strain relationships, Elastic and plastic deformation, Hooke's law, Shear stress and strain, Allowable stresses and allowable loads; Temperature effects, Stresses on inclined surfaces; Analysis of stress and strain: - Plane stresses and

strain, Principal stresses and maximum shear stresses, Mohr's circle of plane stress, Spherical and Cylindrical pressure vessels (Biaxial stress), Triaxial Stress and three-dimensional stress.

### **TCW 1205 Occupational Health, Safety and Environment**

**10 Credits**

The module covers an introduction to the work and health standards in construction environments; construction safety; Introduction to construction codes and safety standards and personal protection, equipment and accident investigation; Introduction to health and safety legislation; Introduction to Environmental Impact assessment (EIA) and Environmental Management planning (EMP) and Construction sites visits for observations.

### **TCW 1206 Civil Engineering Drawing**

**10 Credits**

This module provides the opportunity for the student to apply the previous theory into practical drawing using manual drawing and Auto CAD. This will result in generating typical Civil Engineering and simple architectural drawings. The student will develop graphic and other communication skills using current Auto CAD standard software; Develop Visualization skills by using manual and AutoCAD and to solve Civil Engineering architectural graphical problems. The Civil Engineering layout drawings include detailing for reinforced concrete and steel structures as well as interpretation of architectural drawing.

## **PART II**

### **TCW 2101 Fluid Mechanics**

**10 Credits**

The module offers an introduction to fluid properties, units; Fluid Statics: static pressure relationships, static pressure forces on submerged objects, buoyancy; Fluid kinematics: Classification of flows, velocity and acceleration characterization, Control volume concept, statement of conservation of mass, circulation; Fluid Dynamics: Euler's equation of fluid motion along a streamline, Bernoulli's equation and its applications, impulse momentum principle and its applications, angular momentum principle and its applications; Dimensional analysis; Ideal fluid flow analysis: stream function and velocity potential concepts, potential flow fields; Real fluid flow analysis: laminar and turbulent flow in pipes, pipe friction factor relations, simple pipeline problems; single pipes, pipes in series and pipes in parallel as well as flow measuring systems.

### **TCW 2102 Engineering Survey 1**

**10 Credits**

The module explores definition of surveying, S I Units in survey; Plane and Geodetic survey; Application of plane and geodetic surveys; Topographical, Cadastral, Hydrographic, Mine, Photogrammetry and Engineering Survey; Chain Surveying; Types of measurements in chain survey; Chain Survey Equipment; Care and maintenance; Methods of setting up; Checks and adjustments to the optical square; Ranging a straight line using a prism square; Taping; Corrections to measured lengths; Temperature, slope, standardization, tension, and mean sea level; Electromagnetic measurements; Microwave, Infrared and Laser Instruments; Booking methods; Theory of Errors;

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*Think in other terms*

Systematic and Random errors; Methods of eliminating or minimizing these errors; Compass Surveying; Meridian, magnetic bearing, true north/geographic north, isogons, agonic line and magnetic declination; Factors affecting declination, types of compasses; Bearings; Elimination of local attraction, compass traverses, distance measurement; Adjustment of compass traverses using Bowditch graphical method and reconnaissance work for compass surveys; Areas of regular and irregular figures; Planimetry; Levelling: - dumpy, tilting and automatic levels; Levelling for construction, longitudinal and cross-sections, grading of constructions and some cut and fill work.

### **TCW 2106 Structural Mechanics**

**10 Credits**

The module focuses on application of the equations of equilibrium; Analysis of axially loaded bars: - Displacements of axially loaded Members; Solution of pin jointed frames; Statically determinate trusses: - Type of trusses, Determinacy and stability of trusses, Computation of internal forces using the method of joints and method of sections and graphical methods; Pure bending theory, introduction to combined bending and direct stress; Internal forces in Beams and frames: - moment, shear, and axial force diagrams; Cables and arches; Pure torsion theory; Torsional behavior of members: - Torsional of circular bars, Hollow circular bars, indeterminate circular shafts, Elastic torsion of thin-walled closed tubes; Buckling of axially loaded columns; Instability of ideal and practical struts, beams and beam-columns.

### **TCW 2107 Civil Engineering Materials**

**10 Credits**

The module looks at an introduction to Civil Engineering materials; Manufacture and properties of cement, hydration mechanisms and the microstructure of hardened cement paste; Constituent materials and properties of aggregates, fresh cement, hardened concrete and methods of testing; Durability of hardened concrete; Specification and standards of Concrete; Bricks and Blocks; Manufacture of different types of bricks, properties of bricks and mortar; Composite modelling of masonry movements; heat insulation; Structure and mechanical behaviour; Metals:- bonding, structure, plasticity, deformation and strengthening mechanisms of metals; Failure mechanisms of metals in service, welding and corrosion of metals; Timber:- Sources and characteristics of timber; Polymers: - Application and durability of polymers in construction; Nature, composition and properties of bituminous mixtures and testing of Civil Engineering Materials.

### **TCW 2105 Engineering Geology**

**10 Credits**

The module has an introduction to theories behind formation of the earth; surface; structure and the age of the earth; mineralogy, petrology, igneous, sedimentary and metamorphic rocks, geological structures, geological maps and ground water; Various branches of geology, theory of the earth's origin by the gaseous tidal hypothesis; estimation of the age of the earth, description of the internal constituent of the earth including surface processes such as weathering, erosion and deposition; Mineralogy: Definition of a mineral, physical characters of minerals, crystalline form, atomic structures, classification of minerals; silicate minerals and non-silicate minerals as rock forming

minerals and identification of the common rock forming minerals; Petrology: Origin of igneous, metamorphic and sedimentary rocks; Definitions of discordant, concordant bodies, dykes, sills, batholiths, laccoliths, etc of igneous rocks; Formation of various igneous rocks using Bowen reaction sieves and classification of igneous rocks; Texture and structures of sedimentary rocks; Different forms of metamorphic rocks, classes of metamorphic rocks; Geological Structures and Maps: Definition of geological map, dip, strike, folds faults, fault and normal fault and practical aspect of solving geological maps using contour lines or by the 3-point borehole system.

### **TCW 2201 Soil Mechanics**

**10 Credits**

This module explores basic Characteristics of Soils: Soil-phase diagrams, definitions and calculations of the following soil properties - Bulk density, dry density, void ratio, porosity, water content, degree of saturation, specific gravity of soil particles, bulk unit weight, saturated unit weight, dry unit weight, submerged density, submerged unit weight and water content; Experiments to determine water content of a soil sample and specific gravity of soil grains are to be carried out, including classification of soil by the sieve analysis method and the Cassagrande apparatus; Permeability of Soils: Darcy's Law, coefficient of permeability and its determination by construct head method, falling head method and pumping well test analysis; Seepage: critical hydraulic gradient, quicksand conditions and piping, drawing of flow nets and determination of factor of safety against piping; Soil Compaction; Site Investigation: Various methods used to obtain information regarding the sequence of strata and ground water levels and also various methods used to collect soil samples for identification and testing such as trial pits, hand auger or post-hole auger, deep boring and drilling methods, borehole log and writing of a site investigation report.

### **TCW 2202 Engineering Hydrology**

**10 Credits**

This module is an introduction to hydrology; Application of hydrology in engineering; Hydrologic cycle; Hydrologic equation and water balance; Meteorology; Precipitation and analysis; Frequency-Intensity-duration curves; Infiltration and infiltration models; Groundwater hydrology; Groundwater flow; Well hydraulics; Surface runoff; River flow and stream gauging; Hydrographs and analysis; Unit hydrographs; Flood routing; Analysis of floods and design criteria; Urban and small watershed hydrology; Hydrologic design; Linear regression and correlation; Statistical and probability analysis of hydrologic data.

### **TCW 2208 Structural Analysis I**

**10 Credits**

The module looks at the types of structures and loading: - Modelling of structural systems and structural elements, Analysis of different types loads; Analysis of statically determinate structures: - Modelling of supports and reactions; Determinacy, indeterminacy, and stability of structures (beams, frames); Deflections (Double integration method, Method of singularity functions, Moment area method, Method of virtual work, Castigliano's second theorem); Qualitative analysis of beams and frames; Influence lines for determinate structures (Beams and trusses); Approximate Analysis of

statically indeterminate structures; Analysis of indeterminate structures (Flexibility method, slope deflection, moment distribution, stiffness method) and computer application in structural analysis.

### **TCW 2204 Engineering Survey II**

**10 Credits**

The module explores Zimbabwean coordinates system and Gaussian system of coordinates; Traversing, triangulation and resection; Fieldwork/reconnaissance, station marking, angular measurement and centering errors; Sources of errors during angle measurement, distance measurement and the three-tripod system; Determination of angular misclosures in closed polygon and closed route traverses and distribution; Coordinate misclosures during traversing and their distribution by the Bowditch and Transit methods; Types and classification of triangulation fieldwork in Zimbabwe; Adjustment of angles in braced quadrilaterals and centre point polygons using the method of equal shifts and coordinate calculations; Resection calculations using Collins Auxiliary Point method and Tan K Formula; Theodolites and theodolite work: Temporary and permanent adjustments of theodolite angle measurement using; the repetition, directional and sector methods; Tacheometry work; Curves: circular, reverse, compound, transition and vertical curves; Theory and calculations; Setting out methods: Site inspection, error detection, communication onsite and stages; Vertical control, temporary bench marks, sight rails, travelers and boring rods; Slope rails or batter boards, profile boards; Positioning techniques; Setting out Civil Engineering structures; Practical work; Introduction to Global Positioning Systems; Introduction to Geographic Information Systems as well as computer application in engineering survey.

### **TCW2209 Construction Technology**

**10 Credits**

The module focuses on site clearance, site planning; Temporary works and by-laws: formwork systems, shoring, scaffolding, timbering, excavations; Foundation, Floor, roof and wall construction systems; Water proofing techniques; Internal components and finishes; Structural fire protection; Underpinning; Demolition works; Construction plant and equipment; External work: roads, paving, etc; Durability and maintenance; Site visits and site reporting.

## **PART III**

### **TCW 3107 Hydraulic Design**

**10 Credits**

The module has a review of basic concepts of fluid flow; Open Channel flow: Classification of flows, Uniform flow and resistance factors; Energy and momentum principles; Gradually varied flow and longitudinal profiles; Classification of flows, head loss equations, fittings and minor losses, pipes in series, parallel, and branch systems, Pipe materials; General overview of hydraulic structures: conveyance structures, flow measuring devices, control structures, etc; Types of Pumps, Types of Turbines, Operating curves of pumps, Pumps in pipeline system; Transients in pipes (Surges); Design of municipal drainage systems; Drainage requirements, review of hydrologic variables input into design which include storm flow estimation, time of concentration, intensity-duration-frequency rainfall data; Culvert design; Sewer systems:-Rectangular, trapezoidal and circular, inlets, manholes



and outfall structures; Design of sewerage systems: population estimation, sewerage estimation, sewer materials, flow calculations, sewer appurtenances; Method of analysis and hydraulic design of:- Conveyance structures, water distribution systems and their appurtenances, pump-pipeline systems, Surge and water hammer in pipelines; Pump-turbine-pipeline systems; Pump design and selection, Diversion structures, etc; Storage systems: ground and overhead reservoirs and impoundments and computer application in hydraulic design;

### **TCW 3108 Structural Analysis II**

**10 Credits**

The module looks at plastic analysis Structures: - Elastic-plastic stress-strain relationship, Plastic bending without axial force, Effect of axial load on plastic moment, Collapse loads and collapse mechanisms of beams and frames, Application of Virtual work and the static method; Dynamic analysis single and two degrees of freedom systems (damped and undamped systems), Energy method, Rayleigh method; Plate analysis: Assumptions in thin plate theory, Moment-curvature relations, Equilibrium of an element, Differential Equation of plate bending, Boundary conditions, Navier solution for a plate simply supported on four sides, Levy's method for plate with various support conditions, Transformation of moments and curvatures; Yield line analysis: - Yield line patterns, Guidelines for choosing yield line patterns, Assumptions used in yield line analysis, Virtual work method as well as the equilibrium method.

### **TCW 3103 Design Of Structures I**

**10 Credits**

This module is an introduction to structural design; Loads on structures; Design in Timber; Design in structural steelwork; Design of steel beams, connections and joists; Design of Compression members, loading of continuous spans, moment capacity of members, design of purlins and crane girders, trusses, brackets and bracings.

### **TCW 3104 Wastewater Engineering**

**10 Credits**

The module explores human activities and environmental pollution; Objectives of wastewater treatment; Wastewater characteristics; BOD kinetics; Wastewater flow rates and design flows; Flow equalisation; Wastewater treatment processes and selection; Flow measurement; Screening, Comminution and Grit removal; Primary sedimentation; Introduction to microbial metabolism and role of micro-organisms in biological treatment; Kinetics of biological growth; Trickling filter processes and design; Activated sludge treatment process and design; Biological nutrient removal; Secondary clarification; Wastewater stabilization ponds; Tertiary Treatment; Sludge treatment and disposal; On-site sanitation and low cost appropriate technologies for wastewater treatment and wetland treatment systems.

### **TCW 3109 Transportation Engineering I**

**10 Credits**

The module covers planning and alignment of highways; Highway surveys; Cross-sectional elements and their functions; Geometric design of highway, design of intersections, design of signals, markings

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*Think in other terms*



and signs; Sight distances; Horizontal and vertical curves; Types of road pavements and their design; Construction and maintenance of roads, stabilisation of materials; Generation, distribution of trips, modal split analysis, choice of routes; Road user, vehicle highway and environmental consequences of the use of highway facilities and traffic flow; Traffic control and regulations; Accidents and their prevention, road safety and computer application in transportation engineering.

**TCW 3110 Business Management for Civil Engineers**

**10 Credits**

The module gives an introduction to Business Management, Evolution of Management Theory, Managing in a Changing Environment, Functions of Management, Human Resource Management, Principles of Marketing, Marketing Mix, Consumer Markets, Business Markets, Strategic Marketing, Segmentation, Targeting, Positioning, Management Information Systems and E-commerce.

**TCW 3207 Design Of Structures II**

**10 Credits**

The module focuses on design in Reinforced Concrete; Basis of design; Material properties; Loading; Design of beams, slabs, columns; Design of continuous beams, two way slabs, flat slabs; Design of slender columns; Enhancement of Auto CAD application in Civil Engineering Drawings, e.g; detailing, scheduling, labelling and dimensions; Design in Masonry; Design of vertically loaded masonry walls as well as the design of laterally loaded wall panels.

**TCW 3208 Transportation Engineering II**

**10 Credits**

The module explores the role and characteristics of rail transportation; Types of gauges and their selection; Cross-sectional elements of a railway track, their functions and requirements; Rail failures and defects; Coning wheels, creep of rails; Rail fixtures and fastening; Geometrical design of rail track; Railway station yards and equipment; Signalling and interlocking; Train resistances and stresses in a railway track, tractive effort and traction; Construction and maintenance of a railway track and track drainage.

**TCW 3209 Research Methods**

**10 Credits**

The main objective of the module is to provide the students with the necessary tools to be able to carry out civil and water engineering related research. Topics to be covered include formulating problem statements, research questions and research objectives; Introduction to methods of undertaking research, sources of data, handling and presenting data and findings, data analysis techniques. Continuous assessment will include formulation of research proposals and actual research projects.

**TCW 3204 Irrigation Systems Design**

**10 Credits**

The module gives an introduction to irrigation; Soils and classification in irrigation; Soil-water properties; Soil-water-plant relationships; Storage and measuring of soil moisture; Infiltration in irrigation; Crop water requirements; Determination of crop-water requirements:-Temperature-based,

pan evaporation and combination methods; Selection of crop coefficients; Guide to selection of irrigation systems; Irrigation project planning; Surface irrigation systems and design:- Furrow and border strip; Sprinkler irrigation and design; Trickle irrigation and design; Operation and management of irrigation systems; Economic analysis and computer application in irrigation design;

**TCW 3210 Geotechnical Engineering**

**10 Credits**

Important subjects in the module include principles of effective stress and shear strength of soil; Strain-stress behaviour; Soil stiffness; Lateral earth pressure; Mohr-Coulomb and Rankine approaches; Consolidation theory and permeability, Slope stability; Critical soil model; Geo-structural mechanisms and the critical state soil model; Settlement of foundations and analysis; Geo-technical process for ground improvement; Soil improvement-grouting, vertical drains, geosynthetics, soil reinforcement; Filtration, separation and erosion control; Drainage in plane and flow prevention.

**TCW 3211 Construction Management & Ethics**

**10 Credits**

The module examines the hierarchy of Construction Projects (Team); Duties and responsibilities of construction team; Site productivity; Construction equipment; Selection of equipment and scheduling; Efficient use of machinery at site; Construction automation and robotics; Project scheduling and planning (Critical path method); Estimations, planning; Contract supervision; Programming:- bar and Gantt charts, critical path networks; Cash flow, inflation, interest costing and budgetary control; Construction contracts:- Payment and variations and claims; Contract law; Types of contracts; General conditions of contracts (ZGCC 4), FIDIC; Standard forms of conditions of contract; ZACE Form 1 & 2; Legal aspects (contract law, employment law and health law); Bills of quantities; The Tender; development of a project; types of tenders; tendering procedure; Introduction to Project Management; Social cost benefit analysis; Professional ethics; Code of Ethics, Zimbabwe Institute Engineers; CPD and Continuing Professional Development (Training) CPD.

**PART IV**

**TCW 4000 Industrial Attachment**

**120 Credits**

**PART V**

**TCW 5099 Final Year Project**

**12 Credits**

**TCW 5101 Water Quality and Treatment**

**12 Credits**

The module explores sources and uses of water; Physical, chemical and biological characteristics of water; Water quality standards and guidelines; Health and aesthetic aspects of water quality; Aeration theory, methods and application in water treatment; Water pollution and control; Introduction to Water quality modelling in the environment; Guide to selection of water treatment processes; Coagulation and flocculation; Sedimentation and flotation; Filter media; Slow sand filtration; Rapid

filtration; Hydraulics of filtration and backwash; Membrane processes; Disinfection of water; Chemical and Tertiary treatment; Groundwater treatment; Pilot plant design and testing; Treatment and disposal of sludge from potable water treatment; Design, operation and management of water treatment plants.

**TCW 5104 Civil Engineering Business Studies**

**12 Credits**

The module gives an introduction to Financial Markets And Institutions, Time Value of Money, Fundamental Goal of Financial Management, Determinants of Firm Value, Risk and Return, Portfolio Theory, Project Appraisal, Capital Structure Theory and Practice, and Working Capital Management; Accounting Concepts, Double Entry Bookkeeping, Financial Statements (Income Statement, Balance Sheet and Cash Flow Statement) and Financial Ratio Analysis.

**TCW 5105 Design Of Structures III**

**12 Credits**

The module looks at the general principles of design of foundations for structures; Isolated footings, Combined footings; Retaining Walls: Review of lateral earth pressures; Gravity Walls, Cantilever and Counterfort Walls and design of Piled Foundations.

**TCW 5204 Dam Engineering**

**12 Credits**

The module explores types of dams and methods of dam classification; Hydraulic design of small, medium and large dams: hydrological considerations, flood routing; Outlet works, spillway design, stilling basin design; Siting considerations and environmental considerations in dam design, construction and use; Sediment transport and channel stability and hands-on with hydraulic design software.

**TCW 5205 Water Resources Management**

**12 Credits**

The module has introductory issues on the state of water resources at global and regional and national levels; Challenges to planning of water resource projects; Economics of water resource projects; Planning and management of community-based projects; Optimization methods applied to water resource projects; Principles of integrated approach to water resource management; Demand management; Reservoir capacity analysis and flood plain management.

**ELECTIVES**

All final year students are required to pass at least two electives the choice of which is subject to Departmental Board approval.

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*Think in other terms*

**TCW 5001 Groundwater Hydraulics and Modelling****12 Credits**

The module explores classification of aquifers; Types of formations; Physical properties of aquifers: Porosity, specific retention, storage coefficient, hydraulic conductivity, transmissivity; Principles of groundwater flow: Darcy law, Derivation of equations of flow; Horizontal flow assumption (Dupuit-Forchheimer assumption), Physically-imposed boundary conditions on flow; Methods of solution of groundwater flow equations: Flow nets, Analytical methods, Method of images (Flow near boundaries); Pumping tests and aquifer characterization; Well design, development, and construction, Flow in unconfined aquifers; Numerical modeling of aquifer systems; General concepts of numerical modeling, Finite difference, Finite element, Boundary element, Green element methods; Recharge and discharge area, artificial recharge as a management tool: Methods of artificial recharge as well as groundwater pollution and control.

**TCW 5002 Pipe Network Analysis****12 Credits**

The module has application of computers to Pipe network Design and Interpolation of results; Matrix solution of complex Pipe networks; Analysis of transient development and control; Computer analysis of water hammer; Parameter optimization, programme modification; Pumping systems analysis; Pipe supports; Design of flexible pipes; Air and vapour in pipelines.

**TCW 5003 Liquid Retaining Structures****12 Credits**

The module explores codes and handbooks; Design methods; Design objectives and general recommendations; Design examples; Specification and construction; Quality control and testing.

**TCW 5004 Finite Element Method in Civil Engineering****12 Credits**

The module gives an introduction to the basic concept of the finite element method; Examples; Use of method to design; Review of basic elasticity; Strain energy; Variational theorems: Concept of minimum potential energy; The Ritz method; Spatial discretisation by finite elements; Beam element; Plane stress and plane strain elements; Axisymmetric element; Isoparametric elements and numerical integration; Three dimensional elements; Plate bending elements; Application to structural problems in plane stress; Application to fluid flow, potential problems and consolidation; Implementation of the method on microcomputers-programming strategies as well as the use of packages advantages and pitfalls.

**TCW 5005 Traffic and Airport Studies****12 Credits**

The module explores the need for traffic analysis and studies; Traffic flow characteristics; Speed-density volume relationships; Traffic volume studies, its purpose and methodology, presentation of collected data, its analysis and utility; Speed studies, various methods of conducting speed studies, analysis of data and its presentation; Travel time and delay studies, floating method of study, delay at intersection, and presentation of data; Origination and Destination; Surveys, methods, their advantages and disadvantages, presentation of collected data; Parking studies, methods of parking, parking layout, multi storey parking and underground parking; Accident studies, collection, storing, recording and

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*Think in other terms*

reporting of data, collision diagrams, their analysis; Remedial measures; History of aviation; Development trends in aircraft size, speeds, flying heights and other characteristics affecting airports; Planning of airports, regional planning, master plans, and strategic plan; Aviation forecasting; Airport obstruction clearance; Imaginary surfaces; Control devices; Planning and Design of terminal buildings and its facilities.

### **TCW 5006 Solid Waste Management**

**12 Credits**

The module gives an introduction to evolution of solid waste management; Regulatory framework and management agencies; Sources and types of solid wastes; Diseases and pollution; Classification; Physical, chemical and biological properties;;; Generation and collection rates; Handling, separation and recovery; Transformation and recovery; Storage and processing at source; Collection and transportation of wastes; Disposal of wastes; Hazardous wastes and their disposal; Sanitary landfill design and operation practice; Compositing; Scavenging and its negative and positive impacts; Environmental issues-lactates, odours and gases; Control and monitoring of negative impacts; Restoration and rehabilitation of landfills and environmental impact assessments of landfills.

### **TCW 5007 Wastewater Technology**

**12 Credits**

The module explores wastewater technologies and selection of treatment processes; Control of biological nutrients; Nutrient removal from wastewater: - Biological nutrient removal plant configuration for raw and settled wastewater; Reactor selection; Specialized treatment systems for phosphorous and nitrogen removal: - Modified Ludzack-Ettinger nitrification-denitrification process; Wuhrmann-nitrification-denitrification process; Bardenpho Process for nitrogen removal; Phoredox process for biological nitrogen and phosphorous removal and UCT process; Process volume requirements for the biological nutrient reactor; Solids flux theory; Layout and hydraulic design of biological reactor clarifiers; Wastewater treatment for small communities: On site sanitation; Anaerobic treatment of industrial wastewater; Tertiary treatment processes; Microstrainers; grass plots; maturation ponds; slow and rapid sand filters; Wastewater reclamation, reuse and disposal; Aerated lagoons; Sludge treatment, disposal and reuse; Sludge rheology and transport and visits to wastewater treatment plants.

### **TCW 5008 - Bitumen Technology**

**12 Credits**

The module examines Bitumen and Tar, their types and method of extraction; Practical significance of tests on bitumen; Various types of bituminous roads and treatments, construction techniques; Different tests for Bitumen: Penetration test, softening point test, flash and fire point test, viscosity of bitumen test, Ductility tests, Distillation test; Cutbacks, emulsions etc; Bituminous mix Design; Marshall method, HV method and other methods.

**TCW 5009 Computer Aided Design In Civil Engineering****12 Credits**

The module gives an overview for CAD: Hardware and software for CAD; Introduction to programming techniques; Graphics for CAD; Graphic devices; Mathematics for graphics; Representation of images; Geometric modelling; Application to foundation and frame modelling in three dimensions; Analytical tools, modelling for CAD; Interactive design in CAD environment; Programming environment for CAD; Knowledge based approaches for engineering design; Applications in project management, hydraulic design, foundation engineering, transportation engineering and structural engineering.

**TCW 5010 Computational Techniques in Civil Engineering****12 Credits**

The module gives an introduction to numerical methods; The need and philosophy; Classical approximate methods; Variation methods - The Ritz method and the Galerkin methods; The finite difference method application to beams and plates; Disadvantages; The concept of finite element-discretisation and assembly; Variation principles; Classical element formulation; Interpolation functions; The isoparametric element and numerical integration; Application beams, plane elasticity and two dimensional potential problems; Introduction to boundary element method as well as implementation on microcomputer.

**TCW 5011 Dynamic Analysis of Structures****12 Credits**

The module explores basic concepts of Dynamic Analysis; Damped and undamped vibration; Single and several degrees of freedom and an application of the method to the analysis of structures (building and foundations).

**TCW 5012 Elastic Analysis of Structures****12 Credits**

The module explores basic concepts of Elastic Analysis; Application of the method to slabs; Navier method, Ritz method, concept of minimum potential Energy, Line method; Application of the Navier solution and the Crash of method to the analysis of grillages.

## DEPARTMENT OF ELECTRONIC ENGINEERING

### ***Lecturer and Chairperson***

*Dr. Busiso Mtunzi*, PhD Physics- Renewable Energy (UFH –SA), MSc Renewable Energy. (UZ - Zimbabwe), BTech (Hons) Applied Physics. (UZ-Zimbabwe)

### ***Secretary***

*U, Magaya*

### ***Technicians***

*Mr. Keith Ncube*, Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Bulawayo, Zimbabwe

*Mr. Vusumuzi Ncube*, National Diploma in Control & Instrumentation

## ACADEMIC STAFF

### ***Lecturers***

*Mrs Svetlana Angelova Bebova*, MSc in Radio Electronic Engineering, Technical University, Sofia, Bulgaria, 1980

*Eng. Magripa Nleya*, Master of Science in Telecommunications Engineering. Tashkent Electro-Technical Institute of Telecommunications), Tashkent, (former USSR). 1990. Postgraduate Diploma in Higher Education. National University of Science and Technology (NUST), Bulawayo, Zimbabwe.

*Mr. Reginald Gonye*, Master of Philosophy Degree in Electronic Engineering NUST, Bulawayo, Zimbabwe. Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Bulawayo, Zimbabwe

*Mr. Lovemore Gunda*, Master of Engineering Degree in Electronic Engineering, Stellenbosch University, South Africa. Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Bulawayo, Zimbabwe. Further Education Trainer's Certificate (FETC) , Zimbabwe

*Mr. Buthanani Dlodlo*, MSc in Electronic Engineering, UKZN, RSA 2018. Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Zimbabwe, 2007

*Eng. N Ndiweni*, Master of Engineering Degree in Electronic Engineering, University of Leeds, UK, 2012. Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Zimbabwe, 2009.

*Mr. Bhekisisa Nyoni*, Master of Philosophy Degree in Electronic Engineering NUST, Bulawayo, Zimbabwe. Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Bulawayo, Zimbabwe.

### ***Temporary Full time Lecturer***

*Mr. Zedekia Madumbu Nyathi*, Master of Science in Engineering Degree at Leningrad Electro Technical Institute of Communication. Further Education Teachers Certificate (FETC), Zimbabwe

### ***Engineering Instructors***

*Mr. Fidelis Nhenga-Mugarisanwa*, BSc Computer Science, NUST, Zimbabwe. Further Education Teacher's Diploma. Certificate in Training Management (Zimbabwe Institute of Personnel Management). Higher Diploma in Electronic Engineering Bolton UK

*Mr Eben Makumbe*, B Tech degree in Electrical Engineering ,UZ, Zimbabwe. Further Education Teacher's Certificate.



## BACHELOR OF ENGINEERING HONOURS IN ELECTRONIC ENGINEERING

### PART I (125Credits)

#### Semester I

Module Code	Module Description	Credits
SMA1116	Engineering Mathematics 1A	10
TIE1101	Engineering drawing	10
TCE1103	Professional engineering skills	5
TEE1102	Electrical engineering workshop	5
TEE1131	Computer engineering and programming	10
TEE1143	Electrical engineering circuit analysis	10
TEE1154	Physics for electronic engineers	10
<b>Total Credits</b>		<b>60</b>

#### Semester II

SMA1216	Engineering Mathematics 1B	10
TEE1213	Electronic engineering devices and circuits	10
CTL1101	Conflict Transformation and Leadership	10
TEE1231	Software engineering	10
TEE1202	Electronic engineering workshop	5
TEE1214	Digital electronics	10
TEE1232	CAD for electronic engineers	10
<b>Total Credits Semester II</b>		<b>65</b>

### PART II (140 Credits)

#### Semester I

Module Code	Module Description	Credits
SMA2116	Engineering Mathematics 2	10
TEE2104	Laboratory I	5
TEE2106	Design and project I	5
TEE2142	Electrical machines	10
TEE2151	Network theory	10
TEE2115	Analogue electronics 1	10
TEE2113	Digital devices and systems	10
TEE2141	Electrical measurements	10
<b>Total Credits Semester I</b>		<b>70</b>

**Semester II**

SMA2217	Engineering Mathematics 3	10
TEE2204	Laboratory II	5
TEE2206	Design and project II	5
TEE2212	Electronic drives	10
TEE2255	The professional engineer	10
TEE2233	Object oriented programming	10
TEE2256	Electromagnetic theory	10
TEE2215	Analogue electronics 2	10
<b>Total Credits Semester II</b>		<b>70</b>

**PART III (130 Credits)****Semester I**

<b>Module Code</b>	<b>Module Description</b>	<b>Credits</b>
SMA3116	Engineering Mathematics 4	10
TEE3104	Laboratory III	5
TEE3106	Design and project III	5
TEE 3151	Digital signal processing	10
TEE3113	Linear integrated circuits	10
TEE3122	Communication engineering 1	10
TEE3133	Software engineering applications	10
TEE3112	Microprocessors	10
<b>Total Credits Semester I</b>		<b>70</b>

**Semester II**

TEE 3241	Control engineering	10
TEE 3204	Laboratory IV	5
TEE 3206	Design and project IV	5
TEE 3232	Embedded computer systems	10
TEE 3231	Computer architecture and Operating systems	10
TEE 3222	Communication engineering 2	10
TEE 3255	Engineering management	10
<b>Total Credits Semester III</b>		<b>60</b>

**PART IV (120 Credits)****Semester I & II**

<b>Module Code</b>	<b>Module Description</b>	<b>Credits</b>
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TEE 4000	Industrial Attachment	120
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**PART V (120 Credits)**

**Semester I**

<b>Module Code</b>	<b>Module Description</b>	<b>Credits</b>
TEE 5003	Honours project	50
TEE 5155	Project Management	10
TEE 5122	Communication systems performance	10
TEE 5142	Modern control engineering	10

<b>Total Credits Semester I</b>		<b>80</b>
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**Semester II**

TEE 5223	Mobile communication	10
TEE 5233	High speed networks	10

**Elective Modules Select II**

TEE 5222	RF and microwave devices and circuits	10
TEE 5234	Advanced Software Engineering	10
TEE 5241	Industrial control	10
TEE 5221	Communication systems	10
TEE5211	Integrated circuits technologies	10
TEE 5212	Power electronics applications	10

<b>Total Credits Semester II</b>		<b>40</b>
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<b>TOTAL CREDITS FOR THE DEGREE</b>		<b>635</b>
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## MODULE SYNOPSES

### PART I

#### **SMA1116 Engineering Mathematics 1A**

**10 Credits**

The module explores calculus in one variable; Limits and continuity of functions; Differentiation; Leibniz's Rule; L'Hopitals Rule; Elementary functions including hyperbolic functions and their inverses; Integration – techniques including reduction formulae; Applications – arc-length, area, volumes, moments of inertia, centroids; Plane polar coordinates; Complex Numbers: Basic algebra; De Moivre's theorem; Complex exponentials; Linear Algebra: Vector algebra in 2 and 3 dimensions; Scalar and vector products; Equations of lines and planes.

#### **TIE1101 Engineering Drawing**

**10 Credits**

The module has an introduction to plane geometry; First and third angle projection; Dimensioning; Pictorial views; Freehand sketching; Drawing of common objects; sectioning; Intersections, Developments; Conventioneering; Assembly Drawing and exercises.

#### **TCE1103 Professional Engineering Skills 1**

**5 Credits**

The module examines study methods; Communication principles; Technical definitions, Descriptions and instructions; Tables and graphs; Letters; Memoranda and Curricula Vitae; Written reports; Word processing and computer jargon; Interview technique; Running a meeting; Reading as well as understanding and summarizing technical articles.

**TEE1102 Electrical Engineering Workshop****5 Credits**

The module looks at safety regulations; Standard electrical and electronic symbols and circuit diagrams; Use of Electronic equipment: Oscilloscopes, Signal Generators, Multi-meters, Electronic Kits; Soldering/unsoldering techniques Basic Circuit Development and PCB fabrication; Breadboard and veroboard.

**TEE1143 Electrical Engineering Circuit Analysis****10 Credits**

The module focuses on the general concepts of current, voltage and resistance; DC and ac circuits; Kirchoff's Laws; Loop and nodal analysis of circuits (dc and ac); Delta-Wye conversions (dc and ac); Network Theorems (dc and ac); Capacitance; Inductance; Transient analysis of capacitive and inductive networks (for dc sources); Magnetism and introduction to magnetic circuits; Steady state response of capacitors and inductors to ac; AC power and an introduction to three phase AC systems.

**TEE1154 Physics For Electronic Engineers****10 Credits**

The module looks at atomic arrangements, unit cell, crystal systems; Intrinsic and Extrinsic semiconductors; Contact phenomenon: P-N junction; Applied mechanics; Statics: scalar and vector quantities, equilibrium, solution of pin jointed frames, stress and strain, pure bending theory, and pure torsion theory; Dynamics: kinematics, types and equations of motion, work done by a constant and a varying force, circular motion, rotational work, power and energy.

**SMA1216 Engineering Mathematics 1B****10 Credits**

The module explores the functions of Several variables: Partial derivatives, chain rules; Applications; Linear Algebra: Matrices – basic operations, rank, inverses; Systems of linear equations; Determinants; Eigen values and Eigen vectors; Linear independence; Ordinary Differential Equations; First order differential equations; Integrating factors; Linear second order equations with constant coefficients; Variation of Parameters; Systems of equations and applications of differential equations.

**CTL1101 Conflict Transformation And Leadership****10 Credits**

The module is tailored in a manner to provide students with intellectual skills on the symbiotic relationship that exist on the three tier terms (peace, leadership and conflict). The module attempts to probe into the interplay between these thematic motifs and show their role and complementarities in the process of human development. The module further seeks to provide a skills tool kit on how to analyse conflicts, identify their underlying causes, evaluate how conflict undermines the productive use of resources thereby plaguing development and how responsible leadership transforms adversity into peaceful, equitable and just global society in harmony with nature. It is envisaged that the students who would successfully completed the module shall be well grounded in the theory and practice to face the challenges of leadership and conflict at personal, community, national and global levels. The students would be able to trace the emerging patterns and conflict trends in Africa shall form the basis of reflection.

**TEE1213 Electronic Engineering Devices and Circuits****10 Credits**

The module outlines rectifying and Zener diodes: structure, operation, characteristics and parameters; Diode applications: rectifiers and power supplies; clippers and clamps; Schottky diode; Transistors; Bipolar Junction Transistors (BJTs): structure, terminals and operation; BJT configurations, static characteristics and parameters; biasing methods; d;c; circuit analysis and design; Darlington pair; BJT packages and data sheet; Field Effect Transistors (FETs): types, structure, terminals and operation; Configurations and static characteristics; d;c; circuit analysis; Power devices and heat sinks; Opto-electronic and photo- electronic devices: Light-Emitting Diodes (LEDs), infra-red diodes, 7-segment displays, Liquid Crystal Displays (LCDs), photodiode and phototransistor; Applications; Thermistors: structure, types, operation and applications.

**TEE1232 CAD for Electronic Engineers****10 Credits**

The module focuses on graphical techniques for drawing circuit diagrams, logic circuits, flowcharts; Concepts of engineering drawings; Presentation of graphs; Design of artwork for printed circuit boards; Use of pictures and cartoons and use of CIRCUIT MAKER PRO program for graphical design.

**TEE1231 Software Engineering****10 Credits**

The module has software development life cycle; Requirements, specification, design implementation and testing, coding, maintenance; Function-oriented design methodologies; Documentation; Implementation strategies; Debugging, anti-bugging; Introduction to specifications, verification and validation; Elementary proof of correctness; Code and design reading; Structured walkthroughs; Testing strategies; Software reliability issues; Configuration Management; CASE tools; Programming languages; Compilers; The DotNet framework and programming in C.

**TEE1202 Electronic Engineering Workshop****5 Credits**

The module examines measuring current-voltage characteristics for rectifying, Zener, light-emitting diode opto-electronic devices and thermistors; Diode rectifiers, clippers and clamps; Bipolar Junction Transistor (BJT) static characteristics in Common-Emitter, Common-Base and Common-Collector configuration; DC biasing methods and Darlington pair.

**TEE1214 Digital Electronics****10 Credits**

This module looks at numerical systems: Binary, Octal, Hexadecimal; System conversions; Mathematical operations in straight and BCD code; Logic gates; Truth tables, Boolean algebra theorems and K-maps; Minimization of logic expressions; Combinational logic applications and design: arithmetic circuits, encoders and decoders, code converters, multiplexers and de-multiplexers as well as Flip-Flops.

**PART II****SMA2116 Engineering Mathematics II****10 Credits**

This module explores multiple Integrals; Iterated integrals, change of order; Change of variable; Polar, cylindrical and spherical coordinates; Applications in three dimensions; Vector Calculus; Scalar and vector fields; Directional derivatives; Gradient, divergence and curl; Line and surface integrals; Theorems of Green, Gauss and Stokes; Fourier Analysis; Fourier Series; Half range series; Fourier integrals and transformations.

**TEE2142 Electrical Machines****10 Credits**

This module covers fields and magnetic circuits; Energy conversion phenomena; Three-phase theory; Transformers: principles, operation and construction; Special transformers; Principles, classification, characteristics and construction of synchronous, induction and dc machines; Single phase induction motors and steady- state transient behaviour of machines.



**TEE2104 Laboratory****5 Credits**

This consists of a number of experiments carried out in the laboratories to support the lecture materials of the semester.

**TEE2106 Design And Project****5 Credits**

The module explores the design of a circuit/system related to the current theoretical subjects; Literature review on a given topic, design, computer simulating and practical test as well as writing a technical report.

**TEE2151 Network Theory****10 Credits**

The module explores DC circuits analysis; First order circuits: The source free RC and RL circuits, step response of RC and RL circuits; Second order circuits: The source free series and parallel RLC circuits, step response of a series and parallel RLC circuit; AC circuits analysis: Kirchhoff's law in the frequency domain; Sinusoidal steady analysis; Frequency response; Series and parallel resonance; Filters; Transfer functions; Advanced circuit analysis: Applications of Laplace Transform, Fourier series and Fourier Transform to circuit analysis; Two-port networks: Impedance parameters, admittance parameters, hybrid parameters, transmission parameters, relationship between parameters and interconnection of networks.

**TEE2113 Digital Devices and Systems****10 Credits**

The module focuses on Flip-Flops review; Master-slave Flip-Flops; Shift registers; Counters: asynchronous, with mod numbers  $< 2N$ , synchronous, down counters, up/down counters, integrated circuits counters; Registers; Memory devices: magnetic memories, semiconductor memories: ROM, static and dynamic RAM and applications.

**TEE2115 Analogue Electronics I****10 Credits**

The module explores Bipolar Junction Transistor (BJT) h-parameters and equivalent circuits; Single stage small-signal amplifiers analysis: Common Emitter (CE), Common Base (CB), Common Collector (CC); Multistage amplifiers; Coupling methods, frequency response, analysis and design; Differential amplifier, Darlington pair; Negative feedback amplifiers; Large signal amplifiers: class A, class B and class C; Circuits analysis and design.

**TEE2141 Electrical Measurements****10 Credits**

The module looks at basic electrical measuring devices, ammeters, voltmeters; Measurement of non-electrical parameters; Transducers and their operating principles; Signal conditioning; Oscilloscopes as measurement instruments; Recording measurement devices; Electronic measuring instruments, digital voltmeters, multimeters and measurement of AC power.

**SMA2217 Engineering Mathematics III****10 Credits**

The module explores Laplace Transforms; Definitions; Basic ideas; Applications to ordinary differential equations; Statistics; An introduction to Applied Statistics; Introduction to probability and distribution theory; Descriptive statistics/initial data exploration; Summary statistics, graphical presentation data; Point estimation/test of hypothesis; Interval Estimation; Analysis of Variance and Regression analysis.

**TEE2212 Electronic Drives****10 Credits**

This module looks at power electronic devices: characteristics, drive requirements and device protection; Converters: DC- DC, DC-AC, AC-AC, AC-DC, and control techniques; Power and distortion factor; Special transformers; Application of AC and DC motors; Special motors; Motor control: variable speed drives, regenerative braking, slip energy recovery, four- quadrant operation; Selection and sizing of motor- drive systems and transducers for power electronics applications.

**TEE2204 Laboratory****5 Credits**

This consists of a number of experiments carried out in the laboratories to support the lecture materials of the semester.

**TEE2255 The Professional Engineer****10 Credits**

The module examines research techniques, project proposals, technical report writing and bibliography; General research survey on technological developments; Brief history of engineering; Engineering boards and ethics.

**TEE2206 Design and Project****5 Credits**

The module outlines the Design of a circuit/system related to the current theoretical subjects; Literature review on a given topic, design, computer simulating and practical test and writing a technical report.

**TEE2233 Object Oriented Programming****10 Credits**

The module explores process-oriented software development: functions, pointers and arrays; Process-oriented analysis, design and implementation, and testing using C++; Data-oriented software development: structures, dynamic memory allocation, file handling, and relational database; Object-oriented software development: encapsulation, polymorphism and inheritance; Object-oriented analysis, design and implementation using C++ classes and objects and structures.

**TEE2256 Electromagnetic Theory****10 Credits**

The module covers Maxwell's equations; Laplace and Poisson equations and their solution; Boundary conditions; Plane waves in a perfect dielectric; propagation in imperfect dielectric; Propagation in imperfect conductors, skin effect; Generalized wave equation, field distributions in rectangular waveguide; Radiation field, dipoles, radiation resistance, impedance, mutual impedance and linear arrays.

**TEE2215 Analogue Electronics II****10 Credits**

The module covers FETs circuits; Optoelectronic devices and thermistor circuits; Positive feedback; Oscillators and Multivibrators; Sine-wave oscillators- Wien-bridge and R-C-shift types; Astable, Mono-stable and Bi- stable multivibrators; RF and crystal oscillators; Voltage regulators and Linear ICs basic building blocks.

## **PART III**

### **SMA3116 Engineering Mathematics IV**

**10 Credits**

The module focuses on differential Equations; Power series solutions; Singular points; Frobenius method; Special functions and their properties; Legendre polynomials, Bessel functions; Partial Differential Equations; Solution of the partial differential equations; Method of separation of variables; Numerical Methods; Errors, absolute and relative; The solution of nonlinear equations; The solution of linear systems; Interpolation and polynomial approximation; Curve fitting; Numerical differentiation and integration and approximate solution of differential equations.

### **TEE3151 Digital Signal Processing**

**10 Credits**

The module has an analysis of continuous and discrete signals and systems; Fourier series and transforms; Laplace transforms, Z transforms, transfer functions, analysis of stability, probabilistic convolution, impulse response and transfer functions.

### **TEE3113 Linear Integrated Circuits**

**10 Credits**

The module covers operational amplifier circuits: comparators, inverting and non-inverting amplifiers, mathematical operations, oscillators and multivibrators, active filters; Voltage regulators; Timer ICs and their applications; Instrumentation amplifiers; Analogue-to-Digital converters and Digital-to-Analogue converters.

### **TEE3122 Communication Engineering I**

**10 Credits**

The module gives an introduction to communication systems; Telecommunication signals; Analogue cellular systems; Amplitude modulation; Angle modulation; Multiplexing methods and noise in communication systems.

**TEE3133 Software Engineering Applications****10 Credits**

The module looks at databases; Data-oriented software development and implementation using SQL; Web development and Java programming.

**TEE3112 Microprocessors****10 Credits**

The module looks at Basic concepts of microprocessors; Architecture and Operation; Instruction sets and assembly language programming; Subroutine, interrupts, I/O and applications of microprocessors.

**TEE3241 Control Engineering****10 Credits**

The module explores examples of controlled processes, objectives and terminology, open and closed-loop controllers; Modeling by transfer functions; Simple servomechanisms; derivation of transfer functions from specifications; Time and frequency–response specifications; Direct analysis and design; stability, Routh criterion; The ITAE and other performance criteria; Examples of servo design; Frequency- response analysis and design; Root-locus methods; system analysis and design.

**TEE3232 Embedded Computer Systems****10 Credits**

The module explores applications of embedded systems; Microcontrollers: memory maps, programming languages, I/O, timers, interrupts, hardware interfacing; Picocontrollers: memory maps, SFRs, stacks, programming languages, oscillator types, configuration fuses, watchdog timers and code protection.

**TEE3204 Laboratory****5 Credits**

This consists of a number of experiments carried out in the laboratories to support the lecture materials of the semester.

**TEE3222 Communication Engineering II****10 Credits**

The module is an introduction to digital communication systems; Digital modulation and demodulation; Digital transmission and multiplexing and digital cellular systems.

**TEE3206 Design And Project****5 Credits**

The module explores the design of a circuit/system related to the current theoretical subjects; Literature review on a given topic, design, computer simulating and practical test and writing a technical report.

**TEE3231 Computer Architecture And Operating Systems****10 Credits**

The module examines evolution of computers hardware for Von Neumann machines; Operating systems for single tasking; Process scheduling for concurrent operation; Inter-process communication; Deadlock avoidance; Memory management; Virtual memory; Architectures for parallel processing and computer networking;

**TEE3255 Engineering Management****10 Credits**

This module is based on “Management by Engineers” by D; Johnson through group discussion and talks by external speakers. Hence it is centred on industrial organizations; reviews and performance measures, planning and managing change, development and motivating groups, leaderships and communication; financial management; business environment; companies and basic accounts.

## **PART IV**

### **TEE4000 Industrial Attachment**

**120 Credits**

The module offers familiarization with actual plant organization and operations, training in practical engineering work for graduate engineers, exposure to as many of the following as possible; industrial management, plant maintenance, design and development, service/field engineering; working with planning, manufacturing, production and marketing departments as well as industrial research.

## **PART V**

### **TEE5003 Honours Project**

**50 Credits**

The module goes through the selection of a problem, research, planning of possible solutions, selection of an optimal solution, acquisition of components, testing, construction of a prototype and writing of the final report.

### **TEE5122 Communication Systems Performance**

**10 Credits**

The module explores the concept of noise characterization and receiver performance; Overview of contemporary communication systems link budget; Random processes and spectral analysis: linear systems; the Gaussian random process; error probabilities for binary signalling and performance of baseband binary systems detection of band-pass binary signals.

### **TEE5142 Modern Control Engineering**

**10 Credits**

The module looks at State Space Analysis: State-space methods of analysis and design; Observability and controllability; Pole placement for the optimization response; State observers and pole placement design with state observers; Multi-input, multi-output systems and cross-coupling problems; Digital Control: Digital time control systems; Modeling of Sampled Processes; Transient response; Steady state response; Stability; Design of Digital Controllers and Root Locus.



**TEE5155 Project Management****10 Credits**

The module is on project proposal writing- types of proposals; Project definition, life cycle, and systems approach; Project scoping, work definition, and work breakdown structure (WBS); Project time estimation and scheduling using GANTT, PERT and CPM; Project costing, budgeting, and financial appraisal; Project control and management, using standard tools of cost and schedule variance analysis; project management use-case through practical, example projects; use of computers in project management, some software tools for PM e.g; MS Project and PM techniques e.g; PRINCE2.

**TEE5223 Mobile Communication Systems****10 Credits**

The module has an introduction to mobile communications; Global System for Mobile communications (GSM); Long term Evolution (LTE); IEEE 802.16 and WIMAX.

**TEE5233 High Speed Networks****10 Credits**

The module gives a comprehensive view of high-speed LAN, MAN, and ATM technologies and standards and evolution towards broadband integrated services digital network (B-ISDN).

**ELECTIVEAL MODULES****TEE5222 RF And Microwave Devices and Circuits****10 Credits**

The module looks at oscillators: Magnetrons, Gunn and Impatt diodes, Other group III-V semiconductor devices; Amplifiers: Bipolar Junction Transistors and GaAs; FET amplifiers, low noise broadband and power amplifier design; Mixers: the mixing process, noise and noise figure measurement, single ended, single balanced and double balanced mixers; Control Devices: P;I;N; diode modulators, switches and phase shifters.

**TEE5241 Industrial Control****10 Credits**

The module focuses on industrial control situations, process control; instrumentation, actuators, transducers and controllers; hybrid systems; time-domain analysis, state-space analysis, stability; computer control; system characterization, algorithm design, feedback control for digital systems and PLC applications.

**TEE5234 Advanced Software Engineering****10 Credits**

The module explores Software Measurement & Testing; Software Design & Architecture, Computational Models: UML and MVC modeling, Access Control & Privacy Policies, Agents & Multi-Agent Systems, Data Structures and their Implementation in C++ or Java, Database Technology, Parallel & Distributed Systems and Software Engineering of Internet Applications.

**TEE5221 Communication Systems****10 Credits**

The module examines optical fibre systems, sources, transmission and system characteristics; digital systems, signal processing, data transmission, switching, satellite communications and television systems.

**TEE5211 Integrated Circuits Technologies****10 Credits**

The module explores Microelectronics procedures for Si and GaAs; Logic families: TTL, ECL, I<sup>2</sup>L, MOSFET, CMOS and PMOS; Introduction to FPGAs and Nano-electronics concepts.

**TEE5212 Power Electronics Applications****10 Credits**

The module gives a review of power electronic devices: ratings, performance and applications; Switch mode DC-DC and DC-AC converters; Control techniques: square wave and PWM outputs; Implementation: hardware, software, implementation problems; Harmonics and interference: EMI reduction, regulation, regulations, filtering; Resonant-mode converters: zero-current and zero-voltage; Switch mode and interruptible power supplies; Static var; compensators, HVDC transmission; Special transformers for switched power applications; Variable speed drivers, control schemes and performance.



**Total Credits for the Undergraduate Programme**

Part I	125 credits
Part II	140 credits
Part III	130 credits
Part IV	120 credits
Part V	120 credits
<b>Total</b>	<b>635 credits</b>

## **REGULATIONS FOR THE POST-GRADUATE DIPLOMA IN ELECTRONIC ENGINEERING WITH A MAJOR IN:**

- i. Communication Systems,
- ii. Computer-Based Systems,
- iii. Control Systems and Instrumentation,
- iv. Electronic Systems

### **1.0 PREAMBLE**

- 1.1 The Senate shall be the final authority for the interpretation of regulations.
- 1.2 The Senate reserves the right to alter, amend, cancel, suspend or replace any of the regulations.
- 1.3 A student who has started a Programme of study following one set of regulations shall not be affected by regulations subsequently adopted unless agreed to in writing by the student.

### **2.0 ENTRY REQUIREMENTS**

- 2.1 A good first degree in Electronic Engineering or related field plus appropriate experience.
- 2.2 Fluency in English and at least one other language for the exchange of knowledge in the African environment. The Faculty of Arts, Education and Social Studies could have Continuing Education Programmes to assist those with a language deficiency.

### **3.0 DURATION OF PROGRAMME**

The programme consisting of course work shall last one academic year or two semesters on a full-time basis and up to two academic years or four semesters on a part-time basis.

### **4.0 STRUCTURE OF PROGRAMME**

- 4.1 The programme shall consist of eight (8) to ten (10) courses distributed over two semesters and with a concentration in either (a) Electronic Systems, (b) Communication Systems (c) Computer-based Systems, or (d) Control Systems and Instrumentation.
- 4.2 Normally five (5) courses in each research area shall be on offer per semester starting in the first semester of the post-graduate academic year.

## **5.0 EXAMINATIONS**

5.1 Formal Examinations will take place at the end of each semester.

5.2 Examinations will be subject to external assessment.

5.3 The student shall be required to take formal examinations in the taught courses, to submit a written dissertation and to attend an oral examination.

## **6.0 MARKING SCHEME**

Courses shall be assessed as follows: 75% from formal examination and 25% from continuous assessment.

## **7.0 AWARD OF THE DIPLOMA**

In order to be awarded the diploma, a candidate shall be required to pass eight of the courses taken in the programme including the design project, provided the student may not drop more than two courses with a failing grade.

## **8.0 DIPLOMA CLASSIFICATION**

The following classification shall be used for the diploma:

80% and above	-	DISTINCTION
70%-79%	-	MERIT
60% - 69%	-	CREDIT
50 - 59%	-	PASS
Below 50%	-	FAIL

## **9.0 SYLLABI**

Details of each course shall be maintained in accordance with the provisions of the General Academic Regulations for Higher Degrees.

## **10.0 PROGRAMME**

### **Communication Systems**

## **Semester I**

<b>Module Code</b>	<b>Module Description</b>	<b>Credits</b>
TEE6121	Fundamentals of Communication Engineering I	
TEE6122	Communication System Error Control Coding	
TEE6123	Theory of Noise Generation and Measurement	
TEE6124	Analysis, Simulation and Design in Electronic Engineering (Cross-listed with SCS 6106)	
TEE 6125	Linear and Non-linear Systems Theory	

## **Semester II**

TEE6221	Fundamentals of Communication Engineering II	
TEE6222	Signal Detection Principles	
TEE6223	Wireless Communication Systems	

## **TWO ELECTIVES**

*from among:*

TEE6225	Communication Circuit Design	
SCS6105	Digital Signal Processing	
SCS6102	Information Systems for Management and Business	
SCS6106	Computer-Aided Design and Engineering	
TEE6201	Engineering Project Management	

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*Think in other terms*

## **11.0 TRANSFERS BETWEEN DIPLOMA IN ELECTRONIC ENGINEERING AND MASTER OF ENGINEERING (ELECTRONIC ENGINEERING) DEGREE PROGRAMMES**

- 11.1 A registered student in the second semester of the diploma programme may apply, on the recommendation of the Departmental Panel of Examiners, for transfer of credit and proceed to the Master of Engineering (Electronic Engineering) Degree.
- 11.2 A registered student in the second semester of the Masters' programme who wishes instead to proceed to the Diploma in Electronic Engineering may apply, on the recommendation of the Supervisory Committee, for transfer of credit and proceed to the Diploma.

## **REGULATIONS FOR THE MASTER OF ELECTRONIC ENGINEERING DEGREE**

### **1.0 ENTRY REQUIREMENTS**

A good Honours degree (First or upper second class) in Electronic Engineering or equivalent.

### **2.0 DURATION OF PROGRAMME**

The programme shall last one-and-a half academic years or three semesters on a full-time basis. It is recommended that the first two semesters be devoted to the course work while the third semester is devoted to the preparation of a dissertation.

### **3.0 STRUCTURE OF THE PROGRAMME**

The programme shall consist of course work (Part I) lasting two semesters full-time and a Masters' thesis (Part II) lasting at least six months full-time.

### **4.0 DEGREE CLASSIFICATION**

The following degree classification shall be used for the Programme:

80% and above	-	DISTINCTION
70% - 79%	-	MERIT
60% - 69%	-	CREDIT
50% - 59%	-	PASS
Below 50%	-	FAIL





## **PROGRAMME SUMMARY**

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*Think in other terms*

# MODULE SYNOPSES

## **TEE 6122 Communication System Error Control**

The module has an introduction; Coding error detection/correction codes, both block and convolutional and survey of error-control strategies used in storage and transmission channels.

## **TEE 6123 Theory of Noise Generation and Measurement**

The module looks at noise representation by statistical parameters, noise generators in measurements and application to communication systems.

## **TEE6124 Analysis, Simulation and Design In Electronic Engineering**

The module explores the implementation of computer-aided and numerical methods of solving problems in electronic engineering.

## **TEE 6125 Linear and Non-Linear Systems Theory**

The module focuses on state-space description and analysis of both continuous and discrete-time dynamic systems and optimisation.

## **TEE6221 Fundamentals of Communication Engineering II**

The module explores statistical analysis of large-scale communication systems subject to noise and multipath fading.

## **TEE 6222 Signal Detection Principles**

The module examines optimum signal detection reception over linear average white Gaussian noise channels; fourier series representation of random signals and derivation of minimum mean square error (MMSE) receivers.

## **TEE 6223 Mobile and Personal Communication Systems**

The module gives a design and performance analysis of wireless communication systems: advanced modulation techniques, optimum receiver design, dispersive channels multipath propagation, multi-signal interference and error control.

### **TEE 6225 Communication Circuit Design**

The module focuses on design and performance testing of low-noise amplifiers, oscillators and filters.

### **TEE 6226 Digital Signal Processing**

The module looks at differential equation characterisation of digital filters, transform analysis, spectral analysis, design and implementation of filters, practicals on aliasing, digitalisation and applications.

### **SCS 6103 Computer Communication and Networks**

*See the Faculty of Applied Science, Department of Computer Science Listing.*

### **SCS 6106 Simulation and Modelling**

*See the Faculty of Applied Science, Department of Computer Science Listing.*

### **TEE 6201 Engineering Project Management**

The module looks at the entrepreneur, project planning, implementation and review, decision making factors, problem formulation and solution using optimisation theory, finite mathematics, and statistical techniques.

### **TEE 7129 Master's Thesis**

The topic selected with the approval of the supervisor and the chairman of the department.

## **REGULATIONS FOR THE MASTER OF PHILOSOPHY DEGREE**

### **1.0 PREAMBLE**

- 1.1 The Senate shall be the final authority for the interpretation of regulations.
- 1.2 The Senate reserves the right to alter, amend, cancel, suspend or replace any of the regulations.
- 1.3 A student who has started a Programme of study following one set of regulations shall not be affected by regulations subsequently adopted unless agreed to in writing by the student.

### **2.0 ENTRY REQUIREMENTS**

- 2.1 A good Honours degree (in the First or Upper Second Class) in Electronic Engineering or equivalent.
- 2.2 Fluency in English and at least one other language for the exchange of knowledge.

### **3.0 DURATION OF PROGRAMME**

- 3.1 The programme shall last one and a half (18 months) to three (3) years on a full-time basis or three (3) to five (5) years on a part-time basis.
- 3.2 During this time, the Masters' degree student shall be free to sit in on courses offered in the chosen area of concentration.

### **4.0 STRUCTURE OF THE PROGRAMME**

- 4.1 The programme shall consist of Parts I, II and III.
- 4.2 Part I is the preliminary stage during which the student studies scientific research methods, conducts literature searches and prepares a preliminary proposal. The stage may last from three (3) to six (6) months in a full-time programme.
- 4.3 Part II is the research stage during which the focus on the limited topic becomes swiftly narrow and specific. In a full-time programme, the research stage may last six (6) to twenty-four (24) months.
- 4.4 Part III is the candidacy stage which may last up to nine (9) months in a full-time programme.
- 4.5 The programme of study may begin any time the University is open.

## **5.0 ASSESSMENT**

- 5.1 The student will be expected to actively participate in weekly research seminars in which staff and students take turns presenting current topics in research. The quality of the reports and their oral presentations will be monitored by the supervisor.
- 5.2 The student will be expected to publish at least one (1) paper in a conference, symposium or an international journal as a contribution to knowledge.
- 5.3 The student will be expected to participate in at least one workshop on a significant problem.
- 5.4 In order to proceed into Part III of the programme, the student will be expected to present a draft dissertation of sufficient merit to satisfy the supervisor or Supervisory Committee.
- 5.5 A prospective degree candidate who fails to meet the conditions set out above shall be permitted to re-submit the draft dissertation only one more time.

## **6.0 MARKING SCHEME**

- 6.1 Performance in seminars, workshops and publications, rate of growth in scholarly research and any courses taken for credit as part of the approved programme shall be a pre-requisite for admission to candidacy for the degree.
- 6.2 The dissertation and its oral defence shall determine the success or failure of the candidate, and shall be assessed as follows:
- 20% for originality, independence and creativity
  - 50% for quality and analysis of design
  - 15% for general understanding of field
  - 10% for application of theory
  - 5% for clarity of the document.

## **7.0 WEIGHTING OF EXAMINATIONS AND AWARD OF THE DEGREE**

- 7.1 The Master's dissertation and its oral defence shall be the sole required criteria for success or failure of the candidate.
- 7.2 In order to be awarded the degree, a candidate shall be required to have satisfactorily conformed to the general regulations of the University on the submission of a thesis for a Master of Philosophy Degree.

## **8.0 DEGREE CLASSIFICATION**

The Master of Philosophy Degree shall not be classified.

## **9.0 FORMAT, SUBMISSION AND DISTRIBUTION OF DISSERTATION**

9.1 A candidate shall be required to submit, for examination, four typed (double-spaced) copies of his dissertation in loose-bound form within a suitable cover in the following format:

Size of Paper: International A4 (210 x 297)

Size of Drawings or Maps: No restriction is placed on the size of drawings or maps.

Margins: There must be a margin of 40 mm on the left hand side, of 10 on the right hand side, and margins of 20 mm at the top and bottom of the page.

9.2 After the dissertation has been approved by the Panel of Examiners, the candidate shall submit at least three copies bound in accordance with the following specifications:-

Art vellum or cloth; overcast; edges uncut; lettered boldly on the spine gold letters indicating DEGREE, DATE, NAME (Letters should be 5 mm and 10 mm in size)

9.3 A candidate shall be required to lodge with the Chairman of Department at least three bound copies of the approved dissertation. One bound copy will be retained by the relevant Department and two bound copies will be deposited in the University Library. Library copies shall be open reference.

## **10.0 SYLLABI**

Details of each course shall be maintained in accordance with the provisions of General Regulations for Higher Degrees.

## **11.0 PROGRAMME IN COMMUNICATION SYSTEMS**

Prospective candidates will propose, in consultation with the supervisor, a programme of study deemed necessary to facilitate the successful completion of the chosen research project. The programme will be submitted first to the Chairperson of the Department and for his approval and then filed with the faculty Higher Degrees Committee. The programme shall include the following compulsory components:-

## PROGRAMME SUMMARY

### PART I: Preliminary Stage

<b>Module Code</b>	<b>Module Description</b>
TEE 7001	Scientific Research Methods
TEE 7002	Research Seminar I
TEE 7021	Research In Communication Systems I

### PART II: Research Stage

TEE 8021	Research Seminar II
TEE 8022	Research in Communication Systems II

### PART III: Candidacy Stage

TEE 8029	Master of Philosophy's Dissertation Pursuit and refinement of topic selected in Part I Variable Credit, continuous registration.
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## **REGULATIONS FOR THE DOCTOR OF PHILOSOPHY DEGREE (UNDESIGNATED)**

### **1.0 PREAMBLE**

- 1.1 The Senate shall be the final authority for the interpretation of regulations.
- 1.2 The Senate reserves the right to alter, amend, cancel, suspend or replace any of the regulations.
- 1.3 A student who has started a Programme of study following one set of regulations shall not be affected by regulations subsequently adopted unless agreed to in writing by the student.

### **2.0. ENTRY REQUIREMENTS**

- 2.1 A Master of Science (Electronic Engineering) with a MERIT or DISTINCTION classification, or equivalent. A lower level pass in a Master's programme might be considered if supported by evidence of scholarly post-qualification activities deemed sufficient by the Departmental Board and approved by the Faculty Higher Degrees Committee
- 2.2 A good command of English.
- 2.3 At least one year of post-baccalaureate practical experience has to have been gained under the supervision of a degreed electronic engineer.

### **3.0 DURATION OF PROGRAMME**

- 3.1 The Programme shall last three (3) to five (5) years on a full time basis or five (5) to eight (8) on a part-time basis.
- 3.2 During this time the doctoral student shall be free to sit in on courses that may enhance his/her competence to conduct research in the chosen area of concentration.

### **4.0 STRUCTURE OF THE PROGRAMME**

- 4.1 The Programme shall consist of Part I, II and III.
- 4.2 Part I is the preliminary stage during which the student studies scientific research methods, conducts literature searches and prepares a preliminary proposal. The stage may last from three (3) to nine (9) months in a full-time programme.
- 4.3 Part II is the research stage during which the focus on the topic becomes increasingly narrow, detailed and specific. In a full-time programme the research stage may last from 20 to 45 months.



- 4.4 Part III is the degree candidacy stage which may last from 7 to 12 months in a full-time programme.

## **5.0 ASSESSMENT**

- 5.1 The student will be expected to actively participate in weekly research seminars in which staff and students take turns presenting current topics in research. The quality of the reports and their oral presentations will be monitored by the supervisor or an alternate designated by him/her.
- 5.2 The student will be expected in addition to present research results in symposia and conferences of international standard at least once during the period of registration for the degree.
- 5.3 The student will be expected to publish at least three (3) papers in international journals if his/her programme is intended as a contribution to the advancement of knowledge.
- 5.4 A practically oriented student will be expected to organise and manage either a week-long (5-working days) workshop on a novel approach to solving a problem (or carrying out a task), or an equivalent number of small workshops on significant problems.
- 5.5 In order to proceed into Part III of the programme, the student will be expected to present a draft dissertation of sufficient merit to satisfy the Supervisory Committee.
- 5.6 A prospective degree candidate who fails to meet the conditions set out in 5.5 above shall be permitted to re-submit the draft dissertation only one more time unless if he/she elects to transfer into the Master of philosophy programme instead.

## **6.0 MARKING SCHEME**

- 6.1 Performance in seminars, rate of growth in mature scholarly research and any courses taken for credit as part of the approved programme shall be prerequisites from admission to candidacy for the degree.
- 6.2 The dissertation and its oral defence shall determine the success or failure of the candidate and shall be assessed as follows:
- |     |  |
|-----|--|
| 30% | for originality, independence and substantial contribution |
| 25% | for quality of analysis and design                         |
| 20% | for depth of understanding of the field and its paradigms  |
| 15% | for pragmatic insight                                      |
| 10% | clarity of thesis statement and supporting argument.       |

## **7.0 WEIGHTING OF EXAMINATIONS AND AWARD OF THE DEGREE**

- 7.1 The doctoral thesis and its oral defence shall constitute the sole criteria for success or failure of the candidate.
- 7.2 In order to be awarded the degree, a candidate shall be required to have satisfactorily conformed to the general regulations of the University on the submission of a thesis for a Doctor of Philosophy Degree.

## **8.0 DEGREE CLASSIFICATION**

The Doctor of Philosophy Degree shall not be classified.

## **9.0 FORMAT, SUBMISSION AND DISTRIBUTION OF DISSERTATIONS**

- 9.1 A candidate shall be required to submit, for examination, at least five typed (double-spaced) copies of his/her dissertation in loose-bound form within a suitable cover in the following format:
- Size of Paper: International A4 (210 x 297)  
Size of Drawings or Maps: No restriction is placed on the size of drawings or maps.  
Margins: There must be a margin of 40 mm on the left hand side, of 10mm on the right hand side, and margins of 20 mm at the top and bottom of the page
- 9.2 After the dissertation has been approved by the Panel of Examiners, the candidate shall submit at least three copies bound in accordance with the following specifications:-  
Art vellum or cloth; overcast; edges uncut; lettered boldly on the spine in bold letters indicating DEGREE, DATE, NAME (Letters should be between 5 mm and 10 mm in size).
- 9.3 A candidate shall be required to lodge with the Chairperson of the Department at least three bound copies of the approved dissertation. One bound copy will be retained by the relevant Department and two bound copies will be deposited in the University Library. Unless Senate has agreed to the contrary, the Library copies shall be open to public reference and dissemination through University Microfiche International.

## **10.0 SYLLABI**

Details of each course shall be maintained in accordance with the provisions of the General Academic Regulations for Higher Degrees.

## **11.0 PROGRAMME AND COURSE SYNOPSIS**

Prospective candidates will propose, in consultation with the supervisor, a programme of study deemed necessary to facilitate the successful completion of the chosen research project. The programme will be submitted first to the Chairperson of the Department for his approval and then filed with the Faculty Higher Degrees Committee. The programme shall include the following compulsory components:

### **PROGRAMME SUMMARY**

## MODULE SYNOPSES

### **PART I**

#### **PRELIMINARY STAGE**

##### **TEE 7001 Scientific Research Methods**

The module looks at the basic concepts, the research process, scientific writing for publication and project management. 3 Credits: 1 Lecture. 6 Practical.

##### **TEE 7021 Research In Communication Systems I**

The module explores the selection and development of current interest in the field in view of the needs of Zimbabwe and the Southern Africa Development Community mainly. 3 Credits: 9 hours Research Reports to supervisor. Co-requisite: TEE 7001 Attendance at presentation and discussion of results by all researchers in the department.

1 Credit for every 15 seminars attended plus report.

### **PART II: RESEARCH STAGE**

##### **TEE 8021 Research Seminar II**

The module looks at presentation and discussion of research results by the student. Up to 3 Credits can be accumulated, 1 Credit per presentation. Pre-requisite: TEE 7002.

##### **TEE 8022 Research in Communication Systems II**

The module explores regular reports to the Supervisory Committee on progress towards the candidacy stage. Activities reported on must include participation in symposia and conferences, publications and workshops.

3 Credits for each accepted formal report. Pre-requisite: TEE 7021

##### **TEE 9021 Doctor's Dissertation**

Pursuit and refinement of topic selected in Part I. Variable Credit, continuous registration.

## DEPARTMENT OF FIBRE AND POLYMER MATERIALS ENGINEERING

### ***Lecturer and Chairperson***

*Prof. Londiwe C. Nkiwane*, MSc. Jassy Romania, MA Gothenburg Sweden, PhD Leeds, UK, PGDHE-NUST

### ***Secretary***

*S. Ndlovu*, HND Office Management, Bcom HR (LSU)

### ***Senior lecturers***

*Dr A.B. Nyoni*, MSc Leeds, PhD Leeds, A.T.I Textile Inst UK, OND, HND Textile Tech, Kaduna, Nigeria, Mzim. AIPMZ, AMS, PGDHE-NUST

*Dr P. Gonde*, BSc Comp. Science, MBA NUST Z'bwe, PGDHE-NUST, PhD NUST

### ***Lecturers***

*M. Moyo*, B.Textile Tech (Hons) NUST, MEng (Mfg Syt & Op Mgt) NUST, PGDHE-NUST, Cert in Textile Testing and Quality Control India, (on study leave)

*L. K. Ncube*, B.Textile Tech (Hons) NUST, MEng (Mfg Syt & Op Mgt) NUST, PGDHE-NUST, Cert in Textile Mill Management India,

*S. R. Ncube*, B Textile Tech (Hons) NUST, MEng Textile Engineering China, PGDHE-NUST

*L. N. Ndlovu*, B Textile Tech (Hons) NUST, MEng Textile Engineering China, PGDHE-NUST (on study leave)

*P. Dzingai*, B Textile Tech (Hons) NUST, Cert in Quality Assurance & Quality Control Speciss, MEng Textile Engineering China, PGDHE-NUST

*N. R. Ndebele*, B Textile Tech (Hons) NUST, MPhil NUST, PGDHE-NUST

*N. Z. Nkomo*, B Textile Tech (Hons) NUST, Cert in Textile Mill Management India, MEng Textile Engineering Kenya

# **BACHELOR OF ENGINEERING HONOURS DEGREE IN FIBRE AND POLYMER MATERIALS**

## **1.0. PREAMBLE**

The Williams Commission report of February 1989 recommended that within the Faculty of Industrial Technology, a department of Textile Technology should be established and the year 1999 saw the first intake of students. The Textile Technology curriculum focuses on spinning and its preparatory processes, weaving, knitting, nonwovens, garment manufacture, technical textiles, dyeing and finishing. Thus, the programme addresses the Textile and Apparel manufacturing industries. The nature of the Textile industry has been changing from the last century, as such the department's research and educational emphasis has been shifting from the production of fibres and fabrics to include the utilization of fibres, especially polymers, in engineered materials. The department has been conducting research in fibrous structural composites, geotextiles, nonwovens, paper manufacture, polymer materials, leather processes, filtration, enzyme treatments, biomedical materials, thermoplastic curing, recycling and utilisation of waste material. This shift to encompass engineered polymer materials is resulting in a need to create a programme to cater for this growth in development of new materials for various applications and also add to available knowledge of polymers and fibres expanding the boundaries of science into new and innovative directions. In light of these developments, the Department consulted its constituencies (students, alumni, current employers of our graduates, potential employers of our graduates, and graduate programs that attract our graduates) so as to draw up a programme that will be built on a solid fundamental understanding of polymers, their synthesis, structure, processing and properties, as well as the structure and properties of fibres and the materials and products manufactured from them.

The world is witnessing a materials revolution with the 20th century's greatest engineering achievements and advances in technology being developments made towards understanding and improving the structure, properties and performance of polymeric materials, as well as their environmental relationships. This increased use of fibres and polymers in all aspects of life, and the influx of materials industries that use fibres and polymers present a unique prospect to utilize such opportunity and invest in the education and research necessary to keep these industries growing.

We live in a world that is both dependent upon and limited by materials. Materials processing industries in the world need expertise in field of material science to Mann and monitor their various production facilities. In Zimbabwe there are a number of companies which deal with leather, plastics, rubber, fibre, yarn and fabric manufacture. However, these companies have expressed the need for experts in their respective fields. Therefore it is the aim of this programme to address these needs by providing graduates trained in the areas identified.

Students from the Fibre and Polymer Materials Engineering programme will graduate with relevant expertise that they can offer not only in Zimbabwe but to the global community.

This rapidly evolving area of science and technology requires professionals who can work at the interface between different disciplines to meet future global challenges. The Fibre and Polymer Materials Engineering programme has a thrust to contribute to the world in line with the Sustainable Development Goals (SDGs). With reference to Goal 12 of the SDGs, the programme seeks to provide training to develop skills to substantially reduce waste generation through prevention, reduction, recycling and reuse so as to achieve sustainable management practises and efficient use of resources especially natural ones. Fibres and polymers abound in everyday life in applications ranging from medical to aerospace as well as in areas as diverse as textiles, composite materials and Hi-tech materials. Some of the research will focus in plastics and resins derived from plants and these bio-based polymers and fibres will become increasingly important in a sustainable future. The review is intended to ensure that the curriculum of the department continues to meet the educational needs of the students, the objectives of the University, the objectives of industries and be applicable in doing community based projects. It is also intended to make sure that the programme remains relevant to technological advances in the industry.

## PROGRAMME SUMMARY

### **PART I**

#### **Semester I**

<b>Module Code</b>	<b>Module Description</b>	<b>Credits</b>
SCH 1102	Organic Chemistry	10
SMA 1116	Engineering Mathematics 1A	10
SPH 1104	Modern Physics	10
TFE 1103	Materials Science	10
TIE 1101	Engineering Drawing I	10
TIE 1102	Engineering Communication Skills	10
SCS 1101	Introduction to Computer Science and Programming	10
CTL 101	Conflict Transformation and Leadership	10

#### **Semester II**

TFE 1203	Fibre Science	10
TFE 1205	Electrical and Electronic	5
TFE 1206	Engineering Mechanics I: Statics (FP)	5
TFE 1207	Fluid Mechanics	10
TCE 1204	Engineering Thermodynamics	10
TIE 1201	Engineering Drawing II	10
SMA 1216	Engineering Mathematics 1B	10
CTL 1201	Conflict Transformation and Leadership II	10



## **PART II**

### **Semester I**

TFE 2101	Polymer Engineering I	10
TFE 2102	Yarn Technology I	10
TFE 2103	Workshop Technology	10
TFE 2108	Engineering Mathematics II (FP)	5
TFE 2105	Software Engineering Concepts	5
TFE 2106	Engineering Mechanics II: Dynamics (FP)	5
TFE 2104	Leather Chemistry	10
TFE 2107	Introduction to Non-woven Materials	10

### **Semester II**

TFE 2201	Polymer Engineering II	10
TFE 2202	Yarn Technology II	10
TFE 2203	Technology of Fabric Manufacture I	10
TFE 2205	Paper and Pulp Technology I	10
TFE 2204	Leather Process Technology	10
CBU 4203	Business Management and Ethics	5
SORS 2211	Applied Statistics for Polymer Engineers	10
TFE 2207	Instrumentation and Control	5

## **PART III**

### **Semester I**

TFE 3100	Research Methods	5
TFE 3101	Plastic Technology I	10

TFE 3102	Rubber Technology I	10
TFE 3103	Technology of Fabric Manufacture II	10
TFE 3105	Paper and Pulp Technology II	10
TFE 3104	Colouration of Materials	10
TFE 3106	Polymer Materials Analysis I	10
TFE 3100	Research Methods	5

### **Semester II**

TFE 3200	Project Design	10
TFE 3201	Plastic Technology II	10
TFE 3202	Rubber Technology II	10
TFE 3203	Factory Planning and Management	10
TFE 3204	Economic Environment	5
TFE 3205	Finishing of Materials	10
TFE 3206	Polymer Materials Analysis II	10

### **PART IV**

#### **Semester I & II**

TFE 4000	Industrial Attachment	120
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### **PART V**

#### **TFE 5000 Research /Design Project (50 credits)**

#### **Semester I**

TFE 5101	Composite Materials I	10
TFE 5102	Mineral Fibrous Materials	10
TFE 5103	CAD/ CAM	10

CAC 2106	Management Accounting	5
TFE 5105	Production and Operations Management Systems	10

### Semester II

TFE 5201	Composite Materials II	10
TFE 5202	Environmental Management	10
TFE 5203	Nano fibre Technology	10
CBU 1209	Principles of Marketing	5
TFE XXXX	<i>Elective Course</i>	10

### TOTAL CREDITS FOR THE PROGRAMME

Part I      135

Part II     135

Part III    130

Part IV    120

Part V     140

**Total minimum credits:    660**

## MODULE SYNOPSES

### PART 1

#### Semester 1

##### **SCH 1102 Organic Chemistry**

**10 Credits**

The module introduces students to the structure and bonding in organic molecules, stereochemistry, organic reaction mechanisms, the chemistry of aliphatic hydrocarbons and the basics of organic spectroscopic analysis.

##### **SMA 1116 Engineering Mathematics 1A**

**10 Credits**

The module focuses on calculus in one Variable: Limits and continuity of functions; Differentiation; Leibniz's Rule; L'Hopital's Rule; Elementary functions including hyperbolic functions and their inverses; Integration – techniques including reduction formulae; Applications – arc-length, area, volumes, moments of inertia, centroids; Plane polar coordinates; Complex Numbers: Basic algebra; De Moivre's Theorem; Complex exponentials; Linear Algebra: Vector algebra in 2 and 3 dimensions; Scalar and vector products and equations of lines and planes.

##### **SPH 1104 Modern Physics**

**10 Credits**

The module looks at the particle nature of radiation - The photon: Planck's postulate and thermal radiation, Blackbody radiation, the photoelectric effect, the Compton effect, X-ray production and pair production; Interaction of radiation with matter-photon emission and absorption; Stationary states, discrete energy spectrum and the continuous energy spectrum; The Frank-Hertz experiment; Spontaneous and stimulated emission; The Wave nature of particles - The matter wave: De Broglie's Postulate; The electron diffraction experiment; The wave-particle duality; The uncertainty principle; The properties of matter waves; The Thomson and Rutherford model; The stability of the atom and Bohr's Postulates and his model of the atom; Atomic spectra; The Hydrogen Atom; Correction for finite nuclear mass; The Nuclear Models: Nuclear properties, sizes and densities, masses and densities; The Nuclear Models - Liquid drop; The deuteron; Shell Fermi gas models; Binding energy nuclear forces; Magic numbers and the nuclear decay and nuclear reactions,  $\alpha$ -capture,  $\beta$  and emission; Fission and fusion and other nuclear reactions; The origin of elements; Introduction to Elementary Particles: Isospin, Pions, Leptons and Families of elementary particles.

##### **TFE 1103 Materials Science**

**10 Credits**

The module has an introduction to polymers, metals, ceramics and composites; Structure and bonding in materials; Phase diagrams and transitions; Defects and imperfections in materials; Diffusion and transport; Polymers: monomers, homopolymers, copolymers, chemical bonding and properties affected by primary and secondary bonds, degree of polymerisation, glass and melting transitions, stereochemistry, addition and condensation polymerisation, molecular weight distribution, techniques

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*Think in other terms*

for polymerisation, structure and properties of thermoplastics, thermosetting and 2 elastomeric polymers; Solubility and swelling of polymers; Additives for polymer products and their effects; Metals and alloys; Structure, properties, processing and applications of traditional and advanced ceramics; Properties and applications of various composites; Optical, electronic and thermal properties of materials; Overview of materials processing: melt processing, powder processing, chemical vapour deposition and composite processing.

### **TIE 1101 Engineering Drawing I**

**10 Credits**

The module gives an introduction to Plane geometry; Space geometry; First and third angle projection; Dimensioning; Pictorial views; Freehand sketching; Drawing of common objects; Sectioning; Intersections; Developments; Conventions; Assembly drawings and exercises.

### **TIE 1102 Engineering Communication Skills**

**10 Credits**

The module examines study methods; Communication principles; Technical definitions, Descriptions and instructions; Tables and graphs; Letters; Memoranda and Curricula Vitae; Written reports; Word processing and computer jargon; Interview technique; Running a meeting; Reading, understanding and summarising technical articles.

### **SCS 1101 Introduction to Computer Science and Programming**

**10 Credits**

The module explores information Society, History of Computers: Data and Information, Number systems and arithmetic, Data representation, Basic Computer Components: - CPU, I/O units, Storage; Brief Concepts of Computer Languages and Programming Techniques: high/low level languages, compiler, interpreter, grammar, recursion, simple data structures (arrays, lists, trees, hash tables, queues & stacks), problem solving; Algorithms: Sorting, compression, numerical and encryption; Operating systems and its functions:- process and memory management, I/O, Data Communication, Job Control; processing:- File structures, organisation and access, Databases; Fundamentals of Networks; A simple program, initialization, printing, components, keywords, constants, assignment and expressions.

### **PLC 1101 Peace, Leadership and Conflict Transformation I**

**10 Credits**

The Peace, Leadership and Conflict Transformation course is tailored in a manner to provide students with intellectual skills on the symbiotic relationship that exist on the three tier terms (peace, leadership and conflict). The course attempts to probe into the interplay between these thematic motifs and show their role and complementarities in the process of human development.

The course further seeks to provide a skills tool kit on how to analyse conflicts, identify their underlying causes, evaluate how conflict undermines the productive use of resources thereby plaguing development and how responsible leadership transforms adversity into peaceful, equitable and just global society in harmony with nature. It is envisaged that the students who would successfully completed the course will be well grounded in the theory and practice to face the challenges of leadership and conflict at personal, community, national and global levels. The students would be able to trace the emerging patterns and conflict trends in Africa shall form the basis of reflection.

## Semester II

### **TFE 1203 Fibre Science**

**10 Credits**

The module explores the basic concepts in fibre science; Essential requirements and examples of fibre forming polymers; Characteristic features of fibres; Classification of fibres – natural and manmade; Origins, production and structure of fibres; Fibre properties and identification; Relationship between polymer structure, fiber properties and utilization.

### **TFE 1205 Electrical and Electronic Engineering Principles**

**5 Credits**

The module gives definitions for electrical quantities and units; Scientific and engineering notations; DC circuits; Voltage and current sources; Resistors in series, parallel and series-parallel; Kirchhoff's voltage and current law; DC circuits analysis, Superposition and Thevenin's theorem; Power in a dc circuit; Capacitors and inductors in dc circuits; AC circuits; AC signals, quantities, parameters and units; Basic ac circuits analysis; Transformers; Introduction to dc and ac machines; Diode types, rectifiers and power supplies; Bipolar and Field-Effect Transistors; Basic transistor circuits dc analysis; Thermistors and opto-electronic devices; Introduction to amplifiers, oscillators and multivibrators; Introduction to linear integrated circuits and operational amplifiers.

### **TFE 1206 Engineering Mechanics I: Statics (FP)**

**5 Credits**

The module objective is to understand the effect of forces on bodies which are at rest, the geometric characteristics of sections, the principle of virtual work, as well as the basics in the mechanics of solids; Principles of statics: Introduction systems of forces; The basic principles of Mechanics; Revision of knowledge of scalar and vector quantities; Fundamental concepts: - Space, time, force, material and mass; Introduction to Newton's laws of motion; first, second and third; Units of measurement; Description of physical problems in relation to mathematics; Precision, Approximations and mathematical limits; Method of solving problems; Definitions of Statics and Dynamics (Kinetics and Kinematics); Concept of equilibrium; Solution of pin jointed frames; Geometrical characteristics of sections; Friction; The principle of Virtual work; Solid mechanics: - Direct stress and strain, Pure bending theory, introduction to combined bending and direct stress and pure torsion theory.

### **TFE 1207 Fluid Mechanics**

**10 Credits**

The module gives an introduction to fluid Properties, Fluids vs; Solids, Viscosity, Newtonian Fluids, Properties of Fluids; Statics; Hydrostatic pressure, Manometry / pressure measurement; Dynamics; The continuity equation, The Bernoulli Equation, Applications of the Bernoulli equation, the momentum equation, Application of the momentum equation; Real Fluids; Boundary layer, Laminar flow in pipes, Transportation of fluids and flow measurement; Process mixing; Flow patterns, power number, blending, mixing times, solids suspension and distribution, gas dispersion and a scale up of mixing vessels.

**TCE 1204 Engineering Thermodynamics****10 Credits**

This module is an introduction to thermodynamics - scope of thermodynamics; First Law, conservation of energy; volumetric properties of pure fluids; Second Law and heat effects.

**TIE 1201 Engineering Drawing II****10 Credits**

The module gives a definition Applications of AutoCAD; Introduction to Menu options on the Opening screen; Settings, Limits and Control of AutoCAD programme; Use of basic operating commands SNAP, GRID, ORTHO, ENTER, ESCAPE, UNDO, SAVE, SAVE AS; Coordinates and coordinate systems: Cartesian, Relative, Polar; AutoCAD function key commands; Toolbars: DRAW; MODIFY, SOLIDS, SUFACES; Control Boxes in AutoCAD: Colors CB, Linetype CB, Lineweight CB, Dimensions CB, Layers CB; Practical lab exercises and assignments in 2D and 3D such as drawing and dimensioning of various Machine Parts, Architectural Plans, Electronic Circuit Diagrams, Process Flow Charts and Block Diagrams.

**SMA 1216 Engineering Mathematics IB****10 Credits**

The module examines functions of Several Variables: Partial derivatives, chain rules; Applications - maxima and minima problems, Lagrange multipliers; Linear Algebra: Matrices - basic operations, rank, inverses; Systems of linear equations - Gauss elimination; Determinants and their properties; Eigen values and Eigen vectors; Linear independence; Ordinary Differential Equations; First order differential equations - separable, linear; Integrating factors; Linear second order equations with constant coefficients; Variation of Parameters; Systems of equations; Applications of differential equations to mechanics, physics and engineering.

## **PART II**

### **Semester I**

#### **TFE 2101 Polymer Engineering I**

**10 Credits**

The module focuses on physical structure of polymers: semi-crystalline, amorphous, and rubbery states; Chain branching, networking in polymers, Iso-free volume theory: deformation of polymers -glassy and viscoelastic; molecular statistics of rubbery states; Tensile, shear, compression and impact properties, Effect of temperature and strain rates in polymers; Rheology: relationship between molecular weight, temperature and shear rates, Effect of additives, Structure-property correlation in glassy, semicrystalline and oriented polymers, Polymer manufacturing: Compression molding, transfer molding, injection molding, blow molding, reaction injection molding, extrusion, pultrusion, calendaring, rotational molding, thermoforming; Commodity and specialty plastics, Nanopolymers and conducting polymers.

#### **TFE 2102 Yarn Technology I**

**10 Credits**

The module explores cotton fibre characteristics, Ginning practices for cotton; Impurities in cotton bale; Purpose of opening, cleaning, and mixing of fibres in blow room; Principles of opening and cleaning in blow room; Sequence of cleaning machines in blow room; Waste disposal; Transportation of fibre mass; Influence of process parameters on opening and cleaning; Principles and methods of fibre mixing and blending; Control of fibre flow; Assessment of blow room performance; Principles of carding; Outline of carding machine; Card feed system: design feature, licker-in clothing, cleaning and analysis; Card cylinder: design feature, clothing, carding, pre and post carding zones; Doffer : web collection, clothing and delivery; Sliver packaging; Assessment of card performance; Carding parameters and its influence; Objectives and principles of drafting; Roller drafting: roller arrangement; Web delivery and condensation; Causes of sliver mass variation; Role of draft and its distribution; Auto-leveller in card and draw frame; Woollen and worsted systems, Preparation (sorting, scouring, drying, carbonizing), Opening & Cleaning, Carding, Gilling; Aim and Objectives of combing; Preparation of fibre assembly for Combing; Fibre fractionation and combing; Sequence of operations in a rectilinear comber; Comber machine elements and modern developments; Theory of fibre fractionation and quality aspects in combing.

#### **TFE 2103 Workshop Technology**

**10 Credits**

The module gives a definition of safety; Objectives of safety; Safety precautions in the workshop; Fire prevention and protocols; Medical equipment; Accidents in the factory; Safety methods: safety by construction, workshop layout, protective clothing etc; Fire prevention in textiles factories; Noise; Dust; Machine Protection; Implementation of safety measures; Description and functions of various tools; Safety measures using various tools; Purpose and language of measurement; Reliability and precision; Measuring instruments; Marking using dividers, punchers, engineers squares, scribes; Tolerances: definition and practises Allowances: definition and practises; Marking, hand sawing and filing; drilling, drilling practices, drilling machines; centre lathe - turning & screw cutting, tapping; Quality control and standards; Maintenance of production facilities; Maintenance Personnel- workshop management; Aims



of a maintenance programme; Maintenance organisation; Maintenance personnel-duties; Computers in maintenance; Basic concepts; Systems and procedures; Lubrication; Definitions in Air engineering; Air conditioning; Machine cleaning; Fibre collection and filtration.

**TFE 2108 Engineering Mathematics II (FP)**

**5 Credits**

The module looks at multiple Integrals; Iterated integrals, change of order; Change of variable; Polar, cylindrical and spherical coordinates; Applications in three dimensions; Vector Calculus; Scalar and vector fields; Directional derivatives; Gradient, divergence and curl; Line and surface integrals; Laplace Transforms; Definitions; Basic ideas and applications to ordinary differential equations.

**TFE 2105 Software Engineering Concepts**

**5 Credits**

The module gives an introduction to Software Engineering Processes and how to model these processes using a derivative of the Structured Analysis and Design Technique (SADT) Methodology; Software Development Life Cycle Processes, Computer Programming (C++), Processes for Planning and Controlling Software Development, Quality Management Processes, Data Communications and Computer Networks and Distributed Computing.

**TFE 2106 Engineering Mechanics II: Dynamics (FP)**

**5 Credits**

The module's objective is to understand the kinematics behavior of rigid bodies and kinetic behavior of bodies under the action of a system of forces; Definition of kinematics; Types of motion (rectilinear motion, angular motion, circular motion of a particle, movement of rigid bodies); Distance, relative linear displacement, speed, relative and linear velocity; Instantaneous center of rotation; Linear acceleration; Equations of motion; Change of direction- mean acceleration, relative velocity; Kinetics: - Work power and energy, work done by constant force, work done by varying force; Energy, conservation of energy, mechanical energy and power; Finding power when velocity is known; efficiency; Circular motion, angular displacement, angular velocity, relationship between angular and tangential velocity; Angular and centripetal acceleration; Centripetal force, complex shapes (sections); Torque and angular acceleration; Newton's second law; Moment of inertia; Calculation of moment of inertia; Parallel axis theorem, rotational work, power and energy; Hoists; Impulse and momentum; Conservation of linear momentum, collision, inelastic and collision and angular momentum.

**TFE 2104 Leather Chemistry**

**10 Credits**

The module explores matrix structure of skin and molecular structure of collagen; Chemical principles involved in pretanning operations; Salt less curing methods - Swelling mechanisms; porosity of hides and skins; Unhairing mechanisms; Chemistry of tanning materials: Classification, isolation, characterization and structural elucidation of vegetable tannins; biogenesis and biosynthesis of hydrolysable and condensed tannins; Mechanism of tanning: Transport of tanning materials into pelt, diffusion equilibria and mechanism of vegetable, mineral and combination tannages, role of crosslinking and fibre coating in matrix stability; Post tanning and finishing: Physicochemical interactions of syntans, fatliquors and dyes with collagen and leather.

**TFE 2107 Introduction to Non-Woven Materials****10 Credits**

The module examines raw materials: Fibrous matter, fibre description considerations, properties of nonwoven materials produced using, different fibrous matter, bonding agents used in nonwovens, properties desired in a bonding agent, working of binders, classification of binders, types of binders, classification of nonwovens, production steps for different methods; General production steps for manufacturing nonwoven: dry bonded production steps, spun bonded production steps, wet bonded production steps, Types of webs and their formation techniques: staple fibre webs, wet laid webs, dry laid webs, fibre preparation, opening, cleaning, blending and mixing, carding, web laying, parallel-laid webs, crosslaid webs, randomly-laid webs, continuous filament webs, spunlaid webs, melt blown webs; Nonwoven materials bonding techniques: mechanical bonding, needle punching technology, stitched bonding technology, hydro-entanglement, adhesive bonding or chemical bonding, saturation adhesive bonding, spray adhesive bonding, foam bonding, application of powders, print bonding, discontinuous bonding, thermal bonding, hot calendaring, area bonding, point bonding, embossing, belt calendaring, through, air bonding, ultrasonic bonding, radiant heat bonding, bonding of spunlaid webs and finishing of nonwoven materials: classification of finish applied to nonwoven materials (shrinkage, wrenching and creping perforating and slitting, singeing, washing, dyeing, printing).

**Semester II****TFE 2201 Polymer Engineering II****10 Credits**

The module examines yield, deformation and fracture mechanism, Factors contributing to strength and toughness of polymeric materials, Strategies to reduce stress and increase toughness of polymers, Fatigue: relationship to processing behaviour, Time temperature superposition, Creep recovery and stress relaxation, Crazeing, Degradation and stabilization of polymers: Effect of different factors including the environment, Degradation prevention of polymeric materials, Thermal properties of polymers Fire-resistant plastics, loss on ignition, Polymer composites: effect of fibre and 8 particulate reinforcement, Methodologies for assessment of polymer properties and performance, Nanocomposites: Design of thermal, electrical, mechanical properties; Biomedical polymers; surface modification/design of polymers, Novel applications and advances in polymers (clean energy, electronics, sensors, smart applications).

**TFE 2202 Yarn Technology II****10 Credits**

The module covers objectives of roving operation; Machine elements of speed frames; Flyer twisting; types and design aspects of flyers; Drafting systems in speed frames; Package building in speed frames; New development and automation in speed frames; Quality aspects in speed frame; Processing of synthetic fibres and their blends; Melt spinning, dry spinning, and wet spinning; Yarn Texturing: Basic principles of various methods and description of essential features of machines; Aim and Objectives of ring spinning; Machine elements of ring frames; Principles of ring twisting; design aspects of spindles,

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*Think in other terms*

rings and travelers; Drafting and package building; New developments and automation in ring frames; Quality aspects in ring spinning; Processing of synthetic fibres and their blends; Principles of yarn winding; Principle of doubling and twisting of yarns; Methods of doubling: Ring, Two-For-One and Three-For-One twisting; Quality aspects in doubling and twisting; Introduction to new spinning systems; Principle of open end spinning; Rotor, air-jet, friction, vortex and electrostatic spinning systems; Comparison of yarn structures; Introduction to other factors in yarn production: effect of environmental conditions, temperature and humidity, regain, lubricant, dust levels, waste control systems, material recovery and maintenance of production facilities.

**TFE 2203 Technology of Fabric Manufacture I**

**10 Credits**

The module is a study of the principles and machine processes needed to construct a range of knitted fabrics, including introduction to knitting, general terms and definition, basic knitted structures, machine knitting needles, warp and weft knitting machines; A study of the classification of knitting machinery by mechanism and end-use; An examination of the pattern potential and mechanism used for pattern control on warp and weft knitting machines; An analysis of the dynamics of knitting systems; A study of the elements of a knitted loop structure; Seamless and 3D knitting; A study of the economics of competing fabric production systems and Knitting calculations.

**TFE 2205 Paper and Pulp Technology I**

**10 Credits**

The module explores wood and fibre raw materials; Preparation of wood and chips for pulping; Pulping: primary categories of pulping, including chemicals, and cooking conditions; Pulping terminology; Kraft pulping; Chemical Pulping: Alkaline pulping; Batch and continuous pulping process, Characteristics of alkaline pulps; Sulphite pulping, Process variables, Characteristics of sulphite pulping: Mechanical Pulping: Mechanical pulping processes; Refiner Mechanical and Chemical refiner Mechanical pulping; Thermo-mechanical and Chemi-Thermomechanical pulping Process; Semi Chemical and Chemi Mechanical Pulping: Types of process; Waste Paper Pulping: Fibre 9 separation of waste paper, Production of unbleached pulps, Deinking of waste paper and various deinking systems.

**TFE 2204 Leather Process Technology**

**10 Credits**

This module looks at speciality leathers: Different types of raw materials used, properties required, physical and chemical standards required and process details to achieve the specifications of different types of leathers; Processing of exotic leathers; Such as reptiles, crocodiles, lizards, fish, ostrich; Cleaner processing – beamhouse: Eco-friendly process technologies: sulphide free unhairing systems; Ammonia - free delimiting, salt free pickling systems, solvent free degreasing systems; Paradigm shift from chemical processing of hides and skins to bio beam house processing; Cleaner processing: tanning, post tanning and finishing; Advanced finishing techniques: Finishing equipment, techniques for newer and novel finishing system.

**CBU 4203 Business Management and Ethics****5 Credits**

The module offers an introduction to Business Management and Ethics, Evolution of Management Theory, Managing in a Changing Environment, Planning, Organising and Delegating, Leadership, Controlling, Human Resource Management, and Management Information Systems; Safety, Background of Ethics (Charter of Rights and Freedoms), Contracts, Torts (Negligent Malpractice), Forms of Carrying on Business, Intellectual Property (patents, trademarks, copyrights and industrial designs), Professional Practice (Professional Engineers Act, Professional Misconduct and Sexual Harassment), Alternative Dispute Resolution, Labour Relations and Employment Law.

**SORS 2211 Applied Statistics for Polymer Engineers****10 Credits**

The module has an introduction to Applied Statistics; Statistics - its definition and scope; Descriptive Statistics/Initial Data Exploration: Summary statistics, measurements of central tendency, mean, mode, median, measures of dispersion, range, variance, standard deviation; Graphical presentation of data, stem and leaf plots, histograms, box plots; Point Estimation/ Tests of Hypothesis, interval estimation, z-test, t-test; Design and Analysis of Experiments, completely randomized design, randomized complete block design, Latin squares, factorial experiment; Regression Analysis, simple linear regression and statistical Computing.

**TIE 2207 Instrumentation and Control****5 Credits**

The module looks at instrumentation; Final control elements, Measuring devices for flow, temperature, pressure and level; Introduction to Process Control; Mathematical Modelling; Development of mathematical Models, Modelling considerations for control purposes; Dynamic Behaviour of Chemical Processes; Computer simulation and the linearization of nonlinear systems, Brief of Laplace transforms, Transfer functions and the input output models; Dynamics and analysis of first, second and higher order systems; Feedback Control Schemes; Concept of feedback control, Dynamics and analysis of feedback-controlled processes, Stability analysis, Controller design, Frequency response analysis and its applications; Advanced Control Schemes; Feedback control 10 of systems with dead time or inverse response, Control systems with multiple loops and feedforward and ratio control.

**PART III****Semester I****TFE 3100 Research Methods****5 Credits**

This is a theory module on introductory topics in design of products using fibrous materials, Review of literature Engineering and design principles, Introduction to methodologies are: Case Study, Grounded Theory, Ethnography, Action Research, Phenomenography, Discourse Analysis and Narrative Analysis.

**TFE 3101 Plastic Technology I****10 Credits**

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*Think in other terms*

The module looks at Definitions, Brief History of Plastics; Petrochemicals and Monomers; Basic Polymerization; The Plastics Industry, Materials, properties and applications: Thermoplastics, Thermoset materials; Plastic additives: Additives and Compounding Ingredients General description of extrusion processes, type of extruders, screw and their output in terms of drag, leakage and pressure flow, influence of screw dimensions and output, die and screw characteristics; Design of barrel and screw for commodity, heat sensitive and engineering polymers; Barrier Screws; Individual extrusion systems, Dies, Sizing and Downstream equipments, Faults, Causes and Remedies for film, pipe, lamination, profiles, cables, sheet, Box Strapping; Twin-screw extrusion and Co Extrusion systems; Casting of films; Multilayer systems for Films and Pipe General description of Compression and Transfer moulding and its application in processing of thermosetting materials.

### **TFE 3102 Rubber Technology I**

**10 Credits**

The module focuses on definition, introduction to rubber products; Basic properties of latex, Latex stabilization; Production of latex concentrate: Introduction and significance of latex concentration, Types of latex concentrate, Properties and testing of latex concentrate, Significant of latex handling and storage; Latex processing: Methods of preparation of latex compounding ingredients, Preparation of latex formulation, Industrial latex processing; Vulcanization Technology: Introduction and significant of vulcanization, Types of vulcanization, Properties and physical testing of vulcanizates, Evaluation of rate and state of cure using vulcanization testing.

### **TFE 3103 Technology of Fabric Manufacture II**

**10 Credits**

This module gives a study of the technology of weaving preparation-winding, warping, sizing, drawing in and tying in; A study of weaving machine design parameters; The types of sheds and Shedding mechanisms: their operation, range of application and programming: cam, dobby and jacquard; Shuttleless weaving machines, their operation and programming; Techno-Economics of shuttleless weaving; Beating up mechanisms- cam and crank arm systems; Take up and let off systems- negative, positive and continuous mechanisms; 'Colour' patterning methods-warp and weft patterning; Multiphase weaving machines and their range of application; Production of 11 woven pile fabrics-terry weaving machine design and operation; Warp and weft stop motions; Methods of driving weaving machines and their control; 3D weaving; Weaving process control and weaving calculations.

### **TFE 3105 Paper and Pulp Technology II**

**10 Credits**

The module highlights pulp processing: different operations in fiber; Line pulp processing: Fiberizing, Washing, Screening, and Cleaning; Major equipment types and key operating variables; Bleaching: bleaching equipment, chemicals bleaching reactions; Recycling: categories of recycled paper and board; Types of contaminants associated with recycled paper; Different operations and equipment involved with contaminant removal; Chemical recovery: Evaporation, Combustion, and Reausticizing; Introduction to paper grades and properties; Paper mill stock preparation: Refining Process, Additives used in paper; Paper machine wet end operations, types of Headboxes used in papermaking; Pressing,

Drying, Calendering and winding; Surface treatments, coating, drying of coating, equipment and mechanism; Effluent treatment: primary and secondary effluent treatment.

**TFE 3104 Colouration of Materials**

**10 Credits**

The module gives an introduction to dyes and colouration of materials; CIE colour system; Colour matching by composition methods; Instrumental match prediction; An introduction to the synthesis and chemical properties of azoic, direct, vat, reactive, sulphur, disperse, cationic, anionic, acid and mordant dyes; The relationship between dye structure and colour; Interactions of dyes and fibrous/polymeric materials; Analysis of dye formulae; Machinery and apparatus involved in dye-stuff manufacturing; The chemistry of dye application; Pre-treatment processes before dyeing such as desizing, singeing, scouring, bleaching, mercerization; Combined preparatory processes for materials; Degradation of materials during pre-treatment processes; Mechanisms of colouration; Colouration of fibrous materials, paper, plastics, leather and rubber; Pre-treatment and dyeing machinery such as batch processing and continuous processing equipment.

**TFE 3106 Polymer Materials Analysis I**

**10 Credits**

The module explores mechanical (physical) testing and analysis of fibres, polymer and fibre materials properties: High Volume Instrument, Advanced Fibre Information System, Tensile strength testers, spectrogram analysis, permeability tests, compression properties; Double cantilever beam tests, shear tests; Inter-laminar fracture toughness; Testing and analysis of composite, paper and pulp, rubber and plastic materials.

**Semester II**

**TFE 3200 Project Design**

**10 Credits**

The module examines sketching, Project-based learning, Interdisciplinary project design, Design and develop products for solutions to real-life problems; Design projects with minimal maintenance requirements and benefits in sustainability and social impact, Fabrication: Suggest and use convenient product prefabricate, Safety, and cost over product design life and Reporting(methodology results, Solid modelling).

**TFE 3201 Plastic Technology II**

**10 Credits**

The module looks at basic concepts of injection moulding for thermoplastics; Machine layout, construction and specification, type of injection units; Principle and theory of standard operation, elements of moulding cycle, screw plasticizing and conveying output, screw driver principles, outline of mould features, clamping devices-hydraulic and toggle types; Process variables and their importance, temperature, pressure, injection rate, etc; Faults and remedies in injection moulding; Injection moulding of thermosets; Reaction injection moulding; Description of various thermoforming processes-simple vacuum, drape, bubble and plug assisted formings; Thermoforming and process variables affecting the product quality; Machining of Plastics; General description of blow moulding processes, type of blow



moulding machines, parison control, types of Dies, process variables, problems and their remedies; Stretch blow moulding; Rotational moulding- description and features of rotational moulding and its comparison with blow moulding; Welding / Joining of Plastics – Definition, Principle of Working ; FRP Processes – Hand lay, Spray, Autoclave, Filament winding, Pultrusion and matched mould – principle.

### **TFE 3202 Rubber Technology II**

**10 Credits**

This module explores rubber processing: Definition and structure of natural rubber, Physical properties of natural rubber, Types of rubber sheets and modified forms of natural rubber; Rubber Compounding: Ingredients of rubber compounding Effect of temperature on cell growth, Method of rubber compounding; Rubber Processing Technology: Equipment using in rubber processing, Types of rubber processing, Stages in Processing; Machinery: Bale Cutters; Mills; Internal / Intensive Mixers; Stock Blenders; Automation; Shaping Processes: Extrusion and Calendering, Curing Processes and Equipment, Compression Moulding and Presses, Transfer and Injection Moulding, Other Curing Systems including Microwaves and Autoclaves; Tyres and Tubes: Tyre Parts and Anatomy - Tyre Markings, Tyre Types, Tyre Building, Curing, Curing Presses and Moulds and inner tubes.

### **TFE 3203 Factory Planning and Management**

**10 Credits**

This module examines location and Design of Plant; A study of Systematic Planning of Production Facilities Layout, Production Plant, Transport and Logistics Facilities, and Configuration of the Organisation; An Analysis of Factory Buildings; Making Decisions to Invest in New Machinery or Second Hand Machinery; Types of Energy used in a Factory, Energy Management and Conservation; Functions of Management, Role of Managers in a Factory and the Systems Approach to Management; Control of Services from Public Utilities; Shift Systems Employed in Factories and their Management; Time and Stress Management; Establishment of Production Norms and Improving Productivity and Managing Factory Costs.

### **TFE 3204 Economic Environment**

**5 Credits**

This module covers basic Principles of Economics, Macroeconomic Theory and Analysis, The Economic Problem, Choice and Opportunity Cost and The Production Possibilities, Different Economic Systems, Demand and Supply, Competitive Markets, Imperfect Competition and Firm Behaviour, Economic Growth and The Business Cycle, Unemployment and Inflation, The Financial Institutions and The Role of The Banking Sector, Fiscal and Monetary Policy.

### **TFE 3205 Finishing Of Materials**

**10 Credits**

This module has an introduction to the finishing of materials; Functional finishes for materials: antimicrobial treatments, heat-setting, cross-linking agents, antistatic agents, surface active agents, water repellence, flame retardants, enzyme treatment and surface modifying finishes; Aesthetic finishes for materials: calendaring, raising, softening and hand-building; Mechanical finishing and chemical finishing equipment; Special finishes for materials: post tanning and finishing of leather, finishing of paper, plastics and rubber; Nature, important features and functions of mechanical and chemical

finishing equipment; their advantages and limitations will be explored; An introduction to print design including methods of repeating designs and preparing a design for hand screen printing; Styles of printing; Pre-treatment of materials for printing; Printing thickeners including synthetic thickeners; Printing auxiliaries; Printing of blended materials; Printing machinery; Printing of fabrics, paper, plastics, leather and rubber and methods of dye fixation after printing.

### **TFE 3206 Polymer Materials Analysis II**

**10 Credits**

The module explores an introduction to methods of characterization, identification and analysis of fibrous and polymer materials; Optical microscopy, dyeing and staining, solvent solubility, chemical reagents, physical testing and separation methods; Examination of fibrous materials for the forensic and cause of fibre modification or damage arising from chemical or physical agents or treatments; Understanding the principles and applications of instruments used in chemical analysis; Chromatography: gas, liquid, paper gel-permeation, thin-layer, ion exchange spectrophotometry; Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Probe Microscopy (SPM); Spectroscopy: Ultraviolet - Visible Spectroscopy (UV/Vis), Fourier Transform Infrared Spectroscopy (FT-IR), Fourier Transform Raman Spectroscopy (FT-RAMAN), Nuclear Magnetic Resonance Spectroscopy (NMR), Electron Spin Resonance Spectroscopy (ESR), Atomic Absorption Spectroscopy (AAS), Atomic Emission Spectroscopy (AES), Plasma Emission Spectroscopy; Thermal Analysis: thermo-gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC), thermo-mechanical analysis (TMA); Graphical presentations and interpretations of testing techniques.

### **PART IV**

#### **TFE 4000 Industrial Attachment**

**120 Credits**

### **PART V**

#### **Semester 1**

### **TFE 5101 Composite Materials I**

**10 Credits**

The module focuses on the introduction to Composites; Basic Definitions and Classification of Composites; Advantages of Composites materials; Reinforcements & Matrices for various types of composites; Fibers/Reinforcement Materials; Matrix Materials; Fiber reinforced Polymer (FRP) Laminated composites Lamina & Laminate Lay-up, Ply-orientation definition; Manufacturing Processes; Laminated Composites: Introduction to Mechanics of Plates (Kirchhoff's Plate Theory); Classical Laminated Plate Theory; Stress-resultants in a Laminate Laminate forces and moments; Structural Mechanics of Laminates); Laminate Stiffness and ABD Matrices; Special Classification of Laminates: Symmetric, Antisymmetric and Nonsymmetric laminates; Behaviour of a Laminae; Linear Elastic Stress-Strain Characteristics of FRP Composites; Stress and Strain concepts in 3-D; Introduction



to Anisotropic Elasticity Stress-Strain relations for Anisotropic and Orthotropic cases; Tensorial concept and indicial notations as well as plane stress concepts.

**TFE 5102 Mineral Fibrous Materials**

**10 Credits**

The module covers traditional Ceramic Raw Materials, Non-Traditional and Special Ceramic Raw Materials; Typical Ceramic Body Compositions; Raw Material Preparation, Batching, and Body Preparation; Forming Processes; Drying; Ceramic Firing; Ceramic Kilns; Glaze Technology; Glass Manufacturing Processes; Additional Technological Factors; Asbestos fibre manufacture; Geology and Fibres Morphology; Crystal Structure of Asbestos Fibres; Properties of Asbestos Fibres; Production process; Industrial Applications; Impact on health and environment.

**TFE 5103 CAD/CAM**

**10 Credits**

This module is on Computer Aided Design (CAD) Systems and Computer Aided Manufacturing (CAM) Systems, Scope of CAD/CAM; Product Life Cycle, Design Process, Application of Computers for Design, Benefits of CAD, Computer configuration for CAD Applications, Grover's Model of product life Cycle for Selection of CAD/CAM; Representation of Drawings from 2D to 3D; (wireframe, surface and solid modelling); Principles of Numerical Control, Numerically Controlled (NC) Machines, Benefits of NC Machines over Conventional Machines, Computer Numerically Controlled (CNC) Machines; Types of CNC Machine Tools, Features of CNC Systems, Direct Numerical Control (DNC), Elements of CNC, and CNC Programming: Types, Manual Part Programming, Canned Cycle, Offset, Computer-Aided Part Programming Tools (Automatically Programmed Tool-APT); Programmable Logic Controllers (PLC): Logical Control and Programming the PLC; Computer Aided Process Planning (CAPP), Automated Material Handling, Automated Assembly and Inspection; CAD/CAM Integration and CAD/CAM Systems.

**CAC 2106 Management Accounting**

**5 Credits**

The module emphasizes the introduction to cost and management accounting; Cost concepts, classification and behaviour; Material and inventory control: Stock valuation, FIFO, LIFO, AVCO; Classification and analysis of overheads; Marginal costing; Fixed, flexible and cash budgets; Income statement according to direct and absorption costing methods; Standard costing systems; Manufacturing costs; Statement of cash flow IAS; Introduction to financial statements; Valuation of a business; Budgeting; Inventory management and an introduction to auditing.

**TFE5105 Production and Operations Management Systems**

**10 Credits**

The module explores an introduction to Production and Operations Management, Classification of production systems, Project Management, Manufacturing Processes and Facility Layout, Service Processes and Waiting Lines, Quality Management, Queuing Systems, Simulation and Modelling, Lean Manufacturing, Demand Management and Forecasting, Aggregate Sales and Operational Planning, Inventory Control, Material Requirements Planning and scheduling.

## **TFE 5000 Research /Design Project**

### **Semester II**

#### **TFE 5201 Composite Materials II**

**10 Credits**

This module explores strength and Failure theories; Strength of Laminates; Failure Mechanics of Composites; Macro mechanical Failure Theories; Maximum stress theory, Maximum Strain Theory, Tsai-Hill Theory, Tsai-Wu Theory, Comparison of Failure Theories; Design Concepts; Typical Structural Component Design process; Laminate Analysis/Design software; Composite Codes & Standards; Behaviour of a Laminae; Micromechanics of Laminae; Mechanics of load-transfer in a Laminae, Prediction of Engineering Property in a Laminae; Macro mechanics of a Laminae; Lamina Stress-Strain relations in material coordinates, Transformation relations, Lamina; Stress-Strain relations in Structure/Global coordinates; Identification of faults; Joining of composites; Environmental Effects of composites; Categories of scrap composites, recycling methods for: Thermoplastic matrix Composites, Thermosets matrix composites and applications.

#### **TFE 5202 Environmental Management**

**10 Credits**

The module explains the fundamentals of Environmental Management and Environmental Management Systems, Environment Health and Safety in Industries, Air Pollution and Control, Noise Pollution and Control, Water Pollution and Control, Solid and Hazardous Waste Management, Environmental Impact Assessment (EIA) and Environmental Conservation.

#### **TFE 5203 Nano fibre Technology**

**10 Credits**

The module focuses on the introduction to textile nanomaterials; Electrospinning: Theoretical background, Electrical pressure and liquid body disintegration, Taylor cone and critical tension, Needleless 16 electro spinning, Coaxial electro spinning, radiation effects, Liquid jet; Electrospinning–modifications, Polymeric nanofibre production, Carbon nanotubes; Application of electrospun materials, Composite materials (nanocomposites), Testing of nanofibrous materials; Physical principles of nanofibre production, Theoretical evolution of electrospinning, Liquid jet in an electric field, Special collectors, Electrospinning variants, Exceptional features of electrospinning, Polymeric solutions for electrospinning, Nanofibres in a cell, drawing of nanofibers; Force spinning and applications of nanofibrous materials.

#### **CBU 1209 Principles of Marketing**

**5 Credits**

This module is an introduction to Marketing, Key Concepts and Marketing Functions, Modern Marketing, The Marketing Environment, The Marketing Mix, Strategic Marketing, Consumer Markets, Business-Business Marketing, Marketing Research, Segmentation and Positioning, Product and Branding Strategy, and Product Life cycle.

## **TFE 5000 Research /Design Project**

**50 Credits**

### **ELECTIVES**

#### **TFE 5205 Green Composites**

**10 Credits**

This module explores Green Composites: An Introduction; Processing Cellulose for Cellulose Fibre and Matrix Composites: Hemp and Hemp-Based Composites; Plant Fibre–Based Composites; Bast Fibers Composites for Engineering Structural Applications; Effect of Halloysite Nanotubes on Water Absorption, Thermal, and Mechanical Properties of Cellulose Fibre–Reinforced Vinyl Ester Composites; Eco-Friendly Fibre-Reinforced Natural Rubber Green Composites; Machining Behaviour of Green Composites: A Comparison with Conventional Composites; Potential Biomedical Applications of Renewable Nanocellulose; Green Composites from Functionalized Renewable Cellulosic Fibres; Properties and Characterization of Natural Fibre–Reinforced Polymeric Composites.

#### **TFE 5206 Biomaterials**

**10 Credits**

The module covers an introduction to biomaterials, the structures of materials, characterization of materials; Classes of biomaterials, Metals, Ceramics, Polymers, Composites, Biological materials; Tissue response to materials, Host response to biomaterials, Material response to host, Biocompatibility of materials; Biomaterials; Soft tissue replacement: sutures, skin, maxillofacial implants, Blood interfacing implants; Hard tissue replacement: long bone repair, joints and teeth, Transplants; Biomaterials in Tissue Engineering; Nanomaterials in tissue engineering; Nanomaterial-cell interactions, Electrospinning technology for nanofibrous scaffolds, Nanomaterials for skeletal, muscle, nerve, and heart tissue engineering, Nanomaterials for stem cell tissue engineering, Nanomaterials for drug delivery, Magnetic nanoparticles for tissue engineering and Nanoparticles/nanotubes/nanowires for cellular engineering.

#### **TFE 5207 Functional Polymer Materials**

**10 Credits**

The module highlights an introduction and Concepts of adaptive polymers and textiles; Adaptive polymers; Adaptive textiles; Shape memory polymers (SMPs): Principles of shape memory function in SMPs; Classification of SMPs; Supramolecular SMPs; Shape memory fibres; Adaptive polymeric gels and applications: Classification and molecular structure of polymeric gels, Synthesis of adaptive polymeric gels; Properties and applications of adaptive polymeric gels; Adaptive polymeric particles and applications; Classification of adaptive polymeric particles; Properties of adaptive polymeric particles; Manufacturing of polymeric particles; Applications of adaptive particles; Adaptive textiles using adaptive polymers: Adaptive textiles for thermoregulation; Shape memory polymeric textiles; Adaptive chameleon textiles; Luminescent adaptive textiles; Conductive polymer textile; Other functional textiles; ; Adaptive polymeric composites and applications: Thermal adaptive polymeric composites; Electro

adaptive polymeric composites; Light adaptive polymeric composites; Magnetic adaptive polymeric composites; Moisture/water adaptive polymeric composites and applications.

**TFE 5208 High-Tech Polymer Materials**

**10 Credits**

This module covers industrial fibrous materials: Types, methods of production and applications; Braided structures and their technical applications; Functional requirements, structure and properties; Geotextiles: Types and application of geosynthetics; Functions and application areas of geotextiles; Protective clothing: Clothing requirements for protection; Coating and Laminating: Coating - need and areas of application of coated fabrics; Polymeric materials and fabric substrates for coating; Coating methods and equipments used; Characteristics of coated and laminated fabrics and their evaluation; Building fibrous materials: Applications of coated fabrics for building structure; Properties of fabrics for architecture and construction; Medical fibrous materials: Introduction and classification of Medical Textiles; Fibres used for medical applications; Medical Drapes and Linen; Implantables; Extracorporeal devices, Tissue Engineering; Healthcare and Hygiene products.

**TFE 5209 Fundamentals and Principles of Packaging**

**10 Credits**

This module explores background to packaging standards; Overview of Packaging Industry; Introduction to packaging; Packaging materials; Introduction to print; Packaging Conversion processes; Quality standards; Legislation; Glass Packaging; Types of container, properties, design, quality standards, defects, risk; Plastics Packaging; Types of plastics, rigid and flexible; Plastics manufacturing techniques, materials, forming methods, quality defects and risks; Paper, Paperboard, Corrugated and Wood Packaging; Manufacture, qualities, testing, decoration methods, corrugated boards, transit properties, adhesives, quality issues; Metal Packaging; Two/three piece can making, containers and closures (steel and aluminium) extrusion, coatings, decoration, flexible metal foil foils.

**TOTAL CREDITS FOR THE PROGRAMME**

<b>YEAR I</b>	<b>200</b>
<b>YEAR II</b>	<b>200</b>
<b>Total minimum credits:</b>	<b>400</b>

## DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

### ***Lecturer and Acting Chairperson***

*Dr Eng N Tayisepi*, Class 1 Fitter & Turner Machinist (MPDA Chapter. 28:02), Dip. Tech Voc. Ed. (HEXCO), Exec. Dip. in Bus. Leadership (ZOU), HND Mech. Eng (HEXCO), B Tech (Hons) Industrial & Mfg. Eng (NUST), M Eng (Mfg Syst & Op Mgt) (NUST), D Eng Mech. Eng (University of Johannesburg), Pr Eng, MZweIE, AMSAIIIE

### ***Secretary***

*Ms A. Ncube*, Advanced Pitman Certificate, Diploma in Personnel Management (IPMZ), Cert. Court & Parliamentary Reporting (Australia), Exec Secretary (Pitman)

## **ACADEMIC STAFF**

### ***Professor***

*(Vacant)*

### ***Associate professor***

*(Vacant)*

### ***Senior Lecturers***

*Eng. S. Mhlanga*, B Eng (Hons) Industrial Eng (NUST), MSc Advanced Mfg Sys (Brunel), UK, Postgrad Cert in Higher Education Management (Wits), Postgrad Cert in Engineering Education & Project Management (Tsinghua University), CEM Certified Energy Manager (SA), MZweIE

*Dr. Eng. W. M. Goriwondo*, B Eng (Hons) Industrial Eng (NUST), MSc Mfg Sys & Op Mgt (UZ), PhD (NUST), Cert of Quality Assurance (City & Guilds), Cert of Modern Safety & Risk Mgt (IRCA), FZweIE

*Dr. Eng. D. Zimwara*, B Tech (Hons) Mech. Eng (UZ), MSc Mfg Sys & Op Mgt (UZ), PhD, (NUST), Dip. Tech. Voc. Edu (HEXCO), MZweIE

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*Think in other terms*

## ***Lecturers***

*Mr W. Tumbudzuku*, B Eng (Hons) Industrial Eng (NUST), M Eng Mfg Sys & Op Mgt (NUST)

*Mr V. S. Moyo*, B. Ed. Voc & Tech. (Hudds), MBA (NUST), CAE CGLI, Mech. Eng. TECH Cert PT2. CGLI. T2B, SSC Trs Cert

*Eng. L. Nyanga*, B Eng (Hons) Industrial & Man Eng. (NUST), M Eng Mfg Sys & Op Mgt (NUST), MZweIE

*Eng. T. R. Chikowore*, B Eng (Hons) Industrial & Man. Eng (NUST), M Eng Mfg Sys & Op Mgt (NUST), PGDHE (NUST), MZweIE

*Eng. M. Makhurane*, B Eng (Hons) Industrial & Man. Eng (NUST), M Eng Mfg Eng & Op Mgt (NUST), PGDHE (NUST), MZweIE

*Dr. Eng. L. Mugwagwa*, B Tech (Hons) Production Eng (CUT), M Eng Mfg Eng & Op Mgt (NUST), PhD Industrial Eng (Stellenbosch), PGDHE (NUST), MZweIE, AMSAIE

*Eng. V. M. Sibanda*, ND Mech. Eng. Prod. (HEXCO), FTC Mech. Eng. Plant (C&G) UK, Class 1 Fitter Machinist, B Eng (Hons) Industrial & Mfg. Eng. (NUST), M Eng Mfg. Sys & Op Mgt, (NUST), PGDHE (NUST), FZweIE)

*Eng. S. T. Nyadongo*, B Eng (Hons) Industrial & Mfg Eng (NUST), M Eng. Mfg Eng & Op Mgt (NUST), PGDHE (NUST), MZweIE,

*Eng. E. Murena*, ND Mech DDT (HEXCO), B Eng (Hons) Industrial & Mfg Eng (NUST), M Eng (Mfg Eng & Op Mgt), (NUST), PGDHE (NUST), MZweIE, MSAIE

*Eng. B. Sarema*, B Eng (Hons) Industrial & Mfg Eng (NUST), M Eng. Mfg Eng & Op Mgt (NUST), PGDHE (NUST) MZweIE, AMSAIE, Pr Eng (ECZ), Pr Eng (ECSA)

*Eng. G. Kanyemba*, B Eng (Hons) Mechatronics (CUT), M Eng Mfg Eng & Op Mgt (NUST), PGDHE (NUST), C Eng (UK)

## ***Engineering Instructors***

*Mr N. M. Dewa*, FETC (HEXCO),, ZNCC Mech. (HEXCO), Dip Ad Ed (UZ), B. Tech. Ed (NUST), AMITD (UK)

*Eng. G. Munhuwamambo*, Dip Tech Voc Ed (HEXCO), Class 1 Turner Machinist (MPDA 28:02), NACC (HEXCO), B. Tech Ed. Mech. Eng (NUST), MZweIE

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### ***Chief Technician***

*Eng. A. N. Mnkandla, NC Motor Mech, ND Auto Eng, B Eng (Hons) Industrial & Mfg Eng (NUST), M Eng. Mfg Eng & Op Mgt (NUST), MZweIE, AMSAIE*

### ***Stores Person***

*Ms M. Moyo, Dip Purchasing and Supply Mgt (HEXCO), B Com Purchasing and Supply Mgt (LSU)*

### ***Technical Assistant***

*Mr V. Ndoro, Cert. in Basic Machinshop Eng(Westgate)*

# BACHELOR OF ENGINEERING HONOURS DEGREE IN INDUSTRIAL AND MANUFACTURING ENGINEERING

## PROGRAMME SUMMARY

### PART I SEMESTER I

Module Code	Module Description	Credits
TEE 1103	Electrical Engineering - Basic Circuit Analysis	
SCS 1101	Introduction to Computer Science	
SMA 1116	Engineering Mathematics 1A	
TIE 1101	Engineering Drawing I	
TIE 1102	Engineering Communication Skills	
TIE 1103	Workshop Technology I	
TIE 1104	Ergonomics & Industrial Safety I	
TIE 1105	Introduction to Industrial and Manufacturing Engineering	

### SEMESTER II

CTL 1101	Leadership and Conflict Transformation	
TEE 1203	Electronic Engineering - Electronic Circuits & Devices	
SCS 1206	Visual Programming Concepts and Development	
SMA 1216	Engineering Mathematics 1B	
TIE 1201	Engineering Drawing II	
TIE 1203	Workshop Technology II	
TIE 1204	Ergonomics and Industrial Safety II	
TIE 1206	Applied Mechanics	

### PART II

#### SEMESTER I

SMA 2116	Engineering Mathematics II	
TEE 2114	Electrical & Electronic Technology I	
TIE 2101	Thermodynamics	
TIE 2103	Solid Mechanics I	
TIE 2104	Materials Technology I	
TIE 2106	Dynamics I	
TIE 2109	Computer Applications	
TIE 2107	Engineering Design Principles	



## **SEMESTER II**

SMA 2217	Engineering Mathematics III
TEE 2295	Electrical & Electronic Technology II
TIE 2202	Fluid Mechanics
TIE 2203	Solid Mechanics II
TIE 2204	Materials Technology II
TIE 2206	Dynamics II
TIE 2208	Engineering Design Applications
TIE 2211	Quality & Reliability Engineering

## **PART III**

### **SEMESTER I**

TIE 3108	Introduction to Thermal Systems
TIE 3110	Maintenance Engineering
TIE 3112	Manufacturing Systems I
TIE 3113	Manufacturing Processes I
TIE 3114	Industrial Instrumentation and Control I
TIE 3115	Industrial Management I
TIE 3117	Business Studies I
TIE 3119	Concurrent Engineering I

### **SEMESTER II**

TIE 3212	Manufacturing Systems II
TIE 3214	Industrial Instrumentation and Control II
TIE 3215	Industrial Management II
TIE 3217	Business Studies II
TIE 3219	Concurrent Engineering II
TIE 3220	Manufacturing Engineering Design
TIE 3213	Manufacturing Processes II

## **PART IV**

TIE 4000	Industrial Attachment
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## **PART V**

### **SEMESTER I**

TIE 5101	Manufacturing Systems III
TIE 5102	Production Planning and Control
TIE 5103	Manufacturing Processes III
TIE 5105	Business Studies III
TIE 5111	CAD/CAM I
TIE 5009	Project

### **SEMESTER II**

TIE 5009	Project
TIE 5205	Business Studies IV
TIE 5208	Operations Research
TIE 5211	CAD/CAM II
TIE 5214	Environmental Conscious Manufacturing

### **Electives (*Choose One*)**

TIE 5215	Manufacturing Systems Engineering
TIE 5216	Advanced Manufacturing Technology
TIE 5217	Manufacturing Strategy

## MODULE SYNOPSES

### PART I

#### **TEE 1103 Electrical Engineering Circuit Analysis**

*See Electronic Engineering Department.*

#### **TIE 1101 Engineering Drawing I**

The module examines an introduction; Plane geometry; Space geometry; First and third angle projection; Dimensioning; Pictorial views; Freehand sketching; drawing of common objects; Sectioning; Intersections; Developments; Conventions; Assembly drawings and exercises.

#### **TIE 1102 Engineering Communication Skills**

The module has an introduction to Engineering Communication; Communication in the Work place; Methods of communication; Technical Methods of communication; Business communication at the workplace: Memoranda, Letters, Reports, Curricula vitae, Job Application Letter, Resume, Resignation Letter, Termination Letter; Tables and graphs; Interview techniques; Running a meeting; Technical articles ( Writing technical and conference papers); Presentations; Summaries and abstracts; Referencing; Lab Logs and oral presentations.

#### **TIE 1103 Workshop Technology I**

The module examines an introduction to Workshop Technology; Industrial safety and behaviour, types of production workshops and layout; Measuring and Gauging: Purpose and language of measurement and gauging; Interchangeability and precision; units of measurement, line and end measurement; Precision measuring instruments and gauges; micrometers, vernier callipers, slip gauges, depth and height gauges, telescopic gauges, Vernier height gauges, Go, No GO, dial test indicators, callipers, etc; Machine Shop Practice: marking out; marking out tools – marking out table/surface plate, Angle plate, Vee blocks, dividers, scribing blocks, spirit levels etc; Material removal processes: turning and threading, milling and drilling; Machine tools, centre lathe, milling machines, drilling machines and power saws (Equipment operation and maintenance).

#### **TIE 1104 Ergonomics & Industrial Safety I**

This module focuses on recognition of the environmental factors and hazards: Solvents: Effects, Healthy and Safety procedures, critical exposure factors, evaluation of exposure, Industrial Noise and Vibration, Ionising and Non-ionising radiation, Temperature extremes, Ergonomics guidelines for working posture; Biomechanics; Anthropometrics, sources of anthropometrical data; Assessment of human static strength; Lifting, pushing, pulling and carrying; Work phase design; Standing versus sitting; Human factors/behaviour; displays; Control; Mental overload; Ergonomic checklist;

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*Think in other terms*

Fundamental concepts of industrial safety: Definitions: The safety professional and the industrial hygienist; Government regulations: Factories and Works Act, National Social Security Authority (Accident Prevention and Worker's Compensation Scheme); Environmental factors or stresses: Chemical, Physical and ergonomic stresses; biological agencies; mode of entry of harmful agents - inhalation, skin absorption and ingestion; Occupational diseases: Anatomy, physiology, hazards and pathology of the common target organs: lungs, skin, ear and eyes.

### **TIE 1105 Introduction to Industrial And Manufacturing Engineering**

This module explores the definition of Industrial Engineering and Manufacturing Engineering and difference and definitions of the other engineering disciplines (mechanical, automotive, production, electrical, electronics, chemical, civil and water, textile etc); Career paths in Industrial and Manufacturing Engineering profession and professional practice; Work study principles are application as data gathering to be used in the different courses in the profession and Industrial visits and Seminars with former students as guests.

### **CTL 1101 Leadership and Conflict Transformation**

This module looks at understanding Conflict: The evolution of Conflict Management and Peace studies field; Defining Conflict; Typologies of conflict, Levels and stages of conflict; Theories of conflict; Conflict Analysis and Tools: Conflict Mapping; ABC Triangle; Conflict Tree; Conflict Onion; Force-field analysis; SPITCEROW ; Economic Roots of Conflict: Resource Based Conflicts; Greed vs Grievance Theory; Resource Abundance and Resource Scarcity Theories; Globalisation and Conflict Leadership and Conflict Handling Mechanisms: Multi-Track Diplomacy (Track 1 &2); Litigation and Arbitration.

### **TIE 1201 Engineering Drawing II - Computer Graphics**

This module covers definition Applications of AutoCAD; Introduction to Menu options on the Opening screen; Settings, Limits and Control of AutoCAD programme; Use of basic operating commands SNAP, GRID, ORTHO, ENTER, ESCAPE, UNDO, SAVE, SAVE AS; Coordinates and coordinate systems: Cartesian, Relative, Polar; AutoCAD function key commands; Toolbars: DRAW; MODIFY, SOLIDS, SUFACES; Control Boxes in AutoCAD: Colors CB, Line type CB, Line weight CB, Dimensions CB, Layers CB; Practical lab exercises and assignments in 2D and 3D such as drawing and dimensioning of various Machine Parts, Architectural Plans, Electronic Circuit Diagrams and Process Flow Charts, Block Diagrams.

### **TEE 1203 Electronic Engineering Circuits & Devices**

*See Electronic Engineering Department.*

### **TIE 1203 Workshop Technology II**

The module examines workshop Safety in welding processes; Use of hand tools: Bench working, hand sawing, cutting and filing; Material forming processes: forging, casting and powder metallurgy; Material joining processes: Fusion welding, high energy beam welding, friction welding, soldering, brazing, riveting, bolting and adhesive bonding; Automotive: The engine, engine lubrication, fuel system, cooling system, transmission system, chassis frame and ignition system.

### **TIE 1204 Ergonomics and Industrial Safety II**

The module focuses on recognition of the environmental factors and hazards: Solvents: Effects, Healthy and Safety procedures, critical exposure factors, evaluation of exposure, Industrial Noise and Vibration, Ionising and Non-ionising radiation, Temperature extremes, ergonomics, Biological hazards, Industrial toxicology, Illumination; Evaluation of the environmental factors and hazards: Critical exposure factors, measuring instruments and sampling the environment; Occupational Safety and Health Standards; Basic hazard-recognition procedures, calculations and interpretation of results; Control of the environmental factors and hazards: Methods of Controls; Engineering control, general control methods, training education, Industrial Ventilation, Personnel protective equipment, Respiratory protective equipment, Inspections and administrative control; Occupational health and safety programmes: Governmental Regulations: Factories and Works Act - Chapter 283, 1982; RG Authority (Accident Prevention and Workers Compensation Scheme), Hazardous Substances and Articles Act and Regulations; Shop Licences Act; The Safety Professional: Definitions; Accident prevention activities; Codes and standards; Plans and specifications; Machine design; Records; Education and Training; Total loss and damage control; system safety; Industrial Hygiene Programme as well as seminars and visits to industry.

### **TIE 1206 Applied Mechanics**

The module looks at forces: vectors, equilibrium, free-body diagrams, couples, links; Frameworks: method of sections, method of joints, support reactions and types; Beams: cantilever beams, simple beam, beam with overhang, types of loads, point or concentrated loads, distributed loads, uniform and non-uniform, couples, shear forces (SF), bending moments (BM); Kinematics: uniformly and non-uniformly accelerated motion, kinematic relations for velocity, displacement, time and acceleration, velocity and acceleration diagrams; Kinetics: Newton's 2nd law, force, mass, acceleration, impulse and momentum, work and energy

## **PART II**

### **SMA 2116 Engineering Mathematics II**

The module explores multiple Integrals: Iterated integrals, change of order; Change of variable; Polar, cylindrical and spherical coordinates; Applications in three dimensions; Vector Calculus: scalar and

vector fields; Directional derivatives; Gradient, divergence and curl; Line and surface integrals; Theorems of Green, Gauss and Stokes; Fourier Analysis: Fourier series and transforms.

### **TEE 2114 Electrical and Electronic Technology I**

The module gives an introduction to electromechanical devices with related electronic measurement and control instrumentation for industrial engineers; Electro-mechanics topics in the first course include conversion phenomena, magnetic fields and circuits, transformer performance, principles of electro-mechanics and digital signal conditioning, and process control transducers.

Credits: 3; Lecture sessions: 48; Pre-requisite: TEE 1103

### **TIE 2101 Thermodynamics**

This module focuses on the basic concepts and principles; Principles of fluids (substances); work and heat systems, closed and opened; The First Law of Thermodynamics; The Second Law of Thermodynamics; Entropy, Reversible work, irreversibility; Cycles of internal combustion engines and steam engines, efficiencies; Power and refrigeration vapour and gas cycles and Heat Transfer.

### **TIE 2103 Solid Mechanics I**

This module explores basic concepts, States of loading, Elements of Linear Elasticity, Plane elasticity problem, Applications, Visco-elasticity, Plasticity, Force and deflections, Large Deformation, Constitutive relations, Rigid and deformable solids, Internal forces in bodies, Statically determinacy, Axially loaded members, Shear and bending moment diagrams, Concepts of stress and strain, constitutive relations, Energy methods, Torsion, Columns, Bending and shearing stresses in beams of symmetrical cross-section, Second Moment of Area, Elastic Flexural Formula, Deflection of beams by integration, Torsion of shafts, Power Transmission in Shafts, Stress in cylindrical and spherical shells, Transformation of plane stress and strain, Bending deflection of simple beams by direct integration methods, Energy concepts, Material Property Relationships, Failure Theories, Shaft Design, Slope and Displacement in Transversely loaded Beams, Design of Columns with Concentric and Eccentric Loads, Springs and torque.

Prerequisites: TIE 1206, SMA 1116

### **TIE 2104 Materials Technology I**

The module offers an introduction - Why study materials technology? Classification and application of engineering materials; Atomic structure and interatomic bonding in solids; The structure of crystalline solids - metallic crystal structures, density computations, polymorphism and allotropy, crystal systems, crystallography; Imperfections in solids – vacancies, interstitials, substitutions, line defects, interfacial defects, bulk or volume defects, atomic vibrations; Diffusion – diffusion mechanisms, steady-state diffusion, non-steady-state diffusion, factors that influence diffusion; Mechanical properties of metals - concepts of stress and strain, elastic and plastic deformation, stress-strain behaviour, anelasticity, elastic properties of materials, tensile properties, true stress and strain, compressive, shear, and torsional deformation, destructive methods of testing for mechanical properties, non-destructive

testing techniques of material properties, variability of material properties; Strengthening mechanisms in metals - strengthening by grain size reduction, solid-solution strengthening, strain hardening; recovery, recrystallization, grain growth; Failure - ductile fracture, brittle fracture, principles of fracture mechanics, fatigue, cyclic stresses, creep and generalized creep behaviour.

### **TIE 2106 Dynamics I**

The module looks at the dynamics of particles; Introduction; Force, Mass and Acceleration; Work and Energy; Impulse of energy and momentum, special applications; Dynamics of systems of particles; Introduction; Work and energy; Impulse and momentum; Conservation of energy and momentum; Introduction to three-dimensional dynamics of rigid bodies; Introduction; Angular momentum; Kinetic energy; Momentum and energy equations of motion; Parallel - plane motion; Gyroscopic motion; Mass moments of inertia; mass moments of inertia about an axis and products of inertia. Prerequisites: TIE 1206 - Applied Mechanics.

### **TIE 2107 Engineering Design Principles**

The module focuses on the introduction to engineering design; Phases of the engineering design process; Factors of safety; Fits and tolerances; Design of shafts - shafts subjected to pure twisting or pure bending, shafts subjected to combined and fluctuating loads, design of shaft keys and couplings, types of shaft couplings; Design of power Screws - types of screw threads, Torque required to raise or lower a load, Efficiency of power screws, concept of self-locking; Design of gear drives – classification of gears, gear terminology, gear teeth forms, interference in involute gears, gear materials; spur gears – design for strength, static and dynamic tooth loads, wear loads, design procedure for spur gears; helical gears – types of helical gears, terminology, proportions for helical gears, strength of helical gears, design procedure for helical gears; bevel gears - classification of bevel gears, bevel gear terminology, proportions for bevel gears, forces acting on bevel gears, design procedure for bevel gears; worm gears, worm gear terminology, proportions for worms, efficiency of worm gearing, strength of worm gear teeth, wear tooth load for worm gears, thermal rating of worm gearing, forces acting on worm gears, design procedure for worm gearing; gear trains – simple gear trains, compound gear trains and epicyclic gear trains.

### **TIE 2109 Computer Applications**

The module looks at electronic spreadsheets (MS Excel for Windows): mathematical calculations, VBA programming, graphical analysis, perform queries (using SQL), multi-linked spreadsheets; Database management systems (DBMS): create, maintain, and print reports from a database, customising the user interface by creating and maintaining forms and reports, query tables using basic query operations such as “and”, “or”, “not”; Engineering information modelling that is compliant to STEP/ STEP-NC standards using the following modelling languages; ER/EER, IDEF1X, UML, EXPRESS/ EXPRESS-G, XML; Software development methodologies: design of customised packages targeted at solving various engineering problems i.e.; CNC machining, management information systems, production planning and control, computer-integrated-manufacturing (CIM) systems, and intelligent systems; Computer

applications in- CAD/CAM/CAE/CAPP/CIM, PDM/PLM, Flexible Manufacturing Systems (FMS), & Reconfigurable Manufacturing Systems (RMS); Introduction to C++ programming: Basic structure of C++ program, arithmetic expressions in C++ and Array programming in C++.

### **TIE 2202 Fluid Mechanics**

The module has an introduction to the concepts and applications of fluid mechanics; Hydrostatics (fluids at rest); Fluid motion (fluid dynamics), Types of fluid flow (Lamina and Turbulent flow); steady flow, unsteady flow, uniform flow, non-uniform flow and hybrid flow types; Bernoulli's Equation and its application; Steady Flow energy equation; Pipeline flow; Orifice flow; Fluid measurement; Momentum; Dimensional Analysis and Similarity; Boundary Layer Theory; Turbo-machinery (pumps, compressors, wind turbines etc;) classification and design and sizing procedures.

### **SMA 2217 Engineering Mathematics III**

The module explores Laplace Transforms: Definitions; Basic ideas; Applications to ordinary differential equations; Probability exploration; Summary statistics, graphical presentation of data; Point estimation\test of hypothesis; Interval Estimation; Analysis of Variance; Regression analysis - simple, multiple, polynomial regression; Statistical computing using MINITAB and an editor and applications to engineering problems.

### **TEE 2295 Electrical and Electronic Technology II**

This module is a continuation of TEE 2114. It explores electro mechanics topics: Alternating current machines, automatic control analogue controllers, digital control principles and control loop characteristics. Credits: 3; Lecture sessions: 48; Pre-requisite TEE 2114.

### **TIE 2211 Quality And Reliability Engineering**

The module explores quality and reliability in engineering; Statistical analysis for quality and reliability engineering; Standardised quality management systems: Statistical process control methods, Six Sigma and ISO 9000 series; Quality management and quality assurance programmes; Quality measurement techniques; Process capability, reliability, reliability programmes and reliability engineering.

### **TIE 2206 Dynamics' II**

The module looks at vibrations and time response of single-degree-of-freedom systems; Introduction; Free vibrations of particles: undamped free vibrations, damped free vibrations; Forced vibrations of particles; Undamped forced vibrations; Damped forced vibrations; Vibrations of rigid bodies; Energy methods; Vibrations of two-degree-of-freedom systems; Introduction; Free vibrations; Forced vibrations; Lateral vibrations of beams; Cams; Eccentric circular cam with flat follower and curved follower; Balancing of machines; Introduction; Balancing of a single and multi-cylinder engines; Geared systems; Gear trains; Torque relations in Governors; Function of governor; Spring loaded governors and spring connected balls; Pre-requisites. TIE 1203, 2103 - Solid Mechanics I & II; TIE 2106 – Dynamics I.



### **TIE 2203 Solid Mechanics II**

The module looks at complex Stresses: Stresses on Oblique Planes; Material subjected to pure shear, mutually perpendicular direct stresses, combined direct and shear stresses, principal plane, principal angle, solution methods; Thick cylinders/Thick-walled pressure vessels: Lamé theory, internal pressure only, Stress systems, Change of cylinder dimensions, Compound cylinders – similar materials and different materials, Failure theories, Plastic yielding, Compound Cylindering methods; Asymmetrical Bending: Product second moment of area, Principal second moment of area, Mohr's circle, Land's circle, Rotation of axes, Stress determination, Deflections; Struts: Euler's theory, Equivalent length, Euler theory versus experimental results, validity limit, Struts formulae, Struts loading conditions, Struts with unsymmetrical cross-section and torsion of non-circular thin rings.

*Prerequisites:* TIE 2103, TIE 1206

### **TIE 2204 Materials Technology II**

The module looks at phase diagrams - basic concepts, solubility limit, one-component (or unary), binary phase diagrams, binary isomorphous systems, interpretation of phase diagrams, the iron-iron carbide phase diagram; Phase transformations - isothermal transformation diagrams, continuous cooling transformation diagrams, microstructural changes; Types of metal alloys - ferrous alloys, nonferrous alloys, applications of ferrous and non-ferrous alloys; Heat treatment of metals - annealing processes, tempering, surface or case hardening techniques, bulk hardening, precipitation hardening; Corrosion and degradation of metals - electrochemical considerations; corrosion rates, forms of corrosion, corrosion prevention; Composites – particle reinforced composites, large-particle composites, dispersion-strengthened composites, fibre-reinforced composites, influence of fibre length on fibre strength, influence of fibre orientation and concentration on fibre strength, structural composites, laminar composites, sandwich panels; Ceramic materials - glasses, glass-ceramics, clay products, refractories, abrasives, cements, advanced ceramics; material selection and design considerations.

### **TIE 2208 Engineering Design Applications**

The module outlines the design of belt drives - material used for belts; flat belt drives, open and crossed flat belt drives, power transmitted by a flat belt, ratio of driving tensions for flat belt drives, V-belt drives - advantages and disadvantages of V-belt drive over flat belt drive, ratio of driving tensions for V-belt drives; Design of rope drives - fibre ropes, ratio of driving tensions for fibre ropes; wire ropes - construction of wire ropes, designation of wire ropes, stresses in wire ropes, procedure for designing a wire rope; Design of chain drives - classification of chains, chain drive terminology, length of chain and centre distance, characteristics of roller chains, power transmitted by chains, design procedure for chain drive; Design of springs – types of springs, material for helical springs, terms used in helical springs, stresses in helical springs, deflection of helical springs, energy stored in helical springs; leaf springs - construction of leaf springs, stresses in spring leaves, length of leaf spring leaves; Design of clutches - material for friction surfaces, design of a disc or plate clutch, design of a cone clutch,

centrifugal clutch, design of a centrifugal clutch; Design of brakes - energy absorption and heat dissipation, types of brakes, single block or shoe brake, pivoted block or shoe brake, double block or shoe brake, simple band brake, differential band brake, band and block brake, internal expanding brake; joints - bolted, riveted and welded joints and lubrication systems.

### **PART III**

#### **TIE 3108 Introduction to Thermal Systems**

The module looks at the role of Thermal Energy in the energy mix of a country; Design of Heat driven energy system components and heat exchangers (Boilers, Steam turbines, condensers, cooling towers etc); Improving efficiency of the systems; Steam plants; gas-turbine cycles; Combined cycles, Refrigeration and Air conditioning systems; Heat Pumps; Renewable thermal energy systems (Solar thermal for heating and cooling, Concentrated Solar Plants, Solar thermal heating for domestic and industrial processes, Geothermal energy, Biogas) and Nuclear reactors. Prerequisites: TIE 2101 Thermodynamics, SMA 2116 & 2217 Engineering Mathematics

#### **TIE 3110 Maintenance Engineering**

This module looks at an introduction to Maintenance & Reliability, Maintenance in context; Maintenance Policies: Operating Maintenance Policies, Solved Problems; Types of Maintenance: Preventive, Corrective, Systematic, Condition based; Maintenance Department: Organisation of Maintenance Operations: ABC Analysis, Repair and replacement, An introduction to Condition Based Maintenance, Investigation of failures, Lifetime of physical equipment, Some main maintenance problems, Condition monitoring as a production tool, Troubleshooting, computer based maintenance, Expert systems, Establishing a maintenance plan - Preliminary considerations, Establishing a maintenance plan and schedule, Planning and scheduling of plant shutdowns; Systems Reliability - Weibull Parameters: System reliability - solved problems and estimating machinery reliability - Weibull diagram TPM. Prerequisites: SMA 2117 - Engineering Mathematics III; TIE 2210 Maintenance Engineering I.

#### **TIE 3112 Manufacturing Systems I**

This module focuses on the classification of Manufacturing systems: project, jobbing, batch, line, continuous; Facility layout and design: problems that stimulate facility layout, objectives and performance measures for a good layout, techniques in facility layout design, systematic layout planning, quadratic assignment problem Approach; decomposition of large families, net aisle and department Layout, locating new facilities, single and multifacility; Assembly Lines: Flow line transfer and general serial systems faced lines without buffers, two-stage paced lines with buffers, unpaced lines; Approaches to Line Balancing:- Ranked Positional Weight, - Largest Candidate Rule, - Kilbridge and Western method, - Comsoal Random Sequence Method; Practical issue in line balancing, sequencing of a mixed model and improvements to solutions on line balance.

### **TIE 3113 Manufacturing Processes I**

This module looks at casting Processes: Solidification of castings, Gating and feeding systems, mould materials and their testing, continuous casting, special casting processes, design of castings, casting defects and inspection and quality control. Prerequisites: TIE 1107 & 1207 – Workshop Technology I & II; TIE 2107 & 2207 - Material Technology I & II;

### **TIE 3114 Industrial Instrumentation & Control I**

The module explores Industrial Instrumentation (Measurement): Principles of Measurement: most commonly measured variables; light waves as standards of length; precision of an individual observation; measurement; measurement of a small sample; uncertainty in the sample standard deviation and required sample size; undependable observations; the weighted arithmetic mean; metrological characteristics of measuring means; accuracy classes of limits of error numerical expression for errors of measuring means; static characteristics; gain; sensitivity; resolution sensitivity of an instrument or a transducer; dynamic characteristics of measuring means; errors in engineering measurements statistical quality control; Analogue Measuring Instruments: flow meters (e.g; Rhodes flow indicators), pressure gauges; thermometers; scales etc; Electronic Instrumentation: sensors and transducers; Signal Conditioning & Processing: operational amplifiers; filters; AD/DA Converters; microprocessors; interfacing and interface cards; Instrument Performance; Accuracy and errors of measurement; Axiom of Randomness and axiom of distribution.

### **TIE 3115 Industrial Management I**

The module examines industrial Management, The nature of organization, structure of organization, Company mission statement, Management of function, Industrial Relations, Managing Organizational Conflicts, Communication, The human resources function, The Pareto Principle and Theories of Motivation.

### **TIE 3117 Business Studies I: Marketing**

The module explores the principles, characteristics and functions of marketing.

### **TIE 3119 Concurrent Engineering I**

The module focuses on the stages in the life cycle of a product, characteristics of Global competition, characteristics of a competitive product, Research and Development (R&D): its role in the design of products, factors influencing forward move of a product, concurrent engineering approach in the product development process, identifying customer needs; The product development process: concept development, concept generation, concept selection, Product architecture: product family design, modularisation methods, Industrial design process, Innovation and Intellectual Property (IP): driving forces for innovation, forms of Intellectual Property, requirements for patentability and patent procedure. Prerequisites: TIE 2104, TIE 2204- Materials Technology I & II; TIE 2107- Engineering Design Principles;

### **TIE 3220 Manufacturing Engineering Design**

The module outlines Jig and Fixture Design: Clamping devices in manufacturing, effects on product quality; Principles of location, clamping of work, tool guiding, adjusting devices, assembly fixtures, inspection fixtures in automated manufacturing; Die design: Presses, material strip, blanks, procedure for die design, strip layout, design of die blocks, punches, plates, pilots, gauges, finger and automatic stops, strippers, fasteners, die set selection, types of dies; Design for Manufacturing (DFM) guidelines for polymer processing, metal casting and sheet metal forming; Relative Tooling Cost and Total Relative Part Cost.

### **TIE 3212 Manufacturing Systems II**

This module looks at scheduling with many products: order release, bottleneck scheduling; Job shop sequencing, single-machine scheduling, two-machine flow shops; Job shop scheduling: dispatching rules, schedule generation; Group Technology: definitions, GT Implementation: visual inspection, coding methods, monocode, polycode, hybrid code: Opitz, Dclass, MICLASS coding systems; Selection of classification and coding systems, benefits of GT; Cellular Manufacturing: design of cellular manufacturing; systems cell formation approaches: Production Flow Analysis, Binary Ordering Algorithms, single pass heuristic, similarity coefficient methods; Evaluation of cell Designs; Production Planning and Control in cellular manufacturing systems and economics for cell formation.

### **TIE 3213 Manufacturing Processes II**

The module explores forming Processes: Hot and cold forming; Formability; Wire working; Extrusion; Folling; Deep drawing; Forging; Defects in wrought metals; Sheet forming and forming loads; Welding and Joining Processes: Industrial welding processes; control and practical applications; Residual stresses; Weld metallurgy; Weld defects; Designing against failure; Mechanical fastening and adhesive bonding etc.

### **TIE 3214 Industrial Instrumentation and Control II**

This module looks at industrial Control (Theory & Practice): Time domain and Frequency domain System modelling (time and frequency domains); Representation and Reduction of multiple systems (Block diagram techniques); Stability; Steady-state Errors (Accuracy); Root Locus method; Frequency Response methods; PID Controllers Compensators; Programmable Logic Controllers (PLCs) and introduction to State Space Methods.

### **TIE 3215 Industrial Management II**

This module explores leadership styles, control process, and industrial relations.

### **TIE 3217 Business Studies II: Financial Analysis**

The module emphasizes concepts, Types of investments, cost and management accounting and budgets.

## **TIE 3219 Concurrent Engineering II**

The module covers the introduction to Value Analysis (VA) and Value Engineering (VE), phases of value analysis; Functional Analysis/ Modelling: Product function (Top-Down), Functional Analysis System Technique (FAST) (Top-Down), Subtract and operate procedure (Bottom-Up); Design for “X”-ability (DFX)-design for manufacturability (DFM), design for assembly (DFA), reliability, robustness, serviceability, design for compatibility (DFC), design for green (DFG) and design for logistics (DFL); Assembleability evaluation methods (AEM): Lucas, Boothroyd Dewhurst and Hitachi methods; Robust design methodology: Taguchi quality control, Design of Experiments (DOE): Factorial design, Taguchi design; Product Data Management (PDM) and Product Life Cycle Management (PLM) systems and the capabilities and benefits of PDM/PLM systems. Prerequisites: TIE 3119.

## **PART IV**

### **TIE 4000 Industrial Attachment**

## **PART V**

### **TIE 5102 Production Planning and Control**

Operations functions; Forecasting; Aggregate production planning; Master production planning; Material requirement planning; Production scheduling for flow and job shops; Work methods and measurement engineering; Prerequisites: TIE 3117, 3218 - Business Studies I & II; TIE 3112, 3212 - Manufacturing Systems I & II; TIE 2202 - Quality & Reliability Engineering;

### **TIE 5101 Manufacturing Systems III**

Flexible manufacturing systems; materials Components - machines, part movements, supporting workstation, system controller; Systems Planning and Control - control hierarchy, decision hierarchy, system control; Automated manufacturing systems: Automated material handling, inspection, assembly and distribution logistics; Material management systems; JIT, CIM systems and analytical Queuing Models; Prerequisites: TIE 3112, 3212 - Manufacturing Systems I & II; TIE 2111 - Computer Applications;

### **TIE 5103 Manufacturing Process III**

This module looks at powder metallurgy: Production of metal powders, their characteristics, purity, grain size etc; Control and testing Pre-treatments; Pressing, lubricants; Sintering; Injection moulding, film blowing, calendaring, mixing, extrusions; Machining Process: Metal cutting, cutting tools, mechanics of chip removal, economics of cutting, cutting processes, turning, milling, sawing, thread cutting, metal removal rate calculations and grinding.

### **TIE 5105 Business Studies III: Risk Management**

The module is on risk and Insurance: Risk and uncertainty, risk management, administration, transfer mechanism and market organisation.

### **TIE 5111 Computer Aided Design And Manufacturing I**

The module explores Computer Aided Design: Product Design Process, CAD Hardware: CAD/CAM systems: mainframe, minicomputer, workstation microcomputer; Input-output devices, Selection of CAD/CAM systems; Geometric modelling: wireframe modelling, Analytic curves, parametric representation of curves, Hermite cubic spline, Bezier Curves, B-spline; surface modelling: surface entities, surface representation; solid modelling: Boundary representation, validation of Brep using Euler's Law, constructive solid geometry, sweep representation, primitive instancing method, cell decomposition scheme, Octree spatial decomposition; Computer Graphics and transformations; Computer Aided Engineering Analysis, CAD/CAM Data Exchange; Practicals using AutoCAD; 2D and 3D draughting and modelling.

### **TIE 5009 Final Year Project**

The module aims to develop the student's ability to integrate the theoretical, practical and business aspects of manufacturing, and improve communication skills. The duration is 8 hours/week minimum for semesters I and II. Students should supplement this with additional time as the project demands. Projects may be based on a suitable topic arising from the student's industrial training attachment, or they may be suggested by the Industrial and Manufacturing Engineering staff; They should ideally have a broad production engineering theme, involving various aspects of manufacturing, although projects of a more specialised nature are not excluded.

### **TIE 5214 Environmentally Conscious Manufacturing**

The module focuses on managing environmental quality: Introduction, systems, sustainable development, limits to growth and development, environmental problems an externality, environmental quality, indicators of environmental quality, quality criteria, standards and guidelines; Economic concepts and policies for controlling individual waste discharges, economic concepts relating to regional and national environmental quality management; Pollution technology; Waste removal at source, waste removal at discharge point, efficient use of assimilative capacity; The role of models in integrated environmental management, modelling water quality, modelling biographical interactions, ecosystem models; Eco-design and Lifecycle Assessment.

### **TIE 5208 Operations Research**

This module examines optimisation techniques and strategies; Decision theory: games and decision trees Linear programming: graphical, simplex; Assignment and transportation problems Queuing theory forecast methods and inventory theory; Networks and graph techniques. Prerequisites: SMA 2116, 2217 - Engineering Mathematics II and III.

### **TIE 5211 Computer Aided Design and Manufacture II**

This module explores Computer Aided Manufacturing: Numerically controlled machines, benefits of NC machines over conventional machines, computer numerically controlled machines, motion and coordinate system nomenclature for NC machines, NC-Part programming; Preparatory functions (G-codes), axis motion commands, feed and speed commands, miscellaneous commands; Computer-Aided Part Programming Tools (APT); Programmable Logic Controllers (PLC): Logical Control, Programming the PLC, Counters and Timers; Data communication; Local Area Network; Process interface and practical sessions in the Laboratory both simulation and machining.

### **TIE 5205 Business Studies IV: Banking**

The module looks at the objectives, structure, interest, money and inflation, decision techniques and the Zimbabwe financial system.

### **TIE 5009 Final Year Project**

### **ELECTIVES (Choose One)**

#### **TIE 5215 Manufacturing Systems Engineering**

The module explores robotics and Automation: Microprocessors; Components of robots; Robotics programming and industrial applications; Controllers and interface with process machines; Systems Simulation: Concepts; Modelling and analysis techniques for solving complex problems; Introduction to Computer integrated manufacturing: CIM architecture; Control systems in manufacturing; Data communication and part recognition for automated manufacturing.

#### **TIE 5216 Advanced Manufacturing Technology**

The module outlines integrated manufacturing; Computer aided process planning and optimisation; Computer networks in manufacturing; Expert systems in manufacturing Artificial intelligence in manufacturing; Chip less material removal processes; Electric discharge machinery; Electrochemical machining; Chemical milling; Ultrasonic machining; Use of lasers and planning for machine tool operations.

#### **TIE 5217 Manufacturing Strategy**

The module examines strategic management; Production/operations management; Project management Operations research methods for management and technology management.



# **MASTER OF ENGINEERING (M Eng) DEGREE IN INDUSTRIAL AND MANUFACTURING ENGINEERING**

## **1.0 PREAMBLE**

The Department shall offer the following options of Master of Engineering degrees:

- (a) Master of Engineering in Industrial and Manufacturing Engineering (Manufacturing Systems and Operations Management)
- (b) Master of Engineering in Industrial and Manufacturing Engineering: (Manufacturing Engineering and Operations Management)

## **2.0 ENTRY REQUIREMENTS**

The normal entry requirement for the Master of Engineering shall be a Bachelor's Degree at the level of at least a Second Class Honours, Lower Division in Industrial, Manufacturing, Production, or Mechanical Engineering. In some cases, applicants with qualifications which are deemed to be equivalent to the Honours award may be accepted under the Special Entry requirement.

Additionally, all candidates for the Master of Engineering must have at least two years industrial experience.

## **3.0 PROGRAMME REQUIREMENTS**

- 3.1 An approved programme of study consists of core and elective courses with credit points totalling not fewer than 30 credits (10 courses) and 6 credits for the thesis. Of the 30 credits total, 18 credits are allocated to the First Semester. Not less than 18 credits should be taken from the Manufacturing component.
- 3.2 It is therefore important that a candidate admitted to the programme liaises with the Department to ensure that the Department and Faculty regulations are met.
- 3.3 The project leading to a thesis should be carried out under the supervision of an academic member of staff. On completion of the project, a candidate, must after consultation with, and with the consent of the supervisor, present 3 copies of the thesis to the Department.
- 3.4 Successful completion of the programme requires that the candidate passes all courses totalling 30 credits and defending his/her thesis before the Supervisory Committee. The results shall be considered by the Faculty Board of Examiners and shall be subject to approval by the Academic Board of Examiners and Senate.



## **4.0 STRUCTURE OF PROGRAMME**

### **4.1 Full-time Programme**

The MEng programme will require two semesters taught courses work by full-time students. Candidates should pass all the courses taken and complete the dissertation by the end of the academic year in order for the candidate to qualify for the award of the degree.

### **4.2 Part-time Programme**

The MEng programme taken on part-time basis requires the candidate registering for at least 9 credits per semester in order to complete the programme in 2 years. The dissertation will take at least 6 months before submission for oral examination.

### **4.3 Transfer to the Post-Graduate Diploma Programme (PGD)**

A Master of Engineering degree student may transfer to the PGD programme anytime before the commencement of dissertation, if he or she will have satisfied the requirements for the award for the PGD. Should the student change before the completion of two semesters, he or she would be required to plan the rest of the programme to meet the PGD requirements.

## **5.0 AWARD OF MEng DEGREE**

The award of MEng degree shall be in three categories: 80%

and above	-	Distinction
70% - 79%	-	Merit
60% - 69%	-	Credit
50% - 59%	-	Pass
Below 50%	-	Fail

### **5.1 Submission of Thesis for Examination**

Candidates are required to be still registered with the University until submission of their thesis for examination. Three bound copies shall be submitted. One copy shall be for the candidate's supervisor, one for the student, and one for the University Library.

## **6.0 OPTIONS FOR THE MEng. PROGRAMME**

There are two options for the MEng programme:

- a) Manufacturing Systems and Operations Management
  - b) Manufacturing Engineering and Operations Management
- Manufacturing Systems and Operations Management**

<b>Module Courses</b>	<b>Module Description</b>	<b>Credits</b>
TIE 6210	Systems Modelling and Simulation	
TIE 6110	Manufacturing Information & Database Systems	
TIE 6111	Design, Analysis and Control of Manufacturing Systems	
TIE 6220	Automation and Robotics	
TIE 6211	Manufacturing Strategy	
TIE 6230	Quality Systems	
TIE 6134	Operations Management	
TIE 6000	Master's Thesis	

#### **Electives**

TIE 6120	Computer Control of Manufacturing Systems	
TIE 6121	Computer Aided Design & Manufacturing (CAD/ CAM)	
TIE 6132	Logistics	
TIE 6133	Human Factor Engineering	
TIE 6130	Operations Research	
TIE 6231	Management of Technology	
TIE 6232	Selected Topics in Advances in Manufacturing	
EMB 502	Human Resource Management	
EMB 503	Financial and Management Accounting	

### **Manufacturing Engineering and Operations Management**

<b>Module Code</b>	<b>Module Description</b>	<b>Credits</b>
TIE 6122	Manufacturing Technology	
TIE 6220	Automation and Robotics	
TIE 6120	Computer Control of Manufacturing Systems	
TIE 6121	Computer Aided Design and Manufacturing (CAD/CAM)	
TIE 6230	Quality Systems	
EMB 503	Financial and Management Accounting	
TIE 6134	Operations Management	

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*Think in other terms*

TIE 6000 Master's Thesis

**Electives**

TIE 6221 Environmental Conscious Manufacturing  
TIE 6123 Materials Selection  
TIE 6124 Concurrent Engineering  
TIE 6132 Logistics  
TIE 6133 Human Factor Engineering  
TIE 6134 Operations Research  
TIE 6231 Management of Technology  
TIE 6232 Selected Topics in Advances in Manufacturing  
EMB 502 Human Resource Management

## **POST-GRADUATE DIPLOMA (PGD) IN INDUSTRIAL AND MANUFACTURING ENGINEERING**

### **1.0 ENTRY REQUIREMENTS**

The normal entry requirement for the Post-Graduate Diploma in Industrial- and Manufacturing Engineering shall be:

1.1 A Bachelor's degree in related Engineering disciplines as considered by Senate on the recommendation by the Department and Faculty of Industrial Technology.

**OR**

1.2 A Bachelor's degree in Science as considered by Senate on the recommendation by the Department and Faculty of Industrial Technology.

### **2.0 Post-Graduate Diploma (PGD) Structure: Full-time**

The PGD programme will require two semesters of full-time work consisting of core and elective courses with credit points totalling not fewer than 24 credits (6 courses). These courses may be chosen from the MEng courses in Section 6.

### **3.0 Post-Graduate Diploma (PGD) Structure: Part-time**

The PGD programme taken on part-time basis requires the candidates registering for at least 9 credits per semester in order to complete the programme in 2 years. The dissertation will take at least 6 months before submission for oral examination.

### **4.0 Transfer to the MEng Programme**

A Post-Graduate Diploma student may transfer to the MEng programme as long as the candidate satisfies the entry requirements of the MEng and provided the courses are passed at levels acceptable for the award of MEng degree.

# MASTER OF ENGINEERING IN MANUFACTURING ENGINEERING AND OPERATIONS MANAGEMENT

## First Semester Core Courses

### **TIE 6120 Computer Control of Manufacturing Systems**

The module gives an analysis of microprocessor controlled servo loops, adaptive control, state space methods in controlling analysis of NC machines, robots and their controllers and programmable controllers. 3 Credits: 2 Lab; Prerequisites: (TIE 3114, TIE 3214) - Industrial Instrumentation and Control or equivalent.

### **TIE 6121 Computer Aided Design and Manufacturing (CAD/ CAM)**

The module explores design process and design models; Representation of drawings from 2D to 3D; (wireframe, surface and solid modelling); Techniques of geometric modelling; Elements of interactive computer graphics; Standards for CAD; Computer assisted numerical control programming (manually and automated); Principles of CAD/CAM; Integration of design and manufacturing; Simulation or practical sessions in programming; Automated material handling and storage devices as well as Interfacing between **CAD and CAM**. 3 credits: 2 Lec; 2 Lab; Prerequisites: TIE 2109, - Computer Applications, TIE 1002 Engineering Drawing or equivalent.

### **TIE 6122 Manufacturing Technology**

The module looks at conventional and non conventional machining processes; Plastics manufacturing processes; Additive manufacturing techniques and laser engineering; 3 Credits: Lec., 2 Lab Prerequisites: TIE 5105 - Manufacturing Processes III or equivalent.

### **TIE 6134 Operations Management**

The module examines corporate Operations Strategy; Process strategies; Tactical issues: aggregate production planning, master production scheduling; Operational issues: material requirements planning, manufacturing resource planning, scheduling, lot sizing; Capacity planning from aggregate to shop floor levels; Expert systems and manufacturing automation and case studies. 3 Credits: 2 Lec.; 2 Lab.

### **EMB 503 Financial and Management Accounting**

*(see Executive MBA programme)*

## **ELECTIVES**

### **TIE 6123 Materials Selection**

The module looks at functional requirement of engineering materials; Selection for various properties e.g; static strength, stiffness, toughness, corrosion wear, temperature resistance etc; Effect of material properties on design; Effect of manufacturing processes on design; Reliability of engineering components; Role of design in achieving reliability; Role of design materials and manufacturing in achieving reliability; Economics of materials; The selection process and case studies.3 Credits: 2 Lec, 2 Lab Prerequisites: , - Materials Technology II TIE 2204 - Engineering Design or equivalent; TIE 2207.

### **TIE 6124 Concurrent Engineering**

The module examines definitions for concurrent engineering and driving forces; Schemes for CE: Axiomatic design, DFM guidelines, Design science, Design for assembly, Taguchi method for robust design, manufacturing Process Rules, Quality Function Deployment, Failure-Mode and Effect Analysis and value Engineering. 3 Credit: 2 Lec, 2 Lab.

### **TIE 6132 Logistics**

The module focuses on supply chain management: an overview; The role of purchasing; Partnership with suppliers; Distribution management; Process tools for supply chain management; Outsourcing; Lean supply; Regional logistics and global logistics as well as some case studies; 3 Credits: 2 Lec, 2 Lab.

### **TIE 6133 Human Factor Engineering**

The module is on work Study: method study, time study, motion economy; Ergonomics: man-machine inter-action, work conditions; Industrial psychology; Biomechanical models of human at work and case Studies. 3 Credits: 2 Lec, 2 Lab.

### **TIE 6130 Operations Research**

The module covers O/R advanced concepts: integer and mixed programming, network flows programming dynamic programming, goal programming; New O/R directions and applications: in different areas of Industrial/Manufacturing Engineering. 3 Credits: 2 Lectures 2 Lab Prerequisites: - Engineering Mathematics II & III SMA 2116, SMA 2217 or equivalent.

## **Second Semester Core Courses**

### **TIE 6220 Automation & Robotics**

The module explores industrial Robots: An introduction to industrial robots; Classification of robots and their geometries; Robot end-effectors (tooling and grippers); Safety considerations; Programming Industrial Robots: Robot motion control; resolution, repeatability, accuracy and control; Future trends; Robot Animation Teaching Simulation; Robotics Sensing: Robot sensor technologies; Image

acquisition; Computer vision systems: Image processing; Robot programming using sensors; Automated Assembly: Image processing; transfer and parts presentation; Requirements for general purpose assembly; Some problems with assembly; Design considerations in automated assembly; principles of high volume manufacturing systems; Choosing, specifying and justifying a robot system: Evaluation methods for robot capital investment; Evaluation of manufacturing costs and the hierarchy of evaluation justification. 3 Credits: 2 Lec..., 2 Lab; Prerequisites: Dynamics TIE 2106 and 2206 and Instrumentation and Control, TIE 3114, TIE 3214 or equivalent.

### **TIE 6230 Quality Systems**

The module looks at total quality management: overview, principles, levels of adoption; Pioneering works of Deming, Juran, Crosby, Ishikawa, Imai, Shingo and Fiegenbaum; International Standards: Malcom Baldrige, ISO 9000, ISO 14 000; Cost of quality; Quality function deployment; Quality loss function; Total quality tools and techniques as well as case studies; 3 Credits: 2 Lec., 2 Lab Prerequisites: - Engineering Mathematics III SMA 2217 or equivalent.

### **EMBA 503 Financial and Management Accounting**

The module looks at financial accounting: Record-keeping and double entry; The preparation of the Profit and Loss Account and Balance Sheet; Concepts of profit measurement and the valuation of assets; Company Accounts; Legal and Regulatory Framework; Analysis of Company Reports; Accounting for changing price levels; European harmonisation of Accounting: Taxation; Auditing; Management Accounting: Analysis and classification of costs; Absorption and activity based costing; Cost volume profit analysis; Budgeting and Variance Analysis; Budgetary Control and investment appraisal. 3 Credits: 2 Lec., 2 Lab;

### **TIE 6000 Master's Thesis**

6 Credits

## **ELECTIVES**

### **TIE 6221 ENVIRONMENTAL CONSCIOUS MANUFACTURING**

This module examines cleaner production concepts; Eco-design; Explosive and toxic gases, liquid and metallic poisons; airborne dust-causes and prevention; Physiological effects of vitiated and contaminated air; Compiling of a monitoring strategy, management systems for environmental control; Environmental auditing and case studies. 3 Credits: 2 Lec, 2 Lab.

**TIE 6231 Management of Technology**

The module looks at knowledge; Technology; Technology transfer; Research and development infrastructure, interaction, and cooperation; Technology and its environment - social, human, political factors; managing innovation and technology dynamics as well as change dynamics. 3 Credit: 2 Lec, 2 Lab.

**TIE 6232 Selected Topics in Advances in Manufacturing**

The module looks at constraints management; Lean production; Synchronous manufacturing; Business process re- engineering; Time-based competition; JIT, Agile Manufacturing; Value chain concept; The elements of value; Value chain system models as well as selected readings from journal articles. 3 Credits: 2 Lec, 2 Lab.

**EMBA 502 Human Resource Management**

*(See Executive MBA programme)*



# MASTER OF ENGINEERING IN MANUFACTURING SYSTEMS AND OPERATIONS MANAGEMENT

## MODULE SYNOPSES

### Semester I Core Courses

#### **TIE6110 Manufacturing Information & Database Systems**

The module looks at manufacturing Information Systems: Introduction to manufacturing information and data systems; Manufacturing information (Definitions, structure & flow) Database management systems and database models (hierarchical network, relational database, physical structure of databases); Manufacturing application of databases (manufacturing database, relational database design, query language); Manufacturing resource planning systems; Workshops - introduction to SQL (Using ORACLE); data retrieval (database queuing); computer aided database design; table creation and maintenance; SQL views; MRP software. Manufacturing Data Systems: Shop floor data collection systems (bar-codes, file-tronic labels); Computer aided process planning; (definitions, structure & classification); factors affecting design and implementation of CAPP; Data exchange standards (IGES, PDES, STEP); Electronic data inter-change EDI; Networks (seven layer model multi-drop and multiplexed system) (transmission lines). Management of Manufacturing Information and data Systems: Strategic implications of MIDS (value chain, is strategic planning); Information economics and management of change (human factors, tools and techniques). 3 Credits: 2 Lec., 2 Lab. Prerequisites: TIE 2109 and 2210 - Computer Applications I & II or equivalent.

#### **TIE 6111 Design, Analysis And Control of Manufacturing Systems**

The module explores classification of manufacturing systems; Shop scheduling of many products; Flow line design; Assembly lines; Transfer lines and general serial systems; Flexible manufacturing systems; Group technology; Cellular manufacturing system design; Facility layout; Machine setup and operation sequence; Material handling systems; Automated storage and retrieval systems (warehousing); Analytical queuing models (queuing theory) and Metaheuristics expert systems as applied to manufacturing systems. 3 Credits: 2 Lec., 2 Lab Prerequisites: - Manufacturing Systems I & II TIE 3112, TIE 3212 or equivalent.

#### **TIE 6134 Operations Management**

The module examines corporate Operations Strategy; Process strategies; Tactical issues: aggregate production planning, master production scheduling; Operational issues: material requirements planning, manufacturing resource planning, scheduling, lot sizing; Capacity planning from aggregate to shop floor levels; Expert systems and manufacturing automation and case studies. 3 Credits: 2 Lec., 2 Lab.

## **ELECTIVES**

### **TIE 6120 Computer Control of Manufacturing Systems**

The module gives an analysis of microprocessor controlled servo loops, adaptative control, state space methods in controlling analysis of NC machines, robots and their controllers and programmable controllers. 3 Credits: 2 Lec; 2 Lab; Prerequisites: - Industrial Instrumentation and Control TIE 3114, TIE 3214 or equivalent.

### **TIE 6121 Computer Aided Design and Manufacturing (CAD/CAM)**

The module examines design process and design models; Representation of drawings from 2D to 3D; (wireframe, surface and solid modelling); Techniques of geometric modelling; Elements of interactive computer graphics; Standards for CAD; Computer assisted numerical control programming (manually and automated); Principles of CAD/CAM; Integration of design and manufacturing; Simulation or practical sessions in programming; Automated material handling and storage devices and interfacing between CAD and CAM 3 Credits: 2 Lec;, 2 Lab; Prerequisite: - Computer Applications I & II, TIE 2109, 2210, TIE 1002 Engineering Drawing or equivalent.

### **TIE 6132 Logistics**

The module looks at supply chain management: an overview; The role of purchasing; Partnership with suppliers; Distribution management; Process tools for supply chain management; Outsourcing; Lean supply; Regional logistics; Global logistics and case studies. 3 Credits: 2 Lec;, 2 Lab.

### **TIE 6133 Human Factor Engineering**

This module covers work Study: method study, time study, motion economy; Ergonomics: man-machine inter- action, work conditions; Industrial psychology; Biomechanical models of human at work and case studies. 3 Credits: 2 Lec;, 2 Lab;

### **TIE 6130 Operations Research**

This module explores O/R advanced concepts: integer and mixed programming, network flows programming, dynamic programming, goal programming; New O/R directions and applications: in different areas of Industrial/Manufacturing Engineering. 3 Credits: 2 Lec;, 2 Lab; Prerequisites: - Engineering Mathematics II & III SMA 2116, SMA 2217 or equivalent.

## Semester II Core Courses

### **TIE 6220 Automation & Robotics**

The module focuses on industrial Robots: An introduction to industrial robots; Classification of robots and their geometries; Robot end-effectors (tooling and grippers); Safety considerations; Programming Industrial Robots: Robot motion control; resolution, repeatability, accuracy and control; Future trends; Robot Animation Teaching Simulation; Robotics Sensing: Robot sensor technologies; Image acquisition; Computer vision systems: Image processing; Robot programming using sensors; Automated Assembly: Image processing; transfer and parts presentation; Requirements for general purpose assembly; Some problems with assembly; Design considerations in automated assembly; principles of high volume manufacturing systems; Choosing, specifying and justifying a robot system: Evaluation methods for robot capital investment; Evaluation of manufacturing costs and the hierarchy of evaluation and justification. 3 Credits: 2 Lec.; 2 Lab; Prerequisites: Dynamics TIE 2106 and 2206 and Instrumentation and Control, TIE 3114, TIE 3214 or equivalent.

### **TIE 6210 Systems Modelling and Simulation**

The module gives an introduction to Simulation and Modelling; Basic simulation and modelling methodology; sampling, data collection, analysis and visual output modelling complexities and decision making simulation; Basic simulation topics: random numbers; Statistical functions, experimentation; Applied statistical methods for analysis and modelling; Software for simulation courses; Approaches to structuring stimulation; Simulation Examples: Queuing Systems; Inventory Systems; Investment Decisions; Planning and Control; Maintenance; Analysis of Simulation Models; Output Analysis for a Single Model; Comparison and Evaluation of Alternative System Designs. 3 Credits: 2 Lec.; 2 Lab; Prerequisites: - Introduction to Computers SCS 1101, Computer Applications TIE 2109, SMA 2217 - Engineering Mathematics III or equivalent.

### **TIE 6211 Manufacturing Strategy**

The module focuses on content of corporate strategy: strategy formulation at the interface between functions; linking manufacturing with corporate marketing decisions; order-winners and qualifiers; Benchmarking; Choice of process: continuous processing, batch, line, jobbing, project; Technology strategy; flexibility, technology push versus pull strategies; manufacturing strategy and technological opportunities; Focused manufacturing: steps to achieve focus; plant within a plant configuration; focus and product life cycle; Process positioning; core elements of the business; strategies considerations; span of process and product technology; product volume; Levels of vertical integration; Joint ventures, non-equity-based collaboration, long-term contracts, customer-vendor relationships and JIT production. 3 Credits: 2 Lec.; 2 Lab.

**TIE 6230 Quality Systems**

The module highlights total quality management: overview, principles, levels of adoption; Pioneering works of Deming, Juran, Crosby, Ishikawa, Imai, Shingo and Fiegenbaum; International Standards: Malcolm Baldrige, ISO 9000, ISO 14 000; Cost of tools and techniques and case studies. 3 Credits: 2 Lec, 2 Lab; Prerequisites: SMA 2217 - Engineering Mathematics III or equivalent.

**TIE 6000 Master's Thesis (6 Credits)****ELECTIVES****TIE 6231 Management of Technology**

The module explores knowledge; Technology; Technology transfer; Research and development infrastructure, interaction, and cooperation; Technology and its environment: - social, human, political factors; Managing innovation and technology dynamics and change dynamics. 3 Credits: 2 Lec; 2 Lab;

**TIE 6232 Selected Topics in Advances in Manufacturing**

The module examines constraint management; Lean production; Synchronous manufacturing business process re- engineering; Time based competition; JIT, Agile Manufacturing; Value chain concept; the elements of value; Value chain system models and selected readings from journal articles. 3 Credits: 2 Lec; 2 Lab.

**EMB 502 Human Resource Management**