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# FACULTY OF ENGINEERING

***Dean***

*Busiso Mtunzi,* PhD, Physics - Renewable Energy) (UFH) RSA, MSc. - Renewable Energy (UZ) Z’bwe, BTAS - Applied Physics (UZ) Z’bwe, Dip - Vocational and Technical Education (HEXCO) Z’bwe, Membership: - Institute of Electrical and Electronic Engineers (IEEE); Renewable Energy Institute (REI); Association for Renewable Energy Practitioners (AREP); Renewable Energy Association of Zimbabwe REAZ); South Africa Institute of Physics (SAIP)

***Acting Senior Assistant Registrar***

*Qiniso Ndlovu,* MSc in Human Resources Management (LSU) Z’bwe, BComm in Human Resources Management (LSU) Z’bwe, HND in Office Management (HEXCO) Z’bwe.

***Senior Technician***

*Thomas Taapatsa,* MSc in Big Data Science, (NUST) Z’bwe, (BTech (Hons) Information Technology, Harare Institute of Technology Z’bwe, HND, Computer Studies (HEXCO) Z’bwe.

***Chief Secretary***

*Eliza Mapungwana,* ND Secretarial Studies, (HEXCO) Z’bwe, Certificate of Personnel Management, IPMZ, Z’bwe.

***Secretary***

**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 Evening)*

**NORMAL ENTRY**

1. At least 3 ‘A’ level passes in Pure Mathematics, Physics and Chemistry

**Or**

1. At least 3 ‘A’ level passes in Additional 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.

**Or**

1. 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, Metallurgy and any other equivalent qualification plus 1 year post HND working experience.

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

*(Conventional and Evening)*

**NORMAL ENTRY**

At least 3 `A' level passes in Pure/Additional/Mechanical Mathematics, Physics and Chemistry with either Computer Science, Technical Graphics / Drawing 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 of post-HND working experience.

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

*(Conventional and Evening)*

**NORMAL ENTRY**

At least 3 `A' level passes in Pure/Additional/Mechanical Mathematics, Physics and either

Chemistry, Computer science or computing.

**SPECIAL ENTRY**

1. National Diploma in Electronic Engineering or Telecommunication Engineering or Instrumentation and Control or Computer Engineering or in Electric Power plus 2 years post ND working experience.
2. Higher National Diploma in Electronic Engineering or Telecommunication Engineering or Instrumentation and Control or Computer Engineering or Electric Power plus 1 year post HND working experience.

**2.2.4 For admission to the Programme in Fibre and Polymer Materials Engineering**

*(Conventional and Evening)*

**NORMAL ENTRY**

a) 3 A’ Level passes in Mathematics/Additional Mathematics/Mechanical Mathematics/ Pure. Mathematics, Chemistry, and either Physics or Biology or Geography or Statistics or Computer Science or Textile Technology or Engineering Drawing/ Technical Graphics/ Mechanical Technology and Design/ Geometrical and Mechanical Drawing with 5 “O” Level passes including English Language and Mathematics.

Or

b) 3 A’ Level passes in Mathematics/Additional Mathematics/Mechanical Mathematics/Pure Mathematics, and any two from Physics, Biology, Geography, Statistics, Computer Science, Textile Technology, Engineering Drawing/ Technical Graphics/ Mechanical Technology and Design/ Geometrical and Mechanical Drawing with 5 “O” Level passes including Chemistry/Physical Science, English Language and Mathematics.

**SPECIAL ENTRY**

Diploma in Polymer Science and/ Engineering or Fibre Science and Engineering or Chemistry or Rubber Technology or Plastics Technology or equivalent and 2 years of relevant working experience

**2.2.5 For admission to the Programme in Industrial and Manufacturing Engineering**

*(Conventional and Evening)*

**NORMAL ENTRY**

At least 3 `A' level passes in Pure/Additional/Mechanical Mathematics and Physics and either 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 or equivalent plus 2 years post ND working experience

Or

b) HND in Mechanical, Production, Plant Engineering, Draughting & Design and Refrigeration or equivalent plus 1-year post HND working experience.

**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 module in a Part, at dates to be specified.

**5.1 Mode of module Assessment**

The assessment of a module may contain contributions due to formal examinations, continuous assessment and module work. Unless otherwise specified, the formal examination will contribute 75% and continuous assessment/module work will contribute 25% for the final marks. Where appropriate, continuous assessment/module work 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 module work and examination components. Before the commencement of each academic year, Departments will submit to the Faculty Board for approval lists of modules 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 module 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.

**7.0 PROCEEDING TO THE NEXT PART**

7.1 A student may proceed to the next Part on satisfying the examiners in all the modules for the Part.

**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 the modules.

8.2 Students carrying over Courses will be re-examined at the next regularly scheduled examinations for those Courses, normally taken one year later.

8.3 Students may be required by the Senate to undertake Continuous Assessment with their carry-over Courses. This assessment will then be taken into account in the usual way in determining the overall assessment.

**9.0 REPEATING MODULES**

9.1 A student who fails more than 25% of the modules but their aggregate is more than 50% must repeat the Part.

9.2 If a student is repeating a course (s), he /she shall only be credited with the marks obtained during the “repeat” examination. Nevertheless, a repeat student may be exempted from re-attendance and re-examination in any course (s) in which he / she previously passed.

**10.0 DISCONTINUING**

10.1 A candidate who fails more than half of the modules for any year of their programme or obtains an overall aggregate mark of less than 35% shall discontinue.

10.2 'Discontinue' means that the student must discontinue the Programme in which he/she failed. Such a student will be free to apply for admission/transfer into a different programme and his/her application will be considered through the normal admission procedures.

**11.0 WITHDRAWAL**

11.1 A candidate who is not allowed to proceed to the subsequent Part of the Programme, and

a) has passed less than 25% of the modules in that Part of the Programme, or

b) has failed the same Part of the Programme twice, or

c) has failed two different Programmes, will be required to withdraw.

11.2 'Withdraw' means that the student must withdraw from the University. Once 'withdrawn', the student may apply for admission until after a period of two years has elapsed. Student coming in after withdrawal should re-do all courses.

**12.0 INDUSTRIAL ATTACHMENT**

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

**13.0 FINAL YEAR PROJECT ASSESSMENT**

13.1 Mark Allocation

Assessment during the module of the Project shall constitute 50% of the final mark while the final Report and oral examination will account for 50%.

13.2 Overall Pass

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

13.3 Resubmitting / Repeating

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

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

**14.0 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 II 10%

Part III 20%

Part IV 20%

Part V 50%

**14.1 AWARD OF THE DEGREE**

14.1.1 Students are required to satisfy the examiners in all the modules before being awarded the degree.

14.1.2 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***

*Nonhlanhla G. Mguni,* M.Sc. Chemical Engineering, University of the Witwatersrand, Johannesburg, RSA. PGDHE (NUST) Z’bwe, BEng. (Hons) Chemical Engineering, NUST, Z’bwe. PGDHE, NUST, Z’bwe. Membership - ICHEME, SAICHE, FFF.

***Senior Secretary***

*Helga Nyamweda,* BBA, University of South Africa, Advanced Pitman Certificate

**ACADEMIC STAFF**

***Lecturers***

*Stanford Mudono,* MEng. Chemical Engineering, Tsinghua University, Beijing, (China). BSc. (Hons) Chemical Engineering, University of Oriente, Cuba. PGDHE (NUST) Z’bwe, Certificate in Renewable Energy & Nanomaterials (Sweden), PGDMC (China), Post Diploma in Chemical Engineering (China), Membership - ZIE, ECZ, EIZ, RAE.

*Liberty. L. Mguni,* PhD (Science Engineering and Technology)- University of South Africa, M.Tech. (Chemical Engineering)- University of Johannesburg, RSA. BEng (Hons) Chemical Engineering - NUST, Z’bwe.

*Siboniwe Bhebhe,* M.Sc. Chemical Engineering, University of the Witwatersrand, RSA. BEng. (Hons) Chemical Engineering, NUST, Z’bwe. PGDHE, NUST, Z’bwe. Membership – AICHE Z’bwe. PGDHE NUST, Z’bwe. Membership - AMIChemE, AMSAIChE, ZIE.

*Tariro Tecla Manhongo,* PhD in Chemical Engineering, Stellenbosch University, RSA, M.Eng. in Manufacturing Systems and Operations Management, NUST, Z’bwe. BEng (Hons) Chemical Engineering, NUST, Z’bwe.

*Langa.B. Moyo,* PhD, University of Witswatersrand, RSA, M.Sc. Chemical Engineering, University of the Witwatersrand, RSA. BSc (Hons) (Chemical Engineering), University of the Witwatersrand, RSA. Membership – ECSA.

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

*Sokesimbone Ncube,* M.Sc. Chemical/Process Engineering, Erlangen-Nuremberg, Germany. BEng (Hons) Chemical Engineering, NUST, Z’bwe.

*Nomvuyo Tshuma,* Meng in Chemical and Environmental Process Engineering, NUST, Z’bwe

Beng (Hons) Chemical Engineering, NUST, Z’bwe.

*Fortune Nkomo*, PhD (Science Engineering and Technology) - University of South Africa, RSA M.Eng. Manufacturing Engineering and Operations Management, NUST, Z’bwe. BEng (Hons) Chemical Engineering, NUST, Z’bwe, PGDHE, NUST, Z’bwe. Membership - ZIE, ECZ, SAICHE, SAIIE.

***Engineering Instructor***

*Lawrencia Tshuma,* MPhil in Chemical Engineering. NUST, Z’bwe, BEng (Hons) Chemical Engineering NUST, Z’bwe. PGD in Project Management, Z’bwe. National Diploma in Chemical Technology, Bulawayo Polytechnic, Z’bwe.

***Senior Technicians***

*Cleopatra Dube,* BEng (Hons) Chemical Engineering NUST, Z’bwe. Higher National Diploma Applied Chemical Technology Bulawayo Polytechnic, Z’bwe. National Diploma in Applied Chemical Technology, Z’bwe.

*Senzelweyinkosi Ngwenya*, BEng (Hons) Chemical Engineering NUST, Z’bwe.

***Technician***

*Hilda V. Kaitano,* MEng in Chemical and Environmental Processing Engineering NUST, Z’bwe, BEng (Hons) Chemical Engineering NUST, Z’bwe.

**BACHELOR OF ENGINEERING HONOURS DEGREE IN CHEMICAL ENGINEERING**

*The department offers both conventional and parallel programmes.*

**PROGRAMME SUMMARY**

**Part 1 (144) Credits**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credits** |
| ECE 1101 | Process Engineering Fundamentals | 12 |
| ECE 1102 | Engineering Materials | 12 |
| ECE 1103 | Professional Engineering Skills | 6 |
| EIE 1101 | Engineering Drawing | 12 |
| EIE 1103 | Workshop Technology | 12 |
| SCS 1101 | Introduction to Computer Science | 12 |
| SMA 1116 | Engineering Mathematics IA | 12 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credits** |
| ECE 1205 | Computational Methods for Chemical Engineers | 12 |
| TEE 2292 | Principles of Electrical Engineering | 12 |
| SCH 1241 | Inorganic Chemistry for Chemical Engineers | 12 |
| SCH 1221 | Organic Chemistry for Chemical Engineers | 12 |
| SMA 1217 | Engineering Mathematics IB | 12 |
| CTL 1101 | Conflict Leadership and Transformation | 6 |

**Part II**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credits** |
| ECE 2101 | Mass Transfer IA | 12 |
| ECE 2104 | Chemical Engineering Thermodynamics | 12 |
| ECE 2105 | Process Fluid Flow | 12 |
| ECE 2106 | Heat Transfer | 12 |
| ECE 2102 | Transport Phenomena | 12 |
| ECE 2109 | Chemical Engineering Process and Projects Lab IA | 6 |
| SMA 2116 | Engineering Mathematics II | 12 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credits** |
| ECE 2201 | Mass Transfer IB | 12 |
| ECE 2104 | Chemical Engineering Thermodynamics | 12 |
| ECE 2207 | Instrumentation Process Dynamics and Control | 12 |
| ECE 2208 | Reactor Analysis and Design | 12 |
| ECE 2209 | Chemical Engineering Process and Projects Lab 1b | 6 |
| SMA 2217 | Engineering Mathematics III | 12 |

**Part III**

**Semester I**

|  |  |  |
| --- | --- | --- |
| Course Code | Course Title | Credits |
| ECE 3101 | Plant and Equipment Design | 12 |
| ECE 3102 | Reactor Analysis and Design II | 12 |
| ECE 3103 | Minerals Processing | 12 |
| ECE 3105 | Fluid Solid Systems | 12 |
| ECE 3108 | Research Methodology | 6 |
| ECE 3109 | Management and Technopreneurship for Process Engineers | 6 |
| SMA3116 | Engineering Mathematics IV | 12 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credits** |
| ECE 3204 | Separation Processes 1a | 12 |
| ECE 3206 | Process Fluid Flow II | 12 |
| ECE 3207 | Biochemical Engineering | 12 |
| ECE 3209 | Health and Safety In Industrial Plants | 6 |

**PART IV**

**Semester I and II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credits** |
| ECE 4000 | Industrial Exposure | 120 |

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credits** |
| ECE 5101 | Management and Optimization | 6 |
| ECE 5102 | Process Dynamics Modelling and Control IA | 12 |
| ECE 5103 | Chemical Engineering Software Packages | 6 |
| ECE 5104 | Environmental Process Engineering IA | 12 |
| ECE 5107 | Extractive Metallurgy IA | 12 |
| \*\*\* | Elective Course | 6 |

**Part V**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credits** |
| ECE 5202 | Process Dynamics Modelling and Control IB | 12 |
| ECE 5005 | Chemical Engineering Design Project | 30 |
| ECE 5006 | Research and Development Project | 12 |
| ECE 5207 | Extractive Metallurgy IB | 12 |

**TCE\*\*\* Electives / Options**

**ELECTIVES / OPTIONS**

|  |
| --- |
| **Course Code Course Title Credits** |
| ECE 5211 Food Processing Engineering 6 |
| ECE 5217 Industrial Energy Management 6 |
| ECE 5110 Modelling and Simulation of Mineral Processing Systems 6 |
| ECE 5218 Fundamentals of Brewing 6 |
| ECE 5115 Process Quality Management 6 |
| ECE 5219 Renewable Technologies 6 |
| ECE 5212 Nanotechnologies In Process Engineering 6 |

**PART I (144 credits)**

**SEMESTER I**

**ECE 1101 Process Engineering Fundamentals 1A/Principles of Chemical Engineering 1A 12 credits**

Dimensional analysis and units, Process and Process Variables. Material Balances; Material Balance Calculations, Balance on Multiple Unit Processes, Recycle and Bypass, Balance on Reactive Systems, Combustion Reactions. Balances on non-reactive processes, Balances on reactive processes. Material and Energy Balances on Transient Processes. Introduction to Computer Aided Balance Calculations.

Phase Diagrams (P-T diagram) and the Phase Rule. Energy Balances; Energy Balances on Closed Systems, Energy Balances on Open Systems at a Steady State, Tables of Thermodynamic Data, steam tables, Energy Balance procedures, Energy Balances on non-reactive processes, Energy Balances on reactive processes. Energy Balances on Transient Processes. Introduction to Computer Aided Balance Calculations.

**ECE 1102 Engineering Materials 12 credits**

Basic Physical Metallurgy, Phase Diagrams, Microstructures and mechanical properties of metals, Relationship between structure and properties, Stress and Strain, Creep, Selection criteria of materials. Corrosion engineering: Fundamentals of corrosion and oxidation of metals, Localized, 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 , Rubber properties and uses.

**ECE 1103 Professional Engineering Skills 6 credits**

Introduction and Overview (Types of skills), Study Methods, Communication principles and Presentation skills, Letters, Memoranda and Curriculum Vitae/ Resumes. Interview Techniques, Meetings, Written reports, Tables, Graphs Technical articles (Reading, understanding, summarizing), Group / Team dynamics. Ethical conduct and professional accountability. Organization structure and skills, Management, Leadership and Conflict resolution skills, Conceptual and Decision-making skills, Time Management and Effective Time Management skills, Stress Management and mitigation measures, Negotiation skills, Commercial / Business acumen skills.

**EIE 1101 Engineering Drawing 12 credits**

Types of Lines and their Applications; Drawing instruments and Materials Description. Uses and Care; Drawing standards Format, Margins, Scales, Title block, Lettering; Dimensioning Standard Symbols; Geometrical Constructions; Tangency Constructions Drawing of Slopes, Tapers and Gradients; Descriptive Geometry and Projection Drawing; Orthographic projections of Simple Geometrical Solids; Geometrical Solids as Elements of Objects: First Angle Orthographic Projection, Third Angle Orthographic Projections; Axonometric Projections; Drawing of Isometric Views from Three and two Orthographic Projections; Freehand Sketching; Intersection of solids; Development of Surfaces Sectioning of Solids by Plane; Sectional views of Machine Parts; Introduction to assembly drawings - limits and fits.

**SCS 1101 Introduction to Computer Science 12 credits**

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 and Stacks), Problem Solving; Algorithms: Sorting, Compression, Numerical And Encryption; Operating Systems and their Functions:-Process and Memory Management, I/O, Data Communication, Job Control; Processing: - File Structures, Organization And Access, Databases; Fundamentals Of Networks; Simple Program: Initialization, Printing, Comments, Keywords, Constants, Assignment, Expressions.

**SMA 1116 Engineering Mathematics 1A 12 credits**

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, Equations of Lines and Planes.

**EIE 1103 Workshop Technology 12 credits**

Types of Production Workshops; Measuring and Gauging Instruments: Purpose and Language of Measurement and gauging; Reliability and Precision; Units of Measurement; Electrical Measuring Instruments; Chemical Structure Measuring Instruments; Industrial Temperature Measuring Instruments; Gas and Pressure measuring instruments; Machine Shop Practice: Marking out, Hand Sawing and Filing; Drilling; Centre Lathe - Turning and Screw Cutting, Tapping, milling, shaping, planning, boring, grinding. Fabrication Practice: Machinery, Tools and Equipment; Metal joining processes – Soldering and Brazing, Gas welding, electric arc welding, pressure welding, Friction stir welding. Sheet metal marking, layout, bending, cutting and rolling; Automotive Engineering: The engine, engine lubrication, fuel system, cooling system, transmission system, chassis frame, ignition system. Maintenance Engineering: Objectives, types of maintenance, classification, procedure and record keeping, computerized maintenance management systems, equipment operation and maintenance.

**SEMESTER II**

**ECE 1204 Engineering Thermodynamics 12 credits**

Fundamentals concepts of thermodynamics, The First Law of Thermodynamics, The Energy Balance, Volumetric properties of pure fluids, Equations of State, Entropy, Heat effects, The Second Law of Thermodynamics, The Entropy Balance, Control Volume Analysis, Steam Tables, The Rankine Cycle

**ECE 1205 Computational Methods for Chemical Engineers 12 credits**

Introduction to Chemical Engineering drawing symbols, Preparation and interpretation of symbols, sketches, & drawings of various equipment, valves, devices and flow diagrams for chemical engineering applications. Introduction of codes for pressure vessel design, classification of pressure vessels as per codes. Chemical drawing for unit operations Reactor vessels, Heat exchangers, Valves, Pumps, Temperature controllers, Pressure controllers, Mixers, Piping network. Basic Block Flow Diagrams (BFD), Basic Process Flow Diagrams (PFD), AutoCAD Drawing (2D and 3D). MS Vision Packages. Excel Solver and GoalSeek tools (Least-squares method). Introduction to MATLAB and Mathematical. MATLAB environment: types of variables; number format; mathematical operations; built-in functions; graphical display. MATLAB programming: Notion of algorithm; m-files structure; indentation; writing programs and user-defined functions; program debugging; data input and output. MATLAB programming: Structured programming with if-structures and loops (for and while).

**EEE 2292 Principles of Electrical Engineering 12 credits**

Electromagnetic theory, D.C. and A.C. circuit analysis, generators and motors, Transformers. Digital and analogue electronics.

**SCH 1241 Inorganic Chemistry for Engineers 12 credits**

Metals: Occurrence and Industrial Uses, an overview: preparations, structures, bonding, reactions and properties complex formation and sequestering structures, nomenclature stability constants, solubility products, redox properties, commercially important sequestering agents toxic metals and the environment, chemical equilibria in liquid/liquid and liquid/solid multiphase systems influence of pH on solubility and complex formation applications to: electrochemical processes, corrosion extraction and separation of metals water treatment molecular sieves organometallics, including hydrides and carbonyls applications to catalysis

Non-Metals An overview of chemical periodicity and the fundamentals of the structure and properties (melting and boiling points, solubility, colour, stability, toxicity, etc) of compounds of the non-metallic elements. Preparations, structures, reactions and properties of representative compounds and materials special emphasis on the elements: H, C, Si, N, P, O, S, Cl. Applications to energy supply, fertilizer, pulp and paper, oil and gas, ceramics, explosives, polymer, detergent and the chemical industries generally and in environmental chemistry (air and water quality). Chemical equilibria in gas/liquid, gas/solid and gas/liquid/solid multiphase systems.

**SCH 1221 Organic Chemistry for Engineers 12 credits**

Structures and bonding in organic molecules. Alkanes, alkenes, dienes and alkynes. Introduction to organic reactions and mechanisms. Stereochemistry, Benzene and its derivatives, Cyclohexane and carbohydrates, Amino acids, Function of various Spectroscopes.

**SMA 1216 Engineering Mathematics 1B 12 credits**

Functions of Several Variable; Partial Derivatives: Chain Rule. Application of Maxima and Minima Problems, Lagrange Multipliers to Engineering; Linear Algebra: Matrices: Basic Operations, Rank, Inverses; Systems of Linear Equations, Gaussian 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 (132 credits)**

**SEMESTER I**

**ECE 2101 Mass Transfer IA 12 credits**

Principles and introduction to mass transfer mechanisms, Maxwell Stefan model, Stagewise operations, Estimation of diffusion coefficients, Fick’s law, Steady – state Diffusion processes, Diffusion in laminar flow and turbulent flow. Transport process analogies, Mass transfer in flow past miscellaneous shapes, Mass transfer to single spheres, Mass transfer by convection, Application of dimensional analysis, Newton’s law of cooling, Forced and natural convection, Convection through laminar and turbulent flow. Correlations for calculation of mass transfer coefficients by convection. Unsteady-state diffusion. Unsteady-state Mass transfer by convection, Application of dimensional analysis, Correlations for calculation of mass transfer coefficients by convection under unsteady-state conditions. Interphase mass transfer theories, Calculations of Interphase Mass transfer coefficients.

Distillation with reflux; Distillation equipment; McCabe Thiele method; Lewis Sorel method; Ponchon Savarit method. Gas adsorption and desorption, principles of mass transfer; Maxwell Stefan model; Stage wise operations Binary distillation processes; Distillation with reflux; Distillation equipment; McCabe-Thiele method; Lewis-Sorel method; Ponchon Savarit method.

**ECE 2102 Transport Phenomena 12 credits**

Fluid flow: Fluid mechanics and properties, Properties of Fluids; Viscosity; Newtonian and Non Newtonian Fluids, Statics Hydrostatic pressure; Manometry pressure measurement, Dynamics The continuity equation; The Bernoulli Equation; Applications of the Bernoulli equation.

Mass Transfer: Basic Introduction to mass transfer mechanisms, Estimation of diffusion coefficients, Fick’s law, Steady state Diffusion processes, Diffusion in laminar flow and turbulent flow state Diffusion processes, Diffusion in laminar flow and turbulent flow. Transport process and Transport process analogies, Mass transfer in flow paalogies, Mass transfer in flow past miscellaneous st miscellaneous shapes, Mass transfer to single spheres, Mass transfer by convection, shapes, Mass transfer to single spheres, Mass transfer by convection, Application of dimensional analysis, Newton’s law of cooling, Forced Application of dimensional analysis, Newton’s law of cooling, Forced and natural convection, Correlations for calculation of mass transfand natural convection, Correlations for calculation of mass transfer er coefficients by convection. Incoefficients by convection. Interphase mass transfer theories, terphase mass transfer theories, Calculations of Interphase Mass transfer coefficients. Heat Transfer: Calculations of Interphase Mass transfer coefficients. Heat Transfer: Introduction to Mechanisms of heat transfer, Steady State Conduction, Introduction to Mechanisms of heat transfer, Steady State Conduction, Forced and Natural Convection, Reynolds Analogy, Forced and Natural Convection, Reynolds Analogy, Heat Transfer Film and Transfer Film Coefficient Correlations, LMTD Heat Transfer Design, Fouling Factors, relations, LMTD Heat Transfer Design, Fouling Factors, Radiation. Radiation.

**ECE 2104 Chemical Engineering Thermodynamics 1A 12 credits**

Thermodynamics properties of fluids, Thermodynamics to flow processes, Production of Power from Heat, Refrigeration and Liquefaction

**ECE 2105 Process Fluid Flow 12 credits**

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;

**ECE 2106 Heat Transfer 12 credits**

Introduction to Mechanisms of heat transfer, Fourier’s law. Steady State Conduction, Application of dimensional analysis. Forced and Natural Convection, Newton’s law of cooling. Reynolds Analogy, Heat Transfer Film Cficient Correlations under steady and unsteady state conditions. 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, Evaporators.

**ECE 2109 Chemical Engineering Process and Projects Laboratory 1A 6 credits**

Introduction to laboratory practice; Safety in the laboratory, Relevant analytical equipment and techniques, Handling of wastes. Series of practicals based on Part I and Part II courses. Experimental studies of unit operations.

**SMA2116 Engineering Mathematics II 12 credits**

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.

**SEMESTER II**

**ECE 2201 Mass Transfer 1B 12 credits**

Gas Absorption/Stripping: Mass transfer in continuous contact separation processes. Calculating the height of packed columns. The effect of temperature and pressure on gas absorption and stripping. Liquid-liquid extraction, Leaching, Humidification and dehumidification, Drying of process material, Cooling towers.

**ECE 2204 Chemical Engineering Thermodynamics 1B 12 credits**

Solution Thermodynamics Theory; Solution Thermodynamics Applications; Vapour Liquid Equilibrium (VLE) at Low to Moderate Pressures; Phase Equilibria; Chemical Reaction Equilibria;

**ECE2207 Instrumentation, Process Dynamics & Control 12 credits**

Balances; the concept of models; Laplace Transforms; transfer functions; parameters of transfer functions; transfer function block diagram algebra, typical linear systems responses.

**ECE 2208 Reactor Analysis and Design 12 credits**

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.

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; Residence Time Distribution Functions for Non-Ideal Flow Reactors.

**ECE 2209 Chemical Engineering Process and Projects Laboratory IB 6 credits**

Series of practicals based on Part I and Part II courses. Laboratory equipment calibration. Given a problem to be addressed by operating a chemical engineering laboratory equipment, devise an experimental approach

**SMA 2217 Engineering Mathematics III 12 credits**

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. Applications to engineering problems.

**PART III (114 credits)**

**SEMESTER I**

**ECE 3101 Plant and Equipment Design IA 12 credits**

Introduction to Fundamentals of Process Plant and Equipment Design, Layout and planning. Basic Design of Piping Systems, Layout and Design Requirements. Design of chemical processes with emphasis on health, safety and environmental aspects, Optimum operating and economic conditions. Economic analysis, depreciation, taxes, investment and profitability. Development of block diagrams, process flowsheet, piping and instrumentation diagram based on fundamental plant and equipment design and control principles. Application of Software packages.Mechanical design of various pressure vessels applied in chemical processing industries. Basic calculation procedures for design of process equipment with examples presented and discussed to enhance skills in design techniques. Procedures for preparation of process data and equipment design specification requirements. Project cost estimation using software packages. Process Integration and Pinch Technology. Computer Aided Design Techniques.

**ECE 3102 Reactor Analysis and Design II 12 credits**

Fluid - fluid reactions: - kinetics and mass transfer, rate equations, design for reaction towers. Fluid - Particle reactions, reaction models for noncatalytic 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.

**ECE3103 Minerals Engineering IA 12 credits**

Introduction to Mineral Processing; Ore Handling, Particle size analysis, Principles of comminution, Crushing; Grinding, Industrial Screening, Classification; - Design of comminution circuits. Case studies: Coal Processing, Diamond Processing, Platinum ore processing, Lithium ore processing.

Introduction to mineral ore concentration, Gravity concentration, Dense Medium Separation,

Flotation, Froth Flotation, Flotation kinetics, Magnetic and High Tension Separation, Dewatering and Tailings Disposal. Mineral Processing Circuits - use principles of size reduction and concentration to design processes for the separation of minerals from waste for different types of ore. Coal, Diamond Lithium and Platinum processing.

**ECE3105 Fluid-Solid Systems 12 credits**

Introduction to powder technology; Particulate systems; Particle characterization; Particle size measurement; Particle size distribution; Particle Formation (Granulation, Size Reduction); Storage handling and Transport (Hopper Design, Pneumatic Conveying, Standpipes, Slurry Flow). Fluid-solid separations: Sedimentation, Filtration, Cyclones and hydro-cyclones, Electrostatic precipitators, Mixing and agitation.

**ECE 3108 Research Methodology 6 credits**

Introduction and overview, Problem assortment, Literature Review, Hypothesis and Postulation, Data Accumulation and Processing, Scientific writing skills and presentations.

**ECE3109 Management and Technopreneurship for Process Engineers 6 credits**

Characteristics and Importance of a Technopreneur; Creativity and Innovation; Intellectual Property Types and Registration; Business Organization, Business plans, Generating, evaluating and presenting saleable business ideas, Commercialization; Financial Options; Marketing of Products, competitive strategy, Growth and sustainability.

**SMA 3116 Engineering Mathematics IV 12 credits**

Differential equations (the wave equation, the one dimensional heat flow problem) 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. Approximate solution of differential equations.

**SEMESTER II**

**ECE 3204 Separation Processes 1B 12 credits**

Introduction to separation processes; UNIFAC and UNIQAC methods; Super critical fluid extraction; Bio-separations; Crystallization: Nucleation processes, Crystal growth, Heat effects, Design of crystallizers; Membranes: Membrane fluxes and membrane characteristics. Asymmetric membranes. Centrifuges, Reverse osmosis. Filtration: Ultrafiltration and Microfiltration. Adsorption: Adsorption Isotherms. Chromatograph; Ion Exchange.

**ECE 3206 Fluid Flow II 12 credits**

Fundamental concepts: The continuum hypothesis and mathematical implications; Analytical Classification of Flow Phenomena; Lagrangian and 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 and 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, Boundary layer analysis.

**ECE3207 Biochemical Engineering 12 credits**

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, scale up, configuration and construction, Ideal reactor operation: sterilization, control, optimisation. Downstream processing.

**ECE 3209 Health and Safety in Industrial Plants 12 credits**

The course teaches the fact that 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 & life cycle analysis and HAZOP.

**PART IV (120 credits)**

**ECE 4000 Industrial Exposure 120 credits**

Industrial Training Attachment training covers application of knowledge gained to real life situations in the industry. The training program should cover Materials Handling and Storage, Production, Marketing among other engineering functions. Students should carry out real life design projects at various stages in their training to assist practical learning. During the training period, the student will be assigned an Academic Supervisor from the university who will work together with an Industrial Supervisor from the company of attachment. The minimum period for Industrial Training and Attachment shall be 300 hours.

**PART V (120 credits)**

**SEMESTER I**

**ECE 5101 Management and Optimization 6 credits**

Introduction to Analytical and Numerical Optimization Techniques; La-Grangian multipliers, Sequential Search, Simplex acceleration, Linear programming, Network analysis, Introduction to Project Planning, Forecasting, Budgeting, Probability Theory for Decision Making.

**ECE 5102 Process Dynamics, Modelling and Control IA 12 credits**

Design of feedback controllers, feed forward and other structures; Modelling Tools for process control dynamics, modelling the static and dynamic behaviour of processes and control strategies; The Routh-Hurwitz test; Root locus analysis; Frequency response techniques; Control systems design techniques and applications to processes.

**ECE 5103 Chemical Engineering Software Packages 6 credits**

Overview of Chemical Engineering Software Packages and Categories i.e. MatLab, ASPEN, SuperPRO, Solidworks, ChemCAD, Pro/II, CFX, LabVIEW (Mathematic, Process & Flow simulators) Basics of modelling and simulation chemical engineering process (Batch, Continuous / Steady & Unsteady state). Fundamental laws for modelling chemical engineering processes, Process Units, Process Streams, Mass & Energy Balances, Process Flow Diagrams Modelling/Process simulation of separation processes. Modelling / Process simulation of heat transfer processes (i.e. Heat Exchangers, Boilers), Modelling /Simulation of chemical reactors. Overall Plant process simulation, Process Scheduling, Gantt Charts, Labour Resource planning, Equipment sizing. Financial and Costing (Project Economic Evaluation). Application processes i.e. Environmental Process Engineering, Mineral Processing, and New Product Development.

**ECE 5104 Environmental Process Engineering IA 12 credits**

Laws on Industrial Waste, Industrial waste classification (Solid, Liquid, Air), solid waste management, characteristics. Identification of Solid pollutants in Production lines. Impact on solid waste on Environment & Health. Technologies – Solid waste treatment. Design of Solid Waste Treatment Plants & Disposal Technologies. Calculations: Solid waste treatment. Case Studies – Solid Waste Treatment. Industrial Liquid/Effluent (Waste Management, Characteristics). Identification & Impact on Environment, Sewerage & Health. Technologies – Liquid wastewater treatment. Design – Liquid wastewater treatment. Waste minimization. Case studies (Liquid wastewater treatment plants). Calculations: Liquid waste treatment. Environmental Sampling, Storage & Analysis. Solid and Liquid Waste characterisation equipment.

Introduction and Overview; Air Quality Regulations, Industrial gaseous waste management. Pollution Cycle, Identification of gaseous pollutants in a production line, Characterization of industrial gaseous waste. Noise pollutants (indoor and outdoor), Impact of industrial gaseous waste and noise pollution on the environment and health, Technologies for air/gaseous waste and noise control. Design of equipment and plants for air/gaseous waste and noise pollution control, Environmental Impact Assessment (EIA), Life Cycle Analysis, Pollution Sampling and Analysis. Calculations: Gaseous waste treatment, Integrated Solid, Liquid and Gaseous waste treatment systems, Energy Management and Conservation aspects in Integrated (Solid, Liquid & Gaseous) waste treatment systems

**ECE 5107 Extractive Metallurgy 1A 12 credits**

Unit operations in pyro-metallurgy; Fuels, coke making; fluxes; Concentrate pre-treatment processes and equipment, Smelting furnaces and reactions, Refining processes and Extraction and uses for selected metals e.g. Cu, Fe, Zn, Cu, Al, PGMs, Ni, Pb

**SEMESTER II**

**ECE 5202 Process Dynamics, Modelling and Control IB 12 credits**

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 optimization; Introduction to PLC.

**ECE5005 Chemical Engineering Design Project 30 credits**

The project involves the conceptual and process design of a modern industrial process, such as a platinum processing plant, a sugar refinery or separating crude oil to its fractions. The project is performed in groups of about five students, and includes all the important aspects of Chemical Engineering design: process flow sheet development, equipment sizing, control, economics, safety and environmental considerations. A major feature of the project is the use of modern IT tools such as process simulators, mathematical tools, drawing packages, and materials databases. Students prepare a report and presentation on their design.

Breakdown of design project requirements: Conceptual Design- use of products and its forms, markets and competition, alternative process routes site location, costing. Basic Process Design- Process flow diagram, equipment list, mass and energy balances. Chemical Engineering specific design(selected item)- Design specification, P&ID, Mechanical Engineering design, Process Control commentary, Energy integration scheme. Other- Plot plan, utilities schedule, Labour requirements, Safety and environmental considerations, Profit forecast, HAZOP analysis. Process Intensification.

**ECE5006 Research and Development Project 12 credits**

Each student undertakes a Research Project, the project is an original piece of research that is closely supervised by a member of staff. The projects available reflect the various research activities in the Department. The research critically involves experimental work. Some projects support ongoing research activities in industry while others are investigations leading to new research programmes. Successful projects sometimes lead to students becoming authors of publications in the scientific literature.

**ECE 5207 Extractive Metallurgy 1B 12 credits**

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 metals, Halide extraction, chlorination processes, reduction of halides.

**TCE\* Options**

**Electives**

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| **ELECTIVES / OPTIONS** |
| **COURSE CODE** | **COURSE TITLE** |
| ECE5211 | Food Processing Engineering |
| ECE5217 | Industrial Energy Management |
| ECE5110 | Modeling And Simulation Of Mineral Processing Systems |
| ECE5218 | Fundamentals Of Brewing |
| ECE5115 | Process Quality Management |
| ECE5219 | Renewable Technologies |
| ECE5212 | Nanotechnologies In Process Engineering |

**ECE 5211 Food Process Engineering 6 credits**

Scope and importance of food engineering, Processing methods, Preservation by drying, Preservation by low temperature, Food conversion operation

**ECE 5217 Industrial Energy Management 6 credits**

Introduction to energy conservation. Supply-demand data. A study of energy audits, rate structures, waste heat recovery, cogeneration and computerized energy management systems. A study of energy auditing, rate structures, economic evaluation techniques, investment analysis and energy legislation, waste heat recovery, lighting efficiency improvement, HVAC optimization, combustion and use of industrial waste, steam generation and distribution system performance, Distributed Digital Control systems, computerized process energy management, and maintenance considerations.

**ECE 5110 Modeling and Simulation of Mineral Processing Systems 6 credits**

What is simulation and why is it the most significant engineering tool of the 20th century?

Use of Matlab and Modsim. Data and information that is required to simulate mineral processing plants successfully. Modeling and simulation of crushing, grinding plants, gravity separation plants, flotation plants, Comminution plants, Mineral liberation and comminution, simulating complex plants, Simulation of plants of interest

**ECE 5218 Fundamentals of brewing 6 credits**

Brewing raw materials, Milling, Mashing, Wort separation, boiling and clarification, yeast fundamentals, Fermentation, Maturation and cold storage, Beer clarification, Properties of beer.

**ECE5115 Process Quality Management 6 credits**

Quality management theory and practice, Quality management systems development, ISO quality systems, Process control and capability in relation to quality assurance

**ECE 5219 Renewable Energy Technologies 6 credits**

Introduction to Renewable Energy and Sustainable Environmental Systems, Waste Fuels to Energy, Biogas, Biomass & Biofuels, Solar Thermal and Solar Electric (PV), Heat Pumps, Hydro Power, Wind systems, Geothermal systems, Integrated Renewable Systems, Energy Storage systems (Fuels Cells) for Renewable systems, Techno-economical assessments of renewable energy systems, Environmental assessments of renewable energy systems and conventional fossil fuel systems. Design renewable/hybrid energy systems that meet specific energy demands, economically feasible and have a minimal impact on the environment.

**ECE 5212 Nano technology in Process Engineering 6 credits**

Introduction, nanoscale phenomena, nanoparticles, carbon nanostructures, nanowires, nanostructured materials, other nanoscale characterization, nanoscale devices and systems. Examination of basic nanomaterials, nanostructures, and processes used in nanotechnology including nanotubes, nanorods, colloids, dots, clusters, wires, platelets, shells, and films. Applications of nanotechnology.

**MASTER OF ENGINEERING IN CHEMICAL AND ENVIRONMENTAL PROCESS ENGINEERING (MENG-CEPE)**

**ENTRY REQUIREMENTS (MENG-CEPE)**

Applicants must be holders of a BSc Honours Degree with a degree class of at least a Lower Second Class (2.2) in Chemical Engineering or related disciplines such as Environmental Engineering, Applied Biochemistry, Applied Chemistry, Metallurgical Engineering, Chemical Technology, Process Engineering or Petrochemical Engineering from an accredited college or university.

Post qualification work experience is an added advantage.

**NB** Admission into the programme will be subject to adequate numbers of applicants qualifying.

**DURATION**

The programme duration shall be as follows:

Two (2) years minimum

Four (4) years maximum.

**STRUCTURE OF THE PROGRAMME**

The MEng programme will consists of two (2) parts which are:

**Part I:** This will be the first year which will be made up of two semesters.

**1st Semester:** In this semester, the programme will consist mainly of coursework. The coursework will consist of four (4) core modules.

**2nd Semester**: In this semester, the programme will consist mainly of coursework. The coursework will consist of four (4) core modules and a seminar.

**Part II:** This will be the second year which will be made up of two semesters.

**1st Semester:** In this semester, the programme will consist mainly of coursework. The coursework will consist of three (3) core modules, one (1) elective module and a seminar. In the beginning of the semester, the students are to present their Dissertation proposal which shall be assessed by a panel selected by the department.

**2nd Semester:** In this semester, the programme will consist mainly of Dissertation writing.

Lectures shall be conducted on a part-time basis in a block period of 4 weeks in each semester. Students shall be given coursework during the remaining 10 weeks of the semester and online learning tools will also be adopted for further interaction with students during this period. Students shall sit for examinations at the end of the semester.

**EXAMINATIONS**

Formal examination will take place at the end of each semester.

Examinations will be subject to external assessment.

A student who has completed eleven (11) core modules, two (2) seminars, one (1) elective module and Dissertation, having a total of 318 credits would have successfully completed the programme. Each student will have two supervisors for the dissertation, one internal and one external supervisor (could be from any other tertiary institution or related field with necessary qualifications to supervise a master’s programme). There will be a panel that will be selected by the department which will assess both the written dissertation and its oral defense.

**ASSESSMENT**

**Module Assessment**

All core and elective modules shall be assessed as follows:

1. 40 % continuous assessment (practicals, tests and assignments, presentations)

2. 60 % examination / dissertation

The General Academic Regulations shall apply for candidates who fail to satisfy Examiners.

The dissertation shall be assessed as follows:

a) Pass with no revision (including designation of mark)

b) Pass with minor revision required followed by re-submission for evaluation solely by the dissertation supervisor

c) Pass with major revision required followed by re-submission for evaluation by full panel of academic assessors

d) Fail without elective for re-submission.

A candidate who fails the dissertation may be allowed to repeat as per the General Academic Regulations.

**Degree Classification and Award of Degree**

The award of the MEng degree will be as follows:

Distinction 80 % - 100%

Merit 70 – 79 %

Credit 60 – 69 %

Pass 50 – 59 %

Fail below 50 %

To be eligible for the award of MEng in Chemical and Environmental Process Engineering degree, a candidate must pass all modules constituting the programme inclusive of the dissertation and earn a total of 318 credits.

A candidate who passes all taught modules of the programme, but fails the dissertation twice, shall be awarded the Post Graduate Diploma in Chemical and Environmental Process Engineering.

**Weighted Part Contribution to the Final Degree Mark**

1. Part I 49 %

2. Part II 51 %

3. Dissertation contributes 48% in the second year modules and contributes 25% to the whole program

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| **PART 1 OF MEng IN CHEMICAL AND ENVIRONMENTAL PROCESS ENGINEERING** |
| **156 CREDITS** |
| **SEMESTER** | **COURSE NAME** | **COURSE CODE** | **CREDITS** |
| **1** | Introduction to Chemical and Environmental Process Engineering | TCE 6101 | 18 |
| **1** | Advanced Chemical Engineering Thermodynamics | TCE 6102 | 18 |
| **1** | Advanced Research Methodology | TCE 6103 | 18 |
| **1** | Entrepreneurship and Innovation | TCE 6104 | 18 |
|  | Total Credits Semester I |  | 72 |
|  |  |  |  |
| **SEMESTER** | COURSE | CODE | CREDITS |
| **2** | Chemical and Environmental Process Engineering I | TCE 6201 | 18 |
| **2** | Seminar I | TCE 6202 | 12 |
| **2** | Advanced Chemical Engineering Transport Phenomena | TCE 6203 | 18 |
| **2** | Process Control | TCE 6204 | 18 |
| **2** | Chemical Process System Engineering | TCE 6205 | 18 |
|  | Total Credits Semester II |  | 84 |

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| **PART 2 OF MEng IN CHEMICAL AND ENVIRONMENTAL PROCESS ENGINEERING** |
| **162 CREDITS** |
| **SEMESTER** | **COURSE NAME** | **COURSE CODE** | **CREDITS** |
| **1** | Chemical and Environmental Process Engineering II | TCE 7101 | 18 |
| **1** | Reactor Technology | TCE 7102 | 18 |
| **1** | Water Chemistry for Engineers | TCE 7103 | 18 |
| **1** | Seminar II | TCE 7104 | 12 |
| **1** | Elective\*\* |  | 18 |
|  | Total Credits Semester III |  | 84 |
|  |  |  |  |
| **SEMESTER** | **COURSE NAME** | **COURSE CODE** | **CREDITS** |
| **2** | Dissertation | TCE 7200 | 78 |
|  | Total Credits Semester IV |  | 78 |
|  |  |  |  |
|  | ELECTIVE\* |  |  |
|  | Effluent management for the Food and Beverage Processing Industry | TCE 7105 | 18 |
|  | Waste treatment in the Minerals Industry | TCE 7106 | 18 |

**11.0 PROGRAMME STRUCTURE**

**TCE 6101 - Introduction to Chemical and Environmental Process Engineering**

Module Content:

1. Mass and Energy Balances

2. Unit Operations in Chemical Engineering

3. Overview of Chemical and Environmental Process Engineering in Industrial Systems

4. Life cycle assessment in Industrial Systems

5. Environmental impact analysis

6. Sustainable development

7. Environmental laws (EMA, EPA, WHO, UN)

8. Circular economy

9. Green engineering

**TCE 6102 - Advanced Chemical Engineering Thermodynamics**

Module Content:

1. The theory of partial and total differentials and the chain rule of differentiation.

2. Energy functions, fundamental relations and canonical variables.

3. Equations of state for the fluid state.

4. Control volume theory applied to kinetic, potential and chemical energies. Thermodynamic equilibrium.

**TCE 6203 - Advanced Chemical Engineering Transport Phenomena**

Module Content:

1. Steady and un-steady state diffusion in dilute and concentrated fluids in different geometries.
2. The Fick and Stefan-Maxwell equations, multicomponent diffusion. Diffusion in porous media.
3. Generalised equations for momentum, mass and heat flow. Laminar and turbulent boundary layers. Mass transfer models.
4. Simultaneous heat and mass transfer and transfer analogies. Introduction to Matlab (Solving ordinary differential and partial differential equations, discretization).

**TCE 6204 – Instrumentation and Process Control**

Module Content

1. First-principle modelling of physical-chemical-biological processes.
2. Transcription into the state-space and linearisation yielding the classical {A, B, C, D} representation: the Linear Time-Invariant System.
3. Laplace transform and transfer function matrix. Graphical representation as block diagrams and frequency plots with a focus on Bode plots.
4. Stability for LTI systems: eigenvalue / pole criterion, Nyquist and Routh criterion.
5. Simple graphical process identification of first-order plus dead-time systems.
6. Model simplification starting with higher-order transfer functions.
7. SISO pole-placement design yielding variations of PID controllers.
8. On-Off control.
9. Introduction to computer-controlled systems.
10. Discrete version of PID with filter and anti-windup.
11. Aliasing and filtering.
12. Advanced subjects: selection of observability and controllability, similarity transformation, MIMO-systems relative gain array, decoupling, model-predictive control and supervisory control.

**TCE 6205 - Chemical Process System Engineering**

Module Content:

1. Process modelling the basis of computational engineering: Review on the systematic construction of dynamic models for physical-chemical-biological processes. Extension into large-scale models and their abstraction into network models and the application of time-scale assumptions leading to cruder process descriptions on a longer time scale.
2. Analysis of linear and nonlinear dynamics:

Focus on stability with possible excursions into observability and controllability.

1. Matching the model to the process:

Focus on multi-dimensional regression and variance analysis of linear-in-parameter models. Extension to system identification of basic dynamic models. Nonlinear parameter identification and model-based design of experiments.

1. Hybrid systems:

Discrete-event dynamic systems and their interaction with continuous processes aiming at supervisory control, planning and logistic issues.

**TCE 7101 - Chemical and Environmental Process Engineering II**

Module Content:

1. Gaseous Waste Management
2. Sources and Origins
3. Environmental, Health and Climate Impact
4. Remediation
5. Environmental Laws

**TCE 7102 - Reactor Technology**

Module Content:

1. Overview and description of selected reactor types applied in industry, with main focus on fixed bed, Fluidized bed, multiphase reactors, and stirred tank reactors.
2. Discussion on the development of the underlying sub-models composing a reactor model: Chemical kinetics, thermodynamics, flow- and transport processes, and physical data.
3. With basis in simple reactor model types, homogeneous and heterogeneous models will be developed for multiphase reactors. Further discussions on dynamics, non-ideal flow patterns, analysis based on residence time distribution functions, and population balance models.
4. The importance of catalysis as a key technology in chemical and petrochemical industry, in energy production and for the protection of the environment.
5. Definition of catalysis, elementary reactions, chain reactions and catalytic sequences. Adsorption, desorption, surface area and porosity. Langmuir-Hinshelwood kinetics.
6. Kinetic modelling. Catalyst preparation and characterisation.
7. Modern theories for surfaces and surface reactions.
8. Internal and external mass and heat transfer in catalyst particles. The effect of diffusion on reaction kinetics.
9. Multifunctional catalysis. Catalysis by transition metal complexes. Ziegler-Natta and single-site polymerization catalysts.

**TCE 7103- Water Chemistry for Engineers**

Module Content:

1. The module provides an introduction to primarily aqueous-phase equilibria governing water quality characteristics of interest in portable water supply, wastewater treatment and natural waters.

Specific topics covered include acid-base and metal-ligand equilibria, oxidation-reduction reactions and chemical reaction thermodynamics. There is some emphasis on equilibria governing inter-phase (gas-liquid, solid-liquid) chemical distribution.

2. Mathematical approaches to prediction of equilibrium chemical speciation are stressed.

Graduate-level requirements include the application of canned computer algorithms to solve

equilibrium chemistry problems.

**TCE 7104 - Seminar 2**

**Module Content:**

Presentations of skills simulated or taught in research methodology and gained in Seminar 1 to be implemented in the presentation of projects proposals for the dissertation.

**TCE 7105 – Effluent Management in the Food and Beverage Processing Industry**

Module Content:

1. Solid waste sources, quantities, hazardous characteristics, quality and standards.
2. Solid waste treatment, handling and disposal.
3. Solid waste chemistry and sampling methods. Water pollution in the food-beverage industry and requirements for treatment.
4. Wastewater chemistry, flow rates and collection systems and sampling methods.
5. Wastewater treatment technologies.
6. Gaseous waste, quantities, hazardous characteristics, quality and standards.
7. Gaseous waste treatment technologies.

**TCE 7106 - Waste Treatment in the Minerals Industry**

Module Content

1. Solid waste sources, quantities, hazardous characteristics, quality and standards.
2. Solid waste treatment, handling and disposal.
3. Solid waste chemistry and sampling methods. Water pollution in the minerals industry and requirements for treatment.
4. Wastewater chemistry, flow rates and collection systems and sampling methods.
5. Wastewater treatment technologies.
6. Gaseous waste, quantities, hazardous characteristics, quality and standards.
7. Gaseous waste treatment technologies

**TCE 7200–Dissertation**

Module Content:

The dissertation helps students to consolidate theoretical knowledge gained in the taught section of the programme by completing a research project. Proposals for the dissertation shall be carried out in the first semester of second year. Second semester second year will be dedicated to the dissertation which should be handed in on a date to be announced by the department. The dissertation will be presented before a panel with a minimum number of 4 PhD holders in relevant disciplines.

**DEPARTMENT OF CIVIL AND WATER ENGINEERING**

***Lecturer and Acting Chairman of Department***

*Felix M. Mudhindi,* MSc CPM (NUST, Z’bwe), Msc Sanitation & Wastewater (UZ)-Cand, PGDHE (NUST, Z’bwe), B.Eng (Hons) Civil & Water Eng ( NUST, Z’bwe), Membership -International Water Association, Z’bwe

***Acting Secretary***

*Neria Makombe,* National Diploma in Secretarial Studies, Bulawayo Polytechnic, Z’bwe.

***Academic Staff***

***Lecturers***

*Pascal Kamwemba,* Msc (Mine Eng Survey) Moscow, Russia.

*Ellen Mangore-Nduna*, Mphil (Civil & Water Eng) NUST, Z’bwe, B.Eng.(Hons), (Civil & Water Eng) NUST, Z’bwe.

*Kudzai Mushunje,* PHD Civil.Eng (Witwatersrand) RSA, MSc Civil. Eng (Witwatersrand) RSA, BSc Civ Eng. (UZ), Z’bwe.

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

*Sheilla Nhandara,* BEng(Hons), MEng Geotech Eng (UCT) RSA, Civil & Water Eng, NUST, Z’bwe.

*Jeremiah Chimhundi,* BEng(Hons), Msc Water Resource Mgt UP, RSA, Civil & Water Eng. NUST, Z’bwe.

***Staff Development Fellows***

*Tendekai Madyangove,* BEng (Hons) Civil & Water Eng. NUST, Z’bwe

*Tinashe Shumba,* BEng (Hons) Civil & Water Eng. NUST, Z’bwe

*Mongiwa I. Ndlovu,* BEng (Hons) Civil & Water Eng. NUST, Z’bwe

*Mpumelelo Zhou,* BEng(Hons) Civil & Water Eng. NUST, Z’bwe

***Senior Technician***

*Doward .C Jecha,* BTechEd. Civil & Construction NUST,Z’bwe, MSc Construction Project Management, NUST, Z’bwe.

***Technician***

*Lawrence Ncube* Diploma in Civil Engineering Bulawayo Polytechnic, Z’bwe.

***Assistant Technician***

*Bridget Tinacho – Certificate in Computers,* Z’bwe.

**BACHELOR OF ENGINEERING HONOURS DEGREE IN CIVIL AND WATER ENGINEERING**

*The department offers both conventional and evening programmes*

**PART I**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| SCS 1101 | Introduction to Computer Science | 10 |
| SMA1116 | Engineering Mathematics 1A | 10 |
| ECW1102 | Engineering Drawing | 10 |
| ECW1103 | Engineering Communication Skills | 10 |
| ECW1104 | Principles of Electrical Engineering | 10 |
| ECW 1105 | Material Science | 10 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| CTL1101 | Leadership and Transformation Management | 10 |
| SMA 1216 | Engineering Mathematics 1B | 10 |
| SCS 1206 | Visual Programming Concepts & Development | 10 |
| ECW 1203 | Civil Engineering Drawing | 10 |
| ECW 1204 | Engineering Mechanics | 10 |
| ECW1205 | Occupational Health Safety and Environment | 10 |

**PART II**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| ECW 2101 | Fluid Mechanics | 10 |
| ECW 2102 | Engineering Surveying I | 10 |
| ECW 2105 | Engineering Geology | 10 |
| SMA 2116 | Engineering Mathematics | 10 |
| ECW 2106 | Structural Mechanics | 10 |
| ECW 2107 | Civil Engineering Materials | 10 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| ECW 2201 | Geo-Mechanics | 10 |
| ECW 2202 | Engineering Hydrology | 10 |
| ECW 2204 | Engineering Surveying II | 10 |
| SMA 2217 | Engineering Mathematics III | 10 |
| ECW 2206 | Structural Analysis I | 10 |
| ECW 2207 | Construction Technology | 10 |

**PART III**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| ECW 3103 | Design of Structures I | 12 |
| ECW 3104 | Wastewater Engineering | 12 |
| ECW 310 | Hydraulic Design | 12 |
| ECW 3108 | Structural Analysis II | 12 |
| ECW 3109 | Transportation Engineering I | 12 |
| ECW 3110 | Entrepreneurship and Business Management for Civil Engineers | 12 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| ECW 3204 | Irrigation Systems Design | 12 |
| ECW 3208 | Transportation Engineering II | 12 |
| ECW 3209 | Civil Engineering Project and Research Methods | 12 |
| ECW 3210 | Geotechnical Engineering I | 12 |
| ECW 3211 | Project Management & Professional Ethics | 12 |
| ECW3212 | Design of Structures II | 12 |

**PART IV**

ECW 4000 Industrial Attachment 120

**PART V**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| ECW 5101 | Water Quality and Treatment | 12 |
| ECW 5099 | Final Year Project | 12 |
| Elective I |  | 12 |
| ECW 5104 | Civil Engineering Business Studies | 12 |
| ECW 5105 | Geotechnical Engineering II | 12 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| ECW 5099 | Final Year Project | 12 |
| Elective II |  | 12 |
| ECW 5204 | Hydraulic Design | 12 |
| ECW 5205 | Water Resources Management | 12 |
| ECW 5206 | Infrastructure Engineering and Design | 12 |

**ELECTIVES FOR PART V**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| ECW 5001 | Groundwater Hydraulics and Modelling | 12 |
| ECW 5002 | Pipe Network Analysis | 12 |
| ECW 5003 | Liquid Retaining Structures | 12 |
| ECW 5004 | Finite Element Method in Civil Engineering | 12 |
| ECW 5005 | Traffic and Airport studies | 12 |
| ECW 5006 | Solid Waste Management | 12 |
| ECW 5007 | Wastewater Technology | 12 |
| ECW 5008 | Bitumen Technology | 12 |
| ECW 5009 | Computer Aided Design in Civil Engineering | 12 |
| ECW 5010 | Computational Techniques in Civil Eng. | 12 |
| ECW 5011 | Dynamic Analysis of Structures | 12 |
| ECW 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 | 120 |

**Total minimum credits: 588**

**MODULE SYNOPSES**

**ECW 1102 Engineering Drawing 10 Credits**

Introduction; Phase geometry; First and third angle projection; Dimensioning; Pictorial views; Freehand sketching, Drawing of common objects; Sectioning; Intersections; Developments; Conventions; Assembly drawings. 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. Introduction to technical drawing, simple geometric constructions.

**ECW 1103 Engineering Communication Skills 10 Credits**

This course 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, study skills.

**ECW 1104 Principles of Electrical Engineering 10 Credits**

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. Elementary power supplies.

**ECW 1204 Engineering Mechanics 10 Credits**

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, Three-dimensional stress.

**ECW 1205 Occupational Health, Safety and Environment 10 Credits**

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). Construction sites visits for observations.

**ECW 1206 Civil Engineering Drawing 10 Credits**

This course 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. Interpretation of architectural drawing.

**Part II**

**ECW 2101 Fluid Mechanics 10 Credits**

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. Flow measuring systems.

**ECW 2102 Engineering Survey 1 10 Credits**

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. 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, cut and fill work.

**ECW 2106 Structural Mechanics 10 Credits**

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.

**ECW 2107 Civil Engineering Materials 10 Credits**

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. Testing of Civil Engineering Materials.

**ECW 2105 Engineering Geology 10 Credits**

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.

**ECW 2201 Geo Mechanics 10 Credits**

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.

**ECW 2202 Engineering Hydrology 10 Credits**

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.

**ECW 2206 Structural Analysis I 10 Credits**

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); computer application in structural analysis.

**ECW 2204 Engineering Survey II 10 Credits**

The 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, transaction 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. computer application in engineering survey.

**ECW 2207 Construction Technology 10 Credits**

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**

**ECW 3107 Hydraulic Design I 10 Credits**

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. Computer application in hydraulic design.

**ECW 3108 Structural Analysis II 10 Credits**

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, Equilibrium method.

**ECW 3103 Design of Structures I 10 Credits**

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.

**ECW 3104 Wastewater Engineering 10 Credits**

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. Wetland treatment systems.

**ECW 3109 Transportation Engineering I 10 Credits**

Planning and alignment of highways. Highway surveys. Cross-sectional elements and their functions. Geometric design of highway, design of intersections, design of signals, markings 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. Computer application in transportation engineering.

**ECW 3110 Entrepreneurship and Business Management for Civil Engineers 10 Credits**

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

**ECW3212 Design of structures II 10 Credits**

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. Design of continuous beams, two way slabs, flat slabs. Design of slender columns. General principles of design of foundations for structures. Isolated footings, combined footings. 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. Design of laterally loaded wall panels.

**ECW 3208 Transportation Engineering II 10 Credits**

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. Signaling and interlocking. Train resistances and stresses in a railway track, tractive effort and traction. Construction and maintenance of a railway track and track drainage.

**ECW 3209 Civil Engineering Project and Research Methods 10 Credits**

The main objective 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.

**ECW 3204 Irrigation Systems Design 10 Credits**

Introduction to irrigation. Soils and classification in irrigation. Soil-water properties. Soil-water-plant relationships. Storage and measuring 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. Computer application in irrigation design.

**ECW 3210 Geotechnical Engineering I 10 Credits**

Lateral earth pressure: Soil mechanics review, Mohr-Coulomb and Rankine’s earth pressure theory, Retaining walls, Gravity, Cantilever, Counterfort, Sheet pile walls, Struts. Slope stability: Failure mechanisms, Stability analysis methods, Slope monitoring Techniques, Slope maintenance and restoration, Flexible stabilization, Slope reinforcement. Geosynthetics: Categories and types- Geotextiles, Geogrids, Geonets, Geomembranes, Geosynthetic clay liners, Geocells, Geocomposites, Geomats and Geotubes, Functions and Design- Earth reinforcement, Drainage, Filtration, Erosion control, Separation, Protection and Barrier. Softwares: GeoStudio and RocScience

**ECW 3211 Project Management & Professional Ethics 10 Credits**

Hierarchy of Construction Projects (Team). Duties and responsibilities of the 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. Continuing Professional Development (Training) CPD.

**Part IV**

TCW 4000 Industrial Attachment **120 Credits**

**Part V**

**ECW 5099 Final Year Project 12 Credits**

**ECW 5101 Water Quality and Treatment 12 Credits**

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.

**ECW 5104 Civil Engineering Business studies 12 Credits**

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.

**ECW 5105 Geotechnical Engineering II 12 Credits**

Geomechanics: Review of Soil Index properties, Soil shear strength, Two dimensional stress analysis, Settlement and Consolidation, Preloading, Physical and mechanical properties of rocks, Tunnel design, Rock stability analysis, Design of rock support systems. Ground Improvement Techniques - Applications and Designs: Vibrocompaction- Liquefaction potential analysis, Stone columns, Dynamic compaction, Sumps, Well point systems, Deep wells, Ejectors, Ground freezing, Electrokinetics, Vertical drains, Deep soil mixing and Grouting. Foundation design: Shallow foundations; Bearing capacity theories- Terzaghi, Mayerhof, Brinch Hansen, and Vesic. Point load stress- Bousnessq and New Mark equations, Foundation settlement, Schertmann method. Deep foundations- Types of piles, Design of single piles and pile groups, Eurocode Pile design, Pile testing.

**ECW 5204 Dam Engineering 12 Credits**

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. Hands-on with hydraulic design software.

**ECW 5206 Infrastructure Engineering and Design 12 Credits**

Reinforced Concrete: Design of slabs Hillerburg strip method, flat slabs and waffle slabs, structured design details, constructional problems and economics, RC foundations, combined bases, rafts and grillages; special problems, RC floorslabs, design of multi-storey frames, tall buildings, bridge structures, water retaining structures, bridge deck design stability. Steel: Design of plate girders with tension field action; design of gantry girders, design of industrial frames, design of multi-storey building, plastic design of simple frames. Prestressed concrete: Fundamental principles, System methods and prestressed losses, Analysis of sections for prestress design, Design of simple and continuous beam cross sections, Design of simple frameworks, Details and function of prestressing equipment, Modern trends in prestressing construction – especially suspension and cable stayed bridge structures. Composite sections: Composite action as displayed by steel, concrete, and reinforced concrete sections, Composite action in prestressed concrete members, Shear connections and their structural actions and Design of simply supported and continuous beams continuous beams

**ELECTIVES**

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

**ECW 5001 Groundwater hydraulics and modelling 12 Credits**

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; Groundwater pollution and control.

**ECW 5002 PIPE NETWORK ANALYSIS 12 Credits**

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.

**ECW 5003 LIQUID RETAINING STRUCTURES 12 Credits**

Codes and handbooks. Design methods. Design objectives and general recommendations. Design examples. Specification and construction. Quality control and testing.

**ECW 5004 FINITE ELEMENT METHOD IN CIVIL ENGINEERING 12 Credits**

Introduction: 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. Isoparameteric 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. Use of packages advantages and pitfalls.

**ECW 5005 TRAFFIC AND AIRPORT STUDIES 12 Credits**

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 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.

**ECW 5006 Solid Waste Management 12 Credits**

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. Environmental impact assessments of landfills.

**ECW 5007 WASTEWATER TECHNOLOGY 12 Credits**

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. Visits to wastewater treatment plants.

**ECW 5008 - BITUMEN TECHNOLOGY 12 Credits**

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.

**ECW 5009 COMPUTER AIDED DESIGN IN CIVIL ENGINEERING 12 Credits**

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.

**ECW 5010 COMPUTATIONAL TECHNIQUES IN CIVIL ENGINEERING 12 Credits**

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. Implementation on microcomputer.

**ECW 5011 DYNAMIC ANALYSIS OF STRUCTURES 12 Credits**

Basic concepts of Dynamic Analysis. Damped and undamped vibration. Single and several degrees of freedom. Application of the method to the analysis of structures (building and foundations)

**ECW 5012 ELASTIC ANALYSIS OF STRUCTURES 12 Credits**

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***

*Buthanani Dlodlo,* MSc in Electronic Engineering, UKZN, RSA, Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Z’bwe.

***Chief Secretary***

*Urita Magaya,* ND Secretarial Studies (HEXCO) Bulawayo Polytechnic, Z’bwe.

***Technicians***

*Peter Maitireni,* Bachelor of Engineering Honours Degree in Electronic Engineering, MSU, Z’bwe. ND in Electronic engineering: Communication systems, Bulawayo Polytechnic, Z’bwe. NC in Electronic/ Radio Communication Engineering, Bulawayo Polytechnic, Z’bwe.

*Vusumuzi Ncube,* BSc in Telecommunications Engineering, MSU, Z’bwe. HND in Electronic Engineering (Microwave Techniques and Radar Systems), Bulawayo Polytechnic, Z’bwe. ND in Electrical Engineering (Radio Communication), Bulawayo Polytechnic Z’bwe. ND in Technical and Vocational Education, Gweru Polytechnic. Journeyman Class One (Radio Communication Technician) Z’bwe.

***Senior Technical Assistant***

*Mbonisi Sibanda,* BSc in Telecommunications Engineering, MSU, Z’bwe. Z’bwe. ND in Electronic Communication Engineering, Bulawayo Polytechnic Z’bwe. Class one Apprenticeship Journeyman: Railway Signalling and Communication, N.R.Z training centre/ZIMDEF, Z’bwe.

***Academic Staff***

***Lecturers***

*Magripa Nleya,* MSc in Telecommunications Engineering. Tashkent Electro-Technical Institute of Telecommunications), Tashkent, (former USSR). Postgraduate Diploma in Higher Education. National University of Science and Technology (NUST), Bulawayo, Z’bwe.

*Reginald Gonye,* MPhil in Electronic Engineering NUST, Bulawayo, Z’bwe. Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Bulawayo, Z’bwe.

*Lovemore Gunda*, MSc Engineering in Electronic Engineering, Stellenbosch University, RSA. Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Bulawayo, Z’bwe. Further Education Trainer’s Certificate (FETC), Z’bwe.

*Nomakhosi Ndiweni,* Master of Engineering Degree in Electronic Engineering, University of Leeds, UK. Bachelor of Engineering Honours Degree in Electronic Engineering, NUST, Z’bwe.

*Bhekisisa Nyoni,* Master of Philosophy in Electronic Engineering NUST, Bulawayo, Z’bwe. Bachelor of Engineering Honours in Electronic Engineering, NUST, Bulawayo, Z’bwe.

*Liston Matindife*, Ph.D in Electrical and Electronic Engineering, University of Johannesburg, RSA. Magister Technologiae in Electrical Engineering (MTech EE:), University of South Africa, RSA. BSc (Hons) in Electrical Engineering, University of Zimbabwe, Z’bwe.

*Shyleen Nhema,* Masters in Space Electronics Devices, South West State University, Russia. BTech Honours Degree in Electronic Engineering, HIT, Z’bwe.

*Joewell Mawanza,* MSc. In Control Science and Engineering, Jiangsu University of Science and Technology, Zhenjiang, China. BSc Hons Telecommunications, MSU, Z’Bwe.

Temporary Full time Lecturer

*Joseph Katekwe,* MSc in Automation and Industrial Computing and BSc in Electronics, University of Boumerdes (Algeria).

***Engineering Instructors***

*Fidelis Nhenga-Mugarisanwa,* MPhil in Electronic Engineering, NUST, Z’bwe. BSc in Computer Science, NUST, Z’bwe. Further Education Teacher’s Diploma. Certificate in Training Management, Zimbabwe Institute of Personnel Management Z’bwe. Higher Diploma in Electronic Engineering Bolton, UK.

*Eben Makumbe,* B Tech degree in Electrical Engineering, UZ, Z’bwe. Further Education Teacher’s Certificate, Z’bwe.

**BACHELOR OF ENGINEERING HONOURS IN ELECTRONIC ENGINEERING**

**PROGRAMME SUMMARY**

**PART I (125Credits)**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| SMA 1116 | Engineering Mathematics 1A | 10 |
| EIE 1101 | Engineering drawing | 10 |
| ECE 1103 | Professional engineering skills | 5 |
| EEE 1102 | Electrical engineering workshop | 5 |
| EEE 1131 | Computer engineering and programming | 10 |
| EEE 1143 | Electrical engineering circuit analysis | 10 |
| EEE 1154 | Physics for electronic engineers | 10 |
| Total Credits |  | 60 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| SMA 1216 | Engineering Mathematics 1B | 10 |
| EEE 1213 | Electronic engineering devices and circuits | 10 |
| CTL 1101 | Conflict Transformation and Leadership | 10 |
| EEE 1231 | Software engineering | 10 |
| EEE 1202 | Electronic engineering workshop | 5 |
| EEE 1214 | Digital electronics | 10 |
| EEE 1232 | CAD for electronic engineers | 10 |
| Total Credits |  | 65 |

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| SMA 2116 | Engineering Mathematics 2 | 10 |
| EEE 2104 | Laboratory I | 5 |
| EEE 2106 | Design and project I | 5 |
| EEE 2142 | Electrical machines | 10 |
| EEE 2151 | Network theory | 10 |
| EEE 2115 | Analogue electronics 1 | 10 |
| EEE 2113 | Digital devices and systems | 10 |
| EEE 2141 | Electrical measurements | 10 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| EEE 2204 | Laboratory II | 5 |
| EEE 2206 | Design and project II | 5 |
| EEE 2212 | Electronic drives | 10 |
| EEE 2255 | The professional engineer | 10 |
| EEE 2233 | Object oriented programming | 10 |
| EEE 2256 | Electromagnetic theory | 10 |
| EEE 2215 | Analogue electronics 2 | 10 |
| Total Credits | Semester II | 70 |

**PART III (130 Credits)**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| SMA 3116 | Engineering Mathematics 4 | 10 |
| EEE 3104 | Laboratory III | 5 |
| EEE 3106 | Design and project III | 5 |
| EEE 3151 | Digital signal processing | 10 |
| EEE 3113 | Linear integrated circuits | 10 |
| EEE 3122 | Communication engineering 1 | 10 |
| EEE 3133 | Software engineering applications | 10 |
| EEE 3112 | Microprocessors | 10 |
| Total Credits |  | 70 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| EEE 3241 | Control engineering | 10 |
| EEE 3204 | Laboratory IV | 5 |
| EEE 3206 | Design and project IV | 5 |
| EEE 3232 | Embedded computer systems | 10 |
| EEE 3231 | Computer architecture and Operating systems | 10 |
| EEE 3222 | Communication engineering 2 | 10 |
| EEE 3255 | Engineering management | 10 |
| Total Credits | Semester II | 60 |

**PART IV (120 Credits)**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| EEE 4000 | Industrial Attachment | 120 |

**PART V (120 Credits)**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| EEE 5003 | Honours project | 50 |
| EEE 5155 | Project Management | 10 |
| EEE 5122 | Communication systems performance | 10 |
| EEE 5142 | Modern control engineering | 10 |
| Total Credits |  | 80 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| EEE 5223 | Mobile communication | 10 |
| EEE 5233 | High speed networks | 10 |
| EEE 5255 | Entrepreneurial Mindset | 10 |

**Elective Modules Select I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| EEE 5222 | RF and microwave devices and circuits | 10 |
| EEE 5234 | Advanced Software Engineering | 10 |
| EEE 5241 | Industrial control | 10 |
| EEE 5221 | Communication systems | 10 |
| EEE5211 | Integrated circuits technologies | 10 |
| EEE 5212 | Power electronics applications | 10 |
| **Total Credits** | **Semester II** | **40** |

**TOTAL CREDITS FOR THE DEGREE 635**

**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.

**EIE1101 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; Conventioning; Assembly Drawing and exercises.

**ECE1103 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.

**EEE1102 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.

**EEE1143 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.

**EEE1154 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.

**EEE1213 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.

**EEE1232 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.

**EEE1231 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.

**EEE1202 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.

**EEE1214 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.

**EEE2142 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.

**EEE2104 Laboratory 5 Credits**

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

**EEE2106 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.

**EEE2151 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.

**EEE2113 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.

**EEE2115 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.

**EEE2141 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.

**EEE2212 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.

**EEE2204 Laboratory 5 Credits**

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

**EEE2255 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.

**EEE2206 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.

**EEE2233 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.

**EEE2256 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.

**EEE2215 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.

**EEE3151 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.

**EEE3113 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.

**EEE3122 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.

**EEE3133 Software Engineering Applications 10 Credits**

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

**EEE3112 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.

**EEE3241 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.

**EEE3232 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.

**EEE3204 Laboratory 5 Credits**

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

**EEE3222 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.

**EEE3206 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.

**EEE3231 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;

**EEE3255 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**

**EEE4000 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**

**EEE5003 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.

**EEE5122 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.

**EEE5142 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.

**EEE5155 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.

**EEE5223 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.

**EEE5233 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).

**EEE5255 Entrepreneurial Mindset**

Introduction to the origins and Concept of Entrepreneurship; Cultural Diversity of Entrepreneurship; Challenges of Entrepreneurs; Factors that contribute to the success of Entrepreneurs; Creativity and Innovation; Disruptive, Incremental and open innovations; Nurturing and managing innovation; Steps in the Entrepreneurial process; Activities including invitations of technopreneurs /entrepreneurs to share their experiences.

**ELECTIVE MODULES**

**EEE5222 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.

**EEE5241 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.

**EEE5234 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.

**EEE5221 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.

**EEE5211 Integrated Circuits Technologies 10 Credits**

The module explores Microelectronics procedures for Si and GaAs; Logic families: TTL, ECL, I2L, MOSFET, CMOS and PMOS; Introduction to FPGAs and Nano-electronics concepts.

**EEE5212 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

**Total 635 credits**

**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 modules 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 modules taken for credit as part of the approved programme shall be a pre-requisite for admission to candidancy for the degree.

6.2 The dissertation and its oral defence shall determine the success or failure of the candidate.

**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.

* 1. **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 draw-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 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. Library copies shall be open reference.

**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 modules 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

5.7 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 modules 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.

**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 the Senate has agreed to the contrary, the Library copies shall be open to public reference and dissemination through University Microfiche International.

**DEPARTMENT OF FIBRE AND POLYMER MATERIALS ENGINEERING**

***Senior Lecturer and Acting Chairperson***

*Lloyd. N. Ndlovu,* B Textile Tech (Hons) NUST, MEng Textile Eng China, PGDHE-NUST, PhD SET, University of South Africa, South Africa, Cert in Tool and Die Making NUST. Membership: South African Dyers and Finishers Association (SADFA), Institute of Electrical and Electronics Engineers-Nanotechnology (IEEE-Nano), African Membrane Society (AMSIC), Society of Plastics Engineers (SPE), and African Materials Research Society (AMRS).

***A/Senior Secretary***

*Saneliso Wanamenda*, B Comm HRM (Hons NUST), Z’bwe. ND Secretarial Studies (Bulawayo Polytechnic) , NC Secretarial Studies (Bulawayo Polytechnic.) Z’bwe.

***Associate Professor***

*Londiwe C. Nkiwane, (Prof.)* MSc. Textile Tech Jassy Romania, MA Textiles and Clothing Education, Gothenburg, Sweden, PhD Textiles in Industries, Leeds, UK, PGDHE-NUS, Z’Bwe.

***Senior Lecturers***

*Peeps Gonde,* PhD Business Administration, NUST, Z’bwe. MBA NUST, Z’bwe. BSc Comp. Science, PGDHE-NUST, Z’bwe.

*Mufaro Moyo,* B.Textile Tech (Hons) NUST, MEng (Mfg Syt & Op Mgt) NUST, PGDHE-NUST, Z’bwe. Cert in Textile Testing and Quality Control, India, PhD Mechanical Eng, Durban University of Technology, South Africa.

*Nkosilathi Z. Nkomo,* PhD Mechanical Eng, Vaal University of Technology, South Africa. Meng Textile Engineering, Moi University, Kenya, B Textile Tech (Hons) NUST, Z’bwe. Cert in Textile Mill Management India,

*Lindani K. Ncube,* MEng (Mfg Syt & Op Mgt) NUST, Z’bwe. B.Textile Tech (Hons) NUST, Z’bwe. PGDHE-NUST, Cert in Textile Mill Management India, (on study leave).

*Sizo R. Ncube,* MEng Textile Eng China, B Textile Tech (Hons) NUST, Z’bwe. PGDHE-NUST, Cert in Tool and Die Making NUST, Z’bwe.

*Pethile Dzingai,* MEng Textile Eng, China, B Textile Tech (Hons) NUST, Z’bwe. Cert in Quality Assurance & Quality Control Speciss, PGDHE-NUST, Z’bwe. (on study leave).

Nqobizitha R Ndebele, MPhil Textile Tech NUST, Z’bwe. B Textile Tech (Hons) NUST, Z’bwe. PGDHE-NUST.

***Lecturers***

*Sithabisiwe Gadlula,* MPhil Fibre and Polymer Materials Eng NUST, Z’bwe. B Textile Tech (Hons) NUST, Z’bwe. Cert in Tool and Die Making NUST, Z’bwe.

**BACHELOR OF ENGINEERING HONOURS 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 utilisation 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 utilise 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 the 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 practices 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 on 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**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| 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**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| 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**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| 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**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| 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**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| 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 | Coloration of Materials | 10 |
| TFE 3106 | Polymer Materials Analysis | 10 |
| TFE 3100 | Research Methods | 5 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| 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**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| TFE 4000 | Industrial Attachment | 120 |

**PART V**

TFE 5000 Research /Design Project 50 credits

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| 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 | Nanofibre Technology | 10 |
| CBU 1209 | Principles of Marketing | 5 |
| TFE XXXX | Elective Module | 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; Stationery 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 mode; 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, e-capture a, 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 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 Planegeometry; 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 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 complete the module will be well grounded in 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, fibre properties and utilisation.

**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, SURFACES; 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 moulding, transfer moulding, injection moulding, blow moulding, reaction injection moulding, extrusion, pultrusion, calendaring, rotational moulding, 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, carbonising), 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 6 of various tools; Safety measures using various tools; Purpose and language of measurement; Reliability and precision; Measuring instruments; Marking using dividers, punchers, engineers squares, scribers; 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; Defi nitions; 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 behaviour of rigid bodies and kinetic behaviour 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 pre-tanning 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, Crazing, 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, 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 deliming, 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, Dismodule Analysis and Narrative Analysis.

**TFE 3101 Plastic Technology I 10 Credits**

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 stabilisation; 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 fibre; 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 Recausticizing; 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, screwdriver 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 repellency, 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 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 Nanofibre 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, Needle-less 16 electro spinning, Coaxial electrospinning, 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**

YEAR I 200

YEAR II 200

**Total minimum credits: 400**

**DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING**

***Senior Lecturer and Chairperson***

*Lameck Mugwagwa*, *(Eng.)* PhD Industrial Engineering (Stellenbosch), RSA. MEng Manufacturing Engineering & Operations Management (NUST), Z’bwe. BTech (Hons) Production Eng (CUT), Z’bwe. PGDHE (NUST), Z’bwe.

***Academic Staff***

***Associate Professor***

*Davison. Zimwara,* (A/*Prof. Eng.)* PhD (NUST), Z’bwe. MSc Manufacturing Systems and Operations Management (UZ), Z’bwe. BTech (Hons) Mech. Eng (UZ), Z’bwe.

***Senior Lecturers***

*Nicholas Tayisepi,* (*Dr. Eng.)* D. Ing. Mechanical. Eng (University of Johannesburg), RSA, MEng Manufacturing Systems and Operations Management (NUST), Z’bwe. BTech (Hons) Industrial & Manufacturing Engineering (NUST), Z’bwe. HND Mech. Eng (HEXCO), Z’bwe. Exec. Dip. in Bus. Leadership (ZOU), Z’bwe. Dip. Tech Voc. Ed. (HEXCO), Z’bwe. Class 1 Fitter & Turner Machinist (MPDA Chapter. 28:02), Pr Eng, MZweIE, AMSAIIE, Z’bwe.

*Sipiwe T. Nyadongo, (Dr. Eng.)*  MEng Manufacturing Engineering & Operations Management (NUST), Z’bwe. B Eng (Hons) Industrial & Manufacturing Engineering (NUST), Z’bwe. PGDHE (NUST), Z’bwe.

*Eriyethi Murena*, *(Dr. Eng.)*  MEng Manufacturing Engineering & Operations Management (NUST), Z’bwe. BEng (Hons) Industrial & Manufacturing Engineering (NUST), Z’bwe. ND Mechanical Draughting and Design Technology (HEXCO), Z’bwe. PGDHE (NUST), Z’bwe.

*Samson Mhlanga,* (*Eng.)* MSc Advanced Manufacturing Systems (Brunel), BEng (Hons) Industrial Engineering (NUST), Z’bwe. Postgrad Cert in Higher Education Management (Wits), RSA. Postgrad Cert in Engineering Education & Project Management (Tsinghua University), China. CEM Certified Energy Manager (SA).

***Lecturers***

*Wellington Tumbudzuku,* MEng Manufacturing Systems & Operations Management (NUST), Z’bwe. BEng (Hons) Industrial & Manufacturing Engineering (NUST), Z’bwe.

*Blessed Sarema,* MEng Manufacturing Engineering & Operations Management (NUST), Z’bwe. BEng (Hons) Industrial & Manufacturing Engineering (NUST), Z’bwe. PGDHE (NUST), MZweIE, AMSAIIE, Pr Eng (ECZ), Pr Eng (ECSA)

*Givemore Kanyemba, (Eng.)*  MEng Manufacturing Engineering & Operations Management (NUST), Z’bwe. BEng (Hons) Mechatronics (CUT), Z’bwe. PGDHE (NUST), MIET (UK)

*Gibson Chirinda,* MEng Manufacturing Engineering & Operations Management (NUST), Z’bwe. BEng (Hons) Industrial & Manufacturing Engineering (NUST), Z’bwe.

*Takudzwa M. Muhla,* MEng Manufacturing Systems & Operations Management (NUST), Z’bwe. BEng (Hons) Industrial & Manufacturing Engineering (NUST), GZweIE

*Innocent Mapindu,* MEng Manufacturing Systems & Operations Management (NUST), Z’bwe. BEng (Hons) Industrial & Manufacturing Engineering (NUST), Z’bwe.

*Margaret Munyau,* MEng Manufacturing Engineering & Operations Management (NUST), Z’bwe. BEng (Hons) Production Engineering (CUT), Z’bwe.

*Tecclar T Chigavazira-Gwara,* MEng Manufacturing Engineering & Operations Management (NUST), Z’bwe. BEng (Hons) Industrial & Manufacturing Engineering (NUST), Z’bwe.

***Engineering Instructors***

*Noel M. Dewa,* B. Tech. Ed (NUST), Z’bwe. FETC (HEXCO), ZNCC Mech. (HEXCO), Z’bwe. Dip Ad Ed (UZ), AMITD (UK)

*Gilbert Munhuwamambo,* MSc Renewable Energy (UZ), Z’bwe. BTech Ed. Mechanical Engineering (NUST), Z’bwe. Dip. Tech. Voc. Ed (HEXCO), Z’bwe. Class 1 Turner Machinist (MPDA 28:02), NACC (HEXCO), Z’bwe.

***Technical Assistant***

*V. Ndoro,* Cert. in Basic Machine shop Eng. (Westgate), Z’bwe.

**BACHELOR OF ENGINEERING HONOURS DEGREE IN INDUSTRIAL AND MANUFACTURING ENGINEERING**

**PART I**

**Semester I**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| EIE 1101 | Engineering Drawing I | 10 |
| EIE 1103 | Workshop Technology I | 10 |
| EIE 1106 | Professional Engineering and Communication | 10 |
| EIE 1107 | Human Factors Engineering | 10 |
| EEE 1103 | Basic Circuit Analysis | 10 |
| SCS 1101 | Introduction to Computer Science | 10 |
| SMA 1116 | Engineering Mathematics 1A | 10 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| **Module Code** | **Module Description** | **Credits** |
| EIE 1201 | Engineering Drawing II | 10 |
| EIE 1203 | Workshop Technology II | 10 |
| EIE 1206 | Applied Mechanics | 10 |
| EIE 1209 | Computer Applications and Programming Concepts | 10 |
| EEE 1203 | Electronic Engineering | 10 |
| CTL 1201 | Conflict Leadership and Transformation | 5 |
| SMA 1216 | Engineering Mathematics 1B | 10 |

**PART II**

**Semester I**

|  |  |  |
| --- | --- | --- |
| EIE 2101 | Thermodynamics | 10 |
| EIE 2103 | Solid Mechanics I | 10 |
| EIE 2107 | Engineering Design Principles | 10 |
| EIE 2111 | Dynamics | 10 |
| EEE 2120 | Electrical Machines | 10 |
| SMA 2116 | Engineering Mathematics II | 10 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| EIE 2202 | Fluid Mechanics | 10 |
| EIE 2203 | Solid Mechanics II | 10 |
| EIE 2208 | Engineering Design Applications | 10 |
| EIE 2212 | Quality Management Systems | 10 |
| EIE 2213 | Materials Technology | 10 |
| SMA 2217 | Engineering Mathematics III | 10 |

**PART III**

**Semester I**

|  |  |  |
| --- | --- | --- |
| EIE 3113 | Manufacturing Processes I | 10 |
| EIE 3121 | Manufacturing Systems I | 10 |
| EIE 3122 | Industrial Instrumentation & Measurement Systems | 10 |
| EIE 3123 | Industrial Management | 10 |
| EIE 3124 | Thermal Systems | 10 |
| EIE 3125 | Asset Management | 10 |
| EIE 3126 | Economics for Engineers | 10 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| EIE 3213 | Manufacturing Processes II | 10 |
| EIE 3120 | Manufacturing Engineering Design | 10 |
| EIE 3221 | Manufacturing Systems II: Simulation and Modeling of Manufacturing Systems | 10 |
| EIE 3222 | Concurrent Engineering | 10 |
| EIE 3223 | Research Methods for Engineers | 10 |
| EIE 3224 | Industrial Control Engineering | 10 |
| EIE 3225 | Technopreneurship | 10 |

**PART IV**

|  |  |  |
| --- | --- | --- |
| EIE 4000 | Industrial Attachment | 120 |

**PART V Semester I**

|  |  |  |
| --- | --- | --- |
| EIE 5103 | Manufacturing Processes III | 10 |
| EIE 5112 | Operations Management | 10 |
| EIE 5113 | Manufacturing Systems III | 10 |
| EIE 5114 | Risk Management and Insurance for Engineers | 10 |
| EIE 5115 | CAD/CAM | 10 |
| EIE 5116 | Project Management | 10 |

**Semester II**

|  |  |  |
| --- | --- | --- |
| EIE 5000 | Industrial Engineering Project | 10 |
| EIE 5215 | Financial and Managerial Accounting for Engineers | 10 |
| EIE 5214 | Environmentally Conscious Manufacturing | 10 |
| EIE 5216 | Advanced Manufacturing Technology | 10 |
| Electives |  |  |
| EIE 5217 | Manufacturing Strategy | 10 |
| EIE 5218 | Advanced Manufacturing Systems | 10 |

**TOTAL CREDITS FOR THE PROGRAMME**

Part I 135

Part II 120

Part III 140

Part IV 120

Part V 150

**Total minimum credits: 665**

**PART I**

**EIE 1101 Engineering Drawing I 10 Credits**

Types of Lines and their Applications; Drawing instruments and Materials Description. Uses and Care; Drawing standards Format, Margins, Scales, Title block, Lettering; Dimensioning Standard Symbols; Geometrical Constructions; Tangency Constructions Drawing of Slopes, Tapers and Gradients; Descriptive Geometry and Projection Drawing; Orthographic projections of Simple Geometrical Solids; Geometrical Solids as Elements of Objects: First Angle Orthographic Projection, Third Angle Orthographic Projections; Axonometric Projections; Drawing of Isometric Views from Three and two Orthographic Projections; Freehand Sketching; Intersection of solids; Development of Surfaces Sectioning of Solids by Plane; Sectional views of Machine Parts; Introduction to assembly drawings - limits and fits.

**EIE 1103 Workshop Technology I 10 Credits**

Workshop Technology: PPE, Safety at Work, Safety of Machines, Environmental safety, Costs associated with safety, employer, Employees and Engineers’ Responsibilities; Types of Production Workshops, Plant Location and Layout; Production Engineering: Production of Iron and Steel, Heat treatment of Iron and Steel, Ferrous and Non-Ferrous Metals; Measuring Instruments: Purpose and Language of Measurement; Reliability and Precision; Units of Measurement; Electrical Measuring Instruments; Chemical Structure Measuring Instruments; Industrial Temperature Measuring Instruments; Gas and Pressure measuring instruments; Machine Shop Practice: Marking, Hand Sawing and Filing; Drilling; Centre Lathe - Turning and Screw Cutting, Tapping

**EIE 1106 Professional Engineering And Communication 10 Credits**

Engineering Professionalism, registration and accreditation of programs and professionals, Professional bodies and their roles, engineering morals, ethics and statutes; Engineering Communication: Verbal (includes oral and written); Non Verbal (engineering drawings, warning signs, symbols signage, body language conduct); Business Communication, Letters, Memorandum and Curriculum Vitae, Interview Techniques, Running Meetings Summarising articles; Technical Reports Writing, Preparation and writing of technical reports, Research and Experiments, journal papers, conference papers.

**EIE 1107 Human Factors Engineering 10 Credits**

Recognition of the environmental factors and hazards, Ergonomics guidelines for working posture; Biomechanics. Anthropometrics, sources of anthropometrical data. Assessment of human static strength. Work space design. Human factors/behaviour. displays. Control. Mental overload. Ergonomic checklist. Fundamental concepts of industrial safety: Definitions: The safety professional and the industrial hygienist. Government regulations; Environmental factors or stresses; Occupational diseases; Recognition of the environmental factors and hazards; 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. 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 Licensing 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. Seminars and visits to industry.

**EEE 1103 Basic Electrical Circuit Analysis 10 Credits**

Introduction to Electricity: Current, Voltage, Resistance, Ohms Law; Power, Energy and Efficiency; Circuit analysis (Direct Current): Series Circuits, Parallel Circuits and Series-Parallel Circuits, Kirchhoff’s Laws, Branch Analysis, Mesh Analysis. Star-Delta Conversions; Network Theorems: Superposition Theorem, Thevenin’s Theorem, Norton’s Theorem, Maximum Power Transfer Theorem; Capacitance; Inductance; Magnetism: Magnetic Fields, Electromagnets, Magneto-motive Force and Reluctance, Magnetic Equivalent Circuits, Hysteresis, Magnetic Losses; Alternating Current: Sinusoidal AC, Phasors to represent AC, Complex Impedance. Basic AC Circuit Analysis: AC Power.

**SCS 1101 Introduction to Computer Science 10 Credits**

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 and 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, Organization And Access, Databases; Fundamentals Of Networks; Simple Program: Initialization, Printing, Comments, Keywords, Constants, Assignment, Expressions.

**SMA 1116 Engineering Mathematics 1A 10 Credits**

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, Equations of Lines and Planes.

**EIE 1201 Engineering Drawing II 10 Credits**

CAD fundamentals: Open, close and save CAD application, Create a new drawing, Set drawing space i.e. units, limits; Set drawing Aids e.g. snap, grid, ortho, Saving CAD drawing template; Drawing: Zoom, Panning a drawing; Create new drawings: Coordinate systems: Absolute, Relative and Polar coordinate system, Drawing commands as line, pline, circle, arc, Draw rectangle, polygon, ellipse, Use snapping tools for accuracy (Endpoint, Intersection etc), Hatching; Modifying Commands: Erase, Copy and Move objects, Rotate, Scale, Stretch Extend & Offset, Mirror and array, Apply Chamfers and Fillets, Edit polylines and spline, decurve, fit, thickness join & explode, Trim, break, explode; Layers: Create layers and assign properties as lineweights, line types, colour, Set layer current, Modify layer attributes; Text and Dimensions: Create and set text styles with different fonts, Understand the difference between Mtext and Stext commands, Understand the text alignment abbreviations eg TR, TC, TL, Create & set dimension style according to ISO Standard, Set as current style; 3D drawing: Changing to 3D viewing, Switching between isoplanes (top, right & left views), Drawing boxes, sphere, cylinder etc, Subtracting, 3D solid editing, Extruding; Plotting a drawing: Understand between Model and Paper space, Add a new title block, Create a viewports with different scales, Select plotter/ printer, Plot all, part of drawing to scale.

**EIE 1203 Workshop Technology II 10 Credits**

Fabrication Practice: Metal joining processes - Gas welding, electric arc welding, pressure welding, soldering and brazing. Automotive Engineering: The engine, engine lubrication, fuel system, cooling system, transmission system, chassis frame, ignition system. Maintenance Engineering: Objectives, types of maintenance, classification, procedure and record keeping, computerised maintenance management systems, equipment operation and maintenance.

**EIE 1206 Applied Mechanics 10 Credits**

Introduction to Mechanics: Newton’s Laws of Motion. Forces: Force System Resultants, Couple Links Vectors. Equilibrium of Rigid bodies: Free Body Diagrams, Couples, Links; Structural Analysis: Method of Joints, Method of Sections. Distributed forces: Beams, Types of beams; Internal Forces: Shear Forces (SH) and Bending Moment (BM) Diagrams; Center of Gravity, Center of Mass and Centroids of Lines, Areas and Volume. Moment of Inertia, Friction; Virtual Work.

**EIE 1209 Computer Applications And Programming Concepts 10 Credits**

The nature and structure of visual applications; Object models and paradigms for the development of visual applications; Visual elements; windows, dialogues, toolbars and controls; Menus and commands, events and handlers; Visual graphs, device context, graphic elements and graphic procedures; Computer Applications: Databases, Spread sheets, Word Processing, Email, Computer Packages for Engineering

**EEE 1203 Electronic Engineering: Electronic Circuits & Devices 10 Credits**

Introduction to basic electronics: semiconductors materials, N-type, P-type, P-N junction. Semiconductor diodes, diode applications, photo-electronic devices; Bipolar junction transistors (BJT), BJT biasing and equivalent circuits; Elements of computer-aided circuit design.

**SMA 1216 Engineering Mathematics 1B 10 Credits**

Functions of Several Variable; Partial Derivatives: Chain Rules. Application of Maxima and Minima Problems, Lagrange Multipliers to Engineering; 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

**CTL 1201 Conflict, Leadership & Transformation 10 Credits**

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; Arbitration

**PART II**

**EIE 2101 Thermodynamics 10 Credits**

Introduction: Basic concepts and principles, Historical background, Types of energy. Laws of thermodynamics: Zeroth law, Thermal equilibrium, First law of thermodynamics, Second law of thermodynamics, Concepts and implications of the second law, Third law of thermodynamics, Conclusion. Properties of the thermodynamic media: Introduction, Heat and specific heat capacity, Joule’s law, Dalton’s and Gibbs law, Expansion and compression of ideal gases, Boyle’s and Charles law, Adiabatic compression and expansion. Cycles of internal combustion engines and steam engines: Engine cycle and thermal efficiency, Carnot cycle, Gas engine cycles, Diesel cycle, Dual combustion cycle, Gas turbine cycles. Vapour power cycles: Vapours, T-s and T-h diagrams, Reheat cycle, Regenerative cycle. Refrigeration cycles: Components of vapour refrigeration cycle, Gas refrigeration cycle. Nozzles and Jet propulsion: General nozzle shapes, Flow analysis, Steam turbines, Turbojets. Effects of temperature change: Thermal expansion and contraction, Change of phase. Heat transfer: Mechanism of transfer, Fourier’s law, Surface and overall heat transfer, Newton’s laws of cooling, Radiation.

**EIE 2103 Solid Mechanics I 10 Credits**

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, Torque. Prerequisites: SMA 1116 Engineering Mathematics 1A, SMA 1216 Engineering Mathematics 1B and TIE 1206 Applied Mechanics

**EIE 2107 Engineering Design Principles 10 Credits**

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, epicyclic gear trains.

**EIE 2111 Dynamics 10 Credits**

Dynamics of particles. Introduction to two Dimensional Dynamics of Particles: Kinematics and Kinetics of particles. Kinematics and Kinetics of Rigid bodies. Force, Mass and Acceleration. Work and Energy. Impulse and Momentum. Introduction to three-dimensional dynamics of rigid bodies. Angular Momentum and Energy Equations. Parallel plane Motion. Gyroscopic Motion. Area moments of inertia. Mass moments of inertia about an axis; products of inertia. Vibrations and time Response of Single- degree systems. Free Vibrations of Particles: Undamped Free Vibrations, Damped Free Vibrations, Undamped Forced Vibrations, Damped Forced vibrations, Vibration of Rigid Bodies, Energy methods. Vibrations of two-degree- of freedom systems. Lateral vibrations of beams. Cams. Eccentric circular cam with flat and curved follower. Balancing of machines, Balancing of a single and multi-cylinder engines. Geared systems, gear trains. Torque relations in governors, Types of governors. Prerequisite: EIE 2103 Solid Mechanics I.

**EEE 2120 Electrical Machines 10 Credits**

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.

**SMA 2116 Engineering Mathematics II 10 Credits**

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.

**EIE 2202 Fluid Mechanics 10 Credits**

The course is an introduction to the fundamentals of fluid mechanics with applications for engineering students. Fluid properties are defined and fundamentals of mechanics are presented to prepare for problem solving in fluid statics, kinematics, and dynamics. Understanding of fluid properties, kinematics, pressure variation, energy concepts, linear momentum, similitude, dimensional analysis, pipe flow, and introductory open channel flow concepts

**EIE 2203 Solid Mechanics II 10 Credits**

Advanced Elements of Linear Elasticity, Plane elasticity problem, Applications, Visco-elasticity, Plasticity, Large Deformation, Complex Stresses: Stresses on Oblique Planes; Material subjected to pure shear, mutually perpendicular direct stresses, combined direct and shear stresses, principal plane, principal angle, and solution methods. Thick cylinders: Lame 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. Torsion of non-circular thin rings and sections. Prerequisite: EIE 2103 Solid Mechanics I

**EIE 2208 Engineering Design Applications 10 Credits**

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; lubrication systems

**EIE 2212 Quality Management Systems 10 Credits**

Quality in engineering; Statistical analysis for quality; 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.

**EIE 2213 Materials Technology 10 Credits**

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, inelasticity, 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, generalized creep behaviour.

**SMA 2217 Engineering Mathematics III 10 Credits**

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. Applications to engineering problems.

**PART III**

**EIE 3113 Manufacturing Processes I 10 Credits**

Casting Processes: Solidification of castings, Gating and feeding systems, mould materials and their testing, continuous casting, special casting processes, design of castings, casting defects, inspection and quality control.

**EIE 3121 Manufacturing Systems I 10 Credits**

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, decomposition of large families, locating new facilities; Manufacturing Lines: Flow line transfer and general serial systems. Line Balancing: - Methods, Practical issues in line balancing, sequencing of a mixed model, improvements to solutions on line balance. 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.

**EIE 3122 Industrial Instrumentation and Measurement Systems 10 Credits**

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.

**EIE 3123 Industrial Management 10 Credits**

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, Theories of Motivation.

**EIE 3124 Thermal Systems 10 Credits**

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.

**EIE 3125 Asset Management 10 Credits**

Introduction: 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, Estimating machinery reliability - Weibull diagram. Total Productive Maintenance.

**EIE 3126 Economics for Engineers 10 Credits**

Principles, characteristics and functions; Engineering Economic Decisions; Interest Rate and Economic Equivalence; Understanding Money and Its Management; Effects of Inflation; Types of investments; Breakeven Analysis; Present-Worth Analysis; Annual Equivalent-Worth Analysis; Rate-of-Return Analysis; Cost Concepts Relevant to Decision Making; Depreciation and Corporate; Developing Project Cash Flows; Cost-Benefit Estimation for Engineering Projects; Project Risk and Uncertainty.

**EIE 3213 Manufacturing Processes II 10 Credits**

Forming Processes: Hot and cold forming. Formability. Wire working. Extrusion. Rolling. 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; adhesive bonding etc.

**EIE 3220 Manufacturing Engineering Design 10 Credits**

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.

**EIE 3221 Manufacturing Systems II - Simulation and Modelling of Manufacturing Systems 10 Credits**

General Manufacturing Systems: Analytical Queuing Model: Common Queuing Situations, Characteristics of Queuing Theory, Arrival Characteristics, Waiting Queue Characteristics, Service Facility Characteristics; Poisson Arrival, Exponential, FCFS Service; Poisson Arrivals General FCFS Service; General, Part-Priority Service; Finite Population Models; Open Networks, Poisson Arrivals and Exponential, FCFS Service, Jackson’s Theorem; Closed Networks, Mean Value Analysis; Simulation and Modelling, Types of Models, Steps Involved In Simulation Study, Modelling, Event Modelling, Process Modelling, Hand Simulation, Computer Simulation.

**EIE 3222 Concurrent Engineering 10 Credits**

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, patent procedure.

**EIE 3223 Research Methodology for Engineers 10 Credits**

Literature search, review and citation practices; Problem identification, formulating research questions; Quantitative and qualitative methods – strengths and weaknesses Instrumentation and data logging Data sampling, collection, testing; Data analysis, interpretation and limitations; Validity, reliability, sources of error Data management and presentation.

**EIE 3224 Industrial Control Engineering 10 Credits**

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); Introduction to State Space Methods.

**EIE 3225 Technopreneurship 10 Credits**

The Concept of Technopreneurship; Traits and Characteristics of Technopreneur; Importance of Technopreneurship; Creativity and Innovation; Intellectual Property Types and Registration; Business Organisation, Commercialization; Financial Options; Marketing of Products

**PART IV**

**EIE 4000 Industrial Attachment 120 Credits**

The student is attached to an organization for a minimum of eight months as an intern. During this time the student is exposed to manufacturing systems engineering practices in the real world of the work environment. The student is expected to participate in the projects the organization will be undertaking at the time as well as administration and office work.

**PART V**

**EIE 5103 Manufacturing Processes III 10 Credits**

Powder metallurgy: Production of metal powders, their characteristics, purity, grain size etc. Control and testing Pre-treatments. Pressing, lubricants. Sintering. Injection molding, 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, grinding.

**EIE 5112 Operations Management 10 Credits**

Operations functions; Forecasting; Aggregate production planning; Master production planning; Material requirement planning; Production scheduling for flow and job shops; 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; Production Planning and Control in cellular manufacturing systems, economics for cell formation; Work methods and measurement engineering. Optimisation techniques and strategies; Decision theory: games and decision trees Linear programming: graphical, simplex; Assignment and transportation problems; Forecast methods and inventory theory; Networks and graph techniques.

**EIE 5113 Manufacturing Systems III 10 Credits**

Flexible manufacturing systems; materials Components - machines, part movements, sup- porting 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.

**EIE 5114 Risk Management and Insurance for Engineers 10 Credits**

Risk and Insurance: Introduction to Risk Management; The Nature of Risk Management; Regulation & Compliance; Risk and Uncertainty, Root Cause Analysis; Loss Scenario Analysis Enterprise Risk Management; Administration, Transfer Mechanism; Insurance Contracts; Insurance Products.

**EIE 5115 CAD/CAM 10 Credits**

Introductory concepts to CAD/CAM/CAE systems, Basic concepts of Graphic programming, Computer Aided Draughting systems, Geometric modelling systems – wire frame, surface and solid modelling, modelling functions, Representation and manipulation of curves, Basics of finite element methods, Representation and manipulation of surfaces, Computer Aided Engineering Analysis, Finite-element modelling, Design optimization, AutoLisp Programming Language and applications in design, Rapid Prototyping and Manufacturing, CAD/CAM Data exchange. practicals using current CAD soft wares, draughting and modelling. Advanced Elements of CAD/CAM, Integration of the CAD/CAM, CAPP, advanced CAM systems application, Automatic Tool path algorithms, Numerically controlled machines, motion and coordinate system nomenclature for NC machines, NC-Part programming, Computer-Aided Part Programming Tools (APT). Manufacturing networks and data communication in networked manufacturing systems, Artificial intelligence in networked manufacturing systems,

**EIE 5116 Project Management 10 Credits**

Elements of Project Management: Project planning; Project scheduling; Resource planning; Budget planning; Procurement Risk management; Quality planning and assessment. Organizing and managing projects - Basic tools and techniques. Managing triple constraints. Stakeholder communication and feedback management.

**EIE 5000 Industrial Engineering Project 10 Credits**

Aim: To develop the student's ability to integrate the theoretical, practical and business aspects of manufacturing, and improve communication skills.

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 specialized nature are not excluded.

**EIE 5214 Environmentally Conscious Manufacturing 10 Credits**

Managing environmental quality: Introduction, systems, sustainable development, limits to growth and development, environmental problems and externalities, 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. Ecodesign, Lifecycle Assessment.

**EIE 5215 Financial and Managerial Accounting for Engineers 10 Credits**

Introduction to: Accounting, Different types of Businesses, Accounting Principles & conventions, Elements, and Ethics in Accounting; Process of Recording Business Transactions; Double Entry System for Assets; Liabilities; Capital; Revenue; Expenses, Discounts and Drawings; The Accounting Cycle; The Accounting Equation; Financial Statements; Cash Flow Statements; The Flow of Inventory Costs and Cost Flow Assumptions: Specific Identification; Average Costing; FIFO; LIFO Methods and JIT Inventory Systems; Taking a Physical Inventory.

**EIE 5216 Advanced Manufacturing Technology 10 Credits**

Non-traditional Manufacturing Technology: Ultrasonic Machining Processes Using Water Jets, Electrochemical Machining, Electrochemical Deburring and Grinding, Electric Discharge Processes, Electron Beam Machining, Laser Beam Machining, Oxyfuel-Cutting Processes, Chemical Machining, Mechanics and Chemistry of Chemical Machining, Chemical Processes, Application Considerations; Fundamentals of Rapid Prototyping: Rapid Prototyping Technologies, Liquid-Based Rapid Prototyping Systems, Solid-Based Rapid Prototyping Systems, Powder-Based Rapid Prototyping Systems, Application Issues in Rapid Prototyping; Micro-systems technology: Microsystem Products, Types of Microsystem Devices, Microsystem Applications, Microfabrication Processes, Silicon Layer Processes, LIGA Process, Other Microfabrication Processes, Printed Circuit Boards (PCB), Structures, Types, and Materials for PCB, Production of the Starting Boards, Processes Used in PCB Fabrication, PCB Fabrication Sequence, Printed Circuit Board Assembly, Component Insertion, Surface-Mount Technology, Adhesive Bonding and Wave soldering; Nano Systems Technology: Nanotechnology Products, Carbon Nanostructures, The National Nanotechnology Initiative, Introduction to Nanoscience, Size Matters, Scanning Probe Microscopes, Nanofabrication Processes, Top-Down Processing Approaches, Bottom-Up Processing Approaches

**EIE 5217 Manufacturing Strategy 10 Credits**

Strategic management; Production/operations management; Project management Operations research methods for management and technology management. Corporate strategy. Benchmarking. Technology strategy

**EIE 5218 Advanced Manufacturing Systems 10 Credits**

Modern manufacturing techniques: World Class Manufacturing Systems, JIT, Lean Six Sigma manufacturing principles Business Logistics; Intelligent Manufacturing Systems: Evolution of IMS, Tools for IMS, Artificial Intelligence in Manufacturing, CIM, Automation and control; Holonic Manufacturing Systems; Holonic Architecture, Holonic Control

**MASTER OF ENGINEERING (MEng) DEGREE MANUFACTURING ENGINEERING/SYSTEMS AND OPERATIONS MANAGEMENT**

**1.0 PREAMBLE**

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

(a) Master of Engineering in Manufacturing Systems and Operations Management

(b) Master of Engineering in Manufacturing Engineering and Operations Management

The MEng programme is designed to provide a broad based education in the principles and practical application of Manufacturing Systems and Operations Management. The programme is designed to enhance the skills and enable graduates to analyse and develop strategies for approaching and solving a variety of problems in a variety of settings within the broader field of manufacturing and operations management. The programme introduces the advanced concepts and professional skills needed to in high-level and specialised positions.

**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.

**3.0 PROGRAMME REQUIREMENTS**

3.1 The programme of study consists of 8 core taught and elective modules with credit points totaling not fewer than 180 credits (10 taught modules) and 90 credits for the dissertation.

3.2 The project leading to a dissertation 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 dissertation to the Department.

3.3 Successful completion of the programme requires that the candidate passes all modules and defends his/her thesis before the Departmental Examination Committee.

**4.0 STRUCTURE OF THE PROGRAMME**

**4.1 Programme duration**

The MEng programme will require a minimum of 3 stages to complete on block release basis. Candidates should pass all the modules taken and complete the dissertation in order for the candidate to qualify for the award of the degree.

**4.2 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 MEng DEGREE CLASSIFICATION**

The award of MEng degree shall be in the following categories:

80% and above - Distinction

70% - 79% - Merit

60% - 69% - Credit

50% - 59% - Pass

Below 50% - Fail

**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

**6.1 MANUFACTURING SYSTEMS AND OPERATIONS MANAGEMENT**

**STAGE I**

|  |  |  |
| --- | --- | --- |
| EIE 6111 | Design Analysis & Control of Manufacturing Systems | 18 |
| EIE 6134 | Operations Management | 18 |
| EIE 6210 | Systems Modeling and Simulation | 18 |
| EIE 6230 | Quality System | 18 |
| Electives (Choose 1) |
| EIE 6121 | Computer Aided Design & Manufacturing | 18 |
| EIE 6132 | Logistics | 18 |
| EIE 6130 | Operations Research | 18 |
| EIE 6133 | Human Factors Engineering | 18 |

**STAGE II**

|  |  |  |
| --- | --- | --- |
| EIE 6110 | Manufacturing Information and Database Systems | 18 |
| EIE 6211 | Manufacturing Strategies | 18 |
| EIE 6220 | Automation and Robotics | 18 |
| EMB 5103 | Financial and Management Accounting | 18 |
| Electives (Choose 1) |
| EIE 6120 | Computer Control of Manufacturing Systems | 18 |
| EIE 6231 | Management of Technology | 18 |
| EIE 6232 | Selected Topics in Advances in Manufacturing | 18 |
| EMB 5102 | Human Resources Management | 18 |

**MANUFACTURING SYSTEMS AND OPERATIONS MANAGEMENT**

**EIE 6111 Design Analysis and Control of Manufacturing Systems 18 Credits**

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); Metaheuristics expert systems as applied to manufacturing systems.

**EIE 6121 Computer Aided Design and Manufacturing 18 Credits**

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. Interfacing between CAD and CAM.

**EIE 6130 Operations Research 18 Credits**

Operations research advanced concepts: integer and mixed programming, network flows programming dynamic programming, goal programming. New operations research directions. Applications in different areas of Industrial/Manufacturing Engineering.

**EIE 6132 Logistics 18 Credits**

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.

**EIE 6133 Human Factors Engineering 18 Credits**

Work Study: method study, time study, motion economy. Ergonomics: man-machine interaction, work conditions. Industrial psychology. Biomechanical models of human at work. Occupational health and safety. Control of ergonomic hazards: Engineering control, general control methods, training education.

**EIE 6134 Operations Management 18 Credits**

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.

**EIE 6210 Systems Modeling and Simulation 18 Credits**

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

**EIE 6230 Quality Systems 18 Credits**

Total quality management: Overview, principles, levels of adoption; Pioneering works of Deming, Juran, Crosby, Ishikawa, Imai, Shingo and Fiegenbaum; International Standards: Malcom Baldridge, ISO 9000, ISO14 000; Cost of quality; Quality function deployment; Quality loss function; Total quality tools and techniques.

**STAGE II**

**EIE 6110 Manufacturing Information And Database Systems 18 Credits**

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, Electronic 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. Management of Manufacturing Information and Data Systems: Strategic implications of MIDS (value chain, is strategic planning); Information economics.

**EIE 6120 Computer Control Of Manufacturing Systems 18 Credits**

Analysis of microprocessor controlled servo loops, adaptive control, state space methods in control and analysis of Numerical Control (NC) machines, robots and their controllers; programmable controllers.

**EIE 6211 Manufacturing Strategy 18 Credits**

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; pan of process and product technology; product volume. Levels of vertical integration. Joint ventures, non-equity-based collaboration, long-term contracts, customer-vendor relationships, JIT production

**EIE 6220 Automation and Robotics 18 Credits**

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.

**EIE 6231 Management of Technology 18 Credits**

Knowledge. Technology. Technology transfer. Research and development infrastructure, interaction, and cooperation. Technology and its environment - social, human, political factors. Managing innovation and technology dynamics. Change dynamics.

**EIE 6232 Selected Topics in Advances In Manufacturing 18 Credits**

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. Selected readings from journal articles.

**EMB 5102 Human Resources Management 18 Credits**

The module is intended to provide focus and coherence to a range of organizational activities which are essentially concerned with managing people and improving their effectiveness. The keys to understanding Human Resources Management lie within its social, economic, political and cultural context and the lectures will aim to make links between context, activities and theory.

**EMB 5103 Financial and Management Accounting 18 Credits**

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. Investment appraisal.

**STAGE III**

**EIE 6000 DISSERTATION**

The dissertation topic is selected by the student with the approval of the supervisor and Departmental Board. The research is conducted over one full year and should demonstrate that the student can solve a higher level problem using skills and techniques mastered at postgraduate level of study.

**MANUFACTURING ENGINEERING AND OPERATIONS MANAGEMENT**

**EIE 6121 Computer Aided Design and Manufacturing 18 Credits**

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. Interfacing between CAD and CAM

**EIE 6122 Manufacturing Technology 18 Credits**

Traditional machining (material removal) processes: Machining processes overview, Cutting technology and cutting mechanics, Tool wear and cutting tool materials; Non-traditional machining processes; Advanced sheet metal forming technologies; Moulding and extrusion processes for plastics; Additive manufacturing technologies; Hybrid manufacturing technologies/process chains; Laser engineering applications.

**EIE 6124 Concurrent Engineering 18 Credits**

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, Value Engineering.

**EIE 6132 Logistics 18 Credits**

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.

**EIE 6130 Operations Research 18 Credits**

Operations research advanced concepts: integer and mixed programming, network flows programming dynamic programming, goal programming. New operations research directions. Applications: in different areas of Industrial/Manufacturing Engineering.

**EIE 6133 Human Factors Engineering 18 Credits**

Work Study: method study, time study, motion economy. Ergonomics: man-machine interaction, work conditions. Industrial psychology. Biomechanical models of human at work. Occupational health and safety. Control of ergonomic hazards: Engineering control, general control methods, training education.

**EIE 6134 Operations Management 18 Credits**

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.

**EIE 6230 Quality Systems 18 Credits**

Total quality management: Overview, principles, levels of adoption; Pioneering works of Deming, Juran, Crosby, Ishikawa, Imai, Shingo and Fiegenbaum; International Standards: Malcom Baldridge, ISO 9000, ISO14 000; Cost of quality; Quality function deployment; Quality loss function; Total quality tools and techniques.

**STAGE II**

**EIE 6110 Manufacturing Information and Database Systems 18 Credits**

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, Electronic 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; Management of change (human factors, tools and techniques).

**EIE 6120 Computer Control of Manufacturing Systems 18 Credits**

Analysis of microprocessor controlled servo loops, adaptive control, state space methods in control and analysis of Numerical Control (NC) machines, robots and their controllers; programmable controllers.

**EIE 6220 Automation and Robotics 18 Credits**

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.

**EIE 6121 Environmentally Conscious Manufacturing 18 Credits**

Manufacturing environments; Environmental quality: Environmental quality KPIs, Water quality, Land quality, Air quality, Noise, Temperature, Radiation; Climate change and global warming: Engineering processes and climate change, Sustainable development, International Treaty Agreements; Sustainable manufacturing: Cleaner production technologies, Green design, Waste management, Innovation towards sustainable manufacturing; Environmental impact assessments: Industrial ecology, Legislation, ISO 14001; Life cycle assessment: Product life cycle and impacts, Green labelling and eco-designs, Life cycle assessment methodologies

**EIE 6123 Material Selection 18 Credits**

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. Case studies.

**EIE 6231 Management of Technology 18 Credits**

Knowledge. Technology. Technology transfer. Research and development infrastructure, interaction, and cooperation. Technology and its environment - social, human, political factors. Managing innovation and technology dynamics. Change dynamics.

**EIE 6232 Selected Topics in Advances In Manufacturing 18 Credits**

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. Selected readings from journal articles.

**EMB 5102 Human Resources Management 18 Credits**

The module is intended to provide focus and coherence to a range of organizational activities which are essentially concerned with managing people and improving their effectiveness. The central proposition of the module is that these activities, when properly integrated and related to the strategic goals of the organization, can have a significant positive impact on its overall performance. The keys to understanding Human Resources Management lie within its social, economic, political and cultural context and the lectures will aim to make links between context, activities and theory.

**EMB 5103 Financial and Management Accounting 18 Credits**

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. Investment appraisal.

**STAGE III**

**EIE 6000 DISSERTATION 90 Credits**

The dissertation topic is selected by the student with the approval of the supervisor and Departmental Board. The research is conducted over one full year and should demonstrate that the student can solve a higher level problem using skills and techniques mastered at postgraduate level of study.

**POSTGRADUATE DIPLOMA 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 the Senate on the recommendation by the Department and Faculty of Engineering.

OR

1.2 A Bachelor's degree in Science as considered by the Senate on the recommendation by the Department and Faculty of Engineering.

**2.0 Post-Graduate Diploma (PGD) Structure**

The PGD programme will require two stages of part-time work consisting of core and elective modules with credit points totaling not fewer than 108 credits (6 modules). These modules may be chosen from the MEng modules.

**3.0 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 modules are passed at levels acceptable for the award of MEng degree.