School of Engineering

DEPARTMENT OF CHEMICAL & PROCESS ENGINEERING

BACHELOR OF ENGINEERING IN CHEMICAL & PROCESS ENGINEERING

STUDENTS' COURSE HANDBOOK

ECEU

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Engineering the Future Today

(ISO 9001:2015 Certified Institution)

Preface

This handbook is produced by the Department of Chemical and Process Engineering, Moi University in conjunction with other academic departments in the School of Engineering offering Undergraduate Programmes. The handbook presents a summarized curriculum for the revised Bachelor of Engineering in Chemical and Process engineering. Great effort has been put in to ensure the Teaching, Learning, Assessment and Evaluation Strategies align very well with the Washington Accord Outcome Based Standards. The handbook will normally be updated after every review cycle of curriculum, preferably 5 years. The following information concerning the program is provided:

- Programme Description
- Programme Educational Objectives (PEOs)
- Programme Outcomes (POs)
- Programme Structure
- Admission / Entry Requirements
- Examination Requirements
- Graduation Requirements
- Degree Award
- Professional Accreditation
- Course Descriptions

Dean, School of Engineering   Chair of Department

BACHELOR OF ENGINEERING IN CHEMICAL AND PROCESS ENGINEERING PROGRAM (WA OBE)

1.1 Program Summary

School	**Engineering**
Department	Chemical & Process Engineering
Contact	hodchemical@mu.ac.ke
Campus	Main
Typical full duration	5 Years
Minimum Credit Hours for Award	256
Award (s)	Bachelor of Chemical & Process Engineering

1.2 Program Description

The Bachelor of Engineering in Chemical and Process Engineering is a uniquely designed programme to equip learners with knowledge, skills, competencies and attitudes that match internationally acceptable engineering graduates' attributes. The curriculum is carefully designed to ensure proper balance between theoretical, practical and industrial experience aspects. The teaching, learning and assessment strategies align well with the Washington Accord (WA) Outcome Based Education (OBE) standards towards ensuring that graduates possess professional competencies which prepare them to practice engineering at the entry level of the profession in all WA signatory countries. Signed in 1989, the Washington Accord, is a multi-lateral agreement between bodies responsible for accreditation or recognition of tertiary-level engineering qualifications within their jurisdictions who have chosen to work collectively to assist the mobility of professional engineers. It is expected that graduates of the Bachelor of Chemical and Process Engineering will demonstrate cognitive, psychomotor and affective skills in line with the EAC graduate profiles, thus being able to tackle complex engineering problems for the betterment of society.

1.3 Programme Educational Objectives (PEOs)

The PEOs outline the expected accomplishments of graduates after three (3) to five (5) years of graduation. There are four (4) PEOs for the Bachelor of Engineering in Chemical and Process Engineering WA OBE aligned programme, formulated based on the Moi University's Vision, Mission, Educational goal, and considering the requirements and interests of the employers and other stakeholders. They include:

PEO1: Graduates that are knowledgeable, competent and employable, capable of pursuing a successful career in Chemical and Process Engineering and allied industries

PEO2: Graduates that are proficient in applying the principles of engineering to design, develop, improve and maintain industrial processes to meet specified needs with consideration of process efficiency, public health, safety, and welfare.

PEO3: Graduates that are innovative, critical thinkers and problem solvers who strive to continuously align their activities for the betterment of the society.

PEO4: Graduates that exhibit entrepreneurial, leadership and high professional skills and attitudes while committed to ethics, professional integrity, sustainable development and lifelong learning

1.4 Programme Outcomes (POs)

The program outcomes specify the accomplishments, abilities, and information that students should have by the time they graduate. These are connected to the knowledge, abilities, and behaviors that students have acquired during the curriculum. The eleven (11) POs for the Bachelor of Chemical and Process

Engineering POs are directly adapted from the Engineering Accreditation Council (EAC) general POs to guarantee alignment and conformance with EAC criteria. They include:

PO1- Engineering Knowledge: Apply the knowledge of chemical engineering, science, and mathematics in solving complex Engineering problems;

P02 - Problem Analysis: Analyze Chemical Engineering process systems and troubleshooting problems;

PO3 - Design/Development of Solutions: Develop chemical processes and systems that meet public health and safety, cultural, societal, and environmental needs;

PO4 - Investigation: Conduct systematic engineering research, to derive valid conclusions in solving societal problem;

PO5 - Modern Tool Usage: Apply modern technology such advanced software to simulate and model chemical processes;

PO6 - The Engineer and the World: Perform professional engineering tasks and duties in a professional manner while considering safety, health and sustainable development and impact on the environment for society;

PO7 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice;

PO8 - Individual and Team Work: Work collaboratively with peers in multidisciplinary settings or work individually under minimal supervision;

PO9 - Communication: Communicate effectively, orally as well as in writing, on complex chemical engineering activities with the engineering community and with society such as through written technical reports and presentations;

PO10 - Project Management and Finance: Demonstrate management and leadership skills in the execution of chemical engineering projects in a multidisciplinary environment;

PO11 - Life Long Learning: Be able to recognize the need for and be engage in independent and life-long learning in the broadest context of technological change.

1.5 Programme Structure

Normally, the study plan for students enrolled in the programme is full time mode. Each academic year runs on two (2) semesters of fourteen (14) weeks of teaching and continuous assessments, and two (2) weeks allocated for examination process. Exceptions occur during the second, third and fourth years where an extra (third) semester of 12 weeks each is included for workshop practice, industrial attachment I and industrial attachment II, respectively. Laboratory work forms core part of this curriculum whereby rigorous practical work is undertaken throughout the study period. Also, during the fifth year of study, every student must select, take and pass a minimum of four (4) taught elective courses and any extra elective will be treated as an optional course. The programme duration is five (5) years.

One (1) Credit Hour (CH) is equivalent to forty (40) nominal hours derived from Total Student Learning Time (SLT). The SLT comprises of lecturer-leaner contact sessions e.g. through lectures, tutorials, consultations, laboratory etc. and student self-learning time. For example, for a three (3) credit hour course without laboratory sessions, two (2) contact hours are allocated for lectures and one (1) contact hour for tutorials session per week.

1.5.1 Core Courses

All courses offered from year one to year four are compulsory. However, in fifth year, in addition to compulsory courses, learners are required to take and pass a minimum of four elective courses (12 CHs).

1.5.2 Recommended Study Plan

Semester dates are communicated by the Moi University Senate through an Almanac for each Semester.

1.6 General Entry Requirements

The minimum entry requirements for the Bachelor of Chemical and Process Engineering programme are:

(i) All candidates admitted to the degree programme of Bachelor of Engineering in Chemical and Process Engineering must satisfy the minimum entrance requirements stipulated in the common university entrance regulations.

(ii) In addition, from the revised Kenya Certificate of Secondary Education (KCSE) structure in which candidates are examined in a minimum of eight (8) subjects, applicants must obtain at least and overall grade of C+ (plus) and the minimum cut-off points for the year as determined by the Kenya Universities and Colleges Central Placement Service (KUCCPS) from any one of the four subject clusters/alternatives listed in Table.

(iii) Applicants holding qualifications equivalent to the above from institutions recognised by Moi University Senate may also be admitted into the programme.

Table: Programme Admission Requirements

ALTERNATIVE A*
Mathematics (C+)
Physics (C+)
Chemistry (C+)
Either Biology or Geography or any
Group V (i.e., technical group of subjects) (C+)

*The above clusters may change from year to year as determined by KUCCPS

1.7 Examination Regulations

The Common Regulations for the examination of Undergraduate Degree Programmes of Moi University shall normally apply.

1.8 Graduation Requirements

To qualify for graduation, a candidate must successfully complete a minimum of two hundred and fifty-three (256) credit hours as prescribed courses, workshop practice and two industrial attachments.

1.9 Degree Award

Upon successful completion of the programme and satisfying all the requirements as stated by the Moi University senate, the candidate will be awarded a Bachelor of Engineering in Chemical and Process Engineering.

1.10 Professional Accreditation

The BEng. Chemical and Process Engineering programme is approved and accredited by the Commission for University Education (Kenya) and regulated by the Engineers Board of Kenya (EBK). Further, the programme is currently seeking approval for Washington Accord Provisional Status by the International Engineering Council (EAC) through EBK.

1.11 Course Descriptions

The programme structure gives a summary and breakdown of all courses offered in each year, semester and their respective EAC credit hours. The courses are described in term of:

- Course Name
- Course Code
- Convener and Venue Details

- Year and Semester
- Rationale
- Total Student Learning Time (SLT) Summary Table
- Credit Value
- Pre-requisite
- Objectives
- Synopsis
- Course Learning Outcomes (COs)
- Mode of Delivery
- Assessment method - CO mapping
- Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile
- Content Outline of the Course and the SLT per Topic
- Core and Supplementary Texts, and other additional information

Table: Distribution of courses offered according to Semester (Programme Structure)

Year - Semester	Code	Course	Status	Credit Hours
Year 1 - Sem 1	MAT101	Basic Engineering Mathematics I	Compulsory	3
	TEC110	Engineers & the World	Compulsory	3
	PHY105	Physics for Engineers	Compulsory	4
	CPE111	Introduction to Materials Science	Compulsory	3
	COE120	Object Oriented Programming	Compulsory	4
	MPE114	Basic Engineering Mechanics	Compulsory	3
	MPE116	Engineering Drawing I	Compulsory	3
Year 1 - Sem 2	STA102	Engineering Statistics I	Compulsory	3
	MAT103	Basic Engineering Mathematics II	Compulsory	3
	TEC112	Chemistry for Engineers	Compulsory	4
	CPE122	Principles of Chemical Process Calculations	Compulsory	3
	ITE125	Introduction to Engineering Safety and Profession	Compulsory	2
	MPE126	Engineering Drawing II	Compulsory	3
	COE121	Programming Methodology and Problem Solving	Compulsory	3
Year 2 - Sem 1	ECE210	Electrical Engineering I	Compulsory	3
	MAT206	Numerical Methods	Compulsory	3
	MAT207	Engineering Mathematics I	Compulsory	3
	SCH211	Atomic Structure and Bonding	Compulsory	3
	CPE225	Particle Technology I	Compulsory	3

	MPE214	Mechanics of Machines I	Compulsory	3
	SCH221	Carbonyl Chemistry	Compulsory	3
Year 2 - Sem 2	ECE220	Electrical Engineering II	Compulsory	4
	STA202	Engineering Statistics II	Compulsory	3
	MAT208	Engineering Mathematics II	Compulsory	3
	MPE222	Solid and Structural Mechanics I	Compulsory	3
	CPE221	Physical Chemistry	Compulsory	3
	CPE222	Principles of Mass and Energy Balance	Compulsory	3
	CSE224	Introduction to Fluid Mechanics	Compulsory	4
	CPE227	Engineering Thermodynamics	Compulsory	3
Year 2 - Sem 3	CPE230	Workshop Practice	Compulsory	6
Year 3 - Sem 1	CPE311	Analytical Chemistry	Compulsory	2
	CPE312	Fluid Mechanics I	Compulsory	3
	CPE313	Heat Transfer	Compulsory	3
	CPE315	Particle Technology II	Compulsory	3
	CPE317	Chemical Engineering Thermodynamics I	Compulsory	3
	CPE318	Fundamentals of Computer Aided Drawing	Compulsory	3
	ECE310	Basic Electronics	Compulsory	3
	ECO330	Economics for Engineers	Compulsory	3
	CPE310	Chemical Engineering Practicals I	Compulsory	2
Year 3 - Sem 2	CPE321	Materials Science	Compulsory	3
	CPE322	Fluid Mechanics II	Compulsory	3
	CPE323	Steam Plant	Compulsory	3
	CPE324	Mass Transfer I	Compulsory	3
	CPE327	Chemical Engineering Thermodynamics II	Compulsory	3
	CPE329	Process Measurements & Instrumentation	Compulsory	3
	ITE327	Research Methods and Report Writing	Compulsory	3
	CPE320	Chemical Engineering Practicals II	Compulsory	2
Year 3 - Sem 3	CPE330	Industrial Attachment I	Compulsory	6
Year 4 - Sem 1	CPE411	Process Economics	Compulsory	3
	CPE412	Mechanics of Non-Newtonian Fluids	Compulsory	2

	CPE414	Mass Transfer II	Compulsory	3
	CPE415	Introduction to Environmental Engineering	Compulsory	3
	CPE416	Reactor Engineering I	Compulsory	3
	CPE418	Chemical Engineering Design I	Compulsory	3
	CPE419	Process Modelling and Simulation	Compulsory	3
	BBM221	Entrepreneurship Theory and Concepts	Compulsory	3
	CPE410	Chemical Engineering Practicals III	Compulsory	2
Year 4 - Sem 2	CPE422	Introduction to Biochemical Engineering	Compulsory	3
	CPE423	Non-Fossil Energy Technologies	Compulsory	2
	CPE424	Mass Transfer III	Compulsory	3
	CPE425	Industrial Pollution Control	Compulsory	3
	CPE426	Reactor Engineering II	Compulsory	3
	CPE428	Chemical Engineering Design II	Compulsory	3
	CPE429	Process Dynamics & Control	Compulsory	3
	BBM351	Operation Research	Compulsory	3
	CPE420	Chemical Engineering Practicals IV	Compulsory	2
Year 4 - Sem 3	CPE430	Industrial Attachment II	Compulsory	6
Year 5 - Sem 1	CPE513	Energy Management	Compulsory	3
	CPE518	Total Quality Management	Compulsory	3
	CPE519	Industrial Chemical Processes	Compulsory	3
	FLB210	Industrial Labour Laws	Compulsory	3
	CPE510	Chemical Engineering Research Project I	Compulsory	3
	CPE580	Plant Design Project I	Compulsory	3
		Elective I	Elective	3
		Elective II	Elective	3
Year 5 - Sem 2	CPE521	Industrial Management	Compulsory	3
	CPE525	Safety in Chemical Industries	Compulsory	3
	CSE521	Environmental and Social Impact Assessment	Compulsory	3
	CPE529	Process Optimization	Compulsory	3
	CPE520	Chemical Engineering Research Project II	Compulsory	3
	CPE581	Plant Design Project II	Compulsory	4
		Elective III	Elective	3

		Elective IV	Elective	3
List of Electives				
	CPE500	Technology of Fats and Oils	Elective	3
	CPE501	Pulp and Paper Technology	Elective	3
	CPE502	Biochemical Engineering	Elective	3
	CPE503	Petroleum Technology	Elective	3
	CPE504	Food Processing Industries	Elective	3
	CPE505	Computer Aided Process Simulation	Elective	3
	CPE506	Electrochemical & Corrosion Technology	Elective	3
	CPE507	Advanced Industrial Pollution Control	Elective	3
	CPE508	Polymer Technology	Elective	3
	CPE509	Pharmaceutical Technology	Elective	3

Course Descriptors

Year One - First Semester

Course Name	Basic Engineering Mathematics I				
Course Code	MAT101				
Course Convener Name Room No. Email	TBC (School of Sciences & Aerospace Studies)				
Year	1				
Semester	1				
Rationale for the inclusion of the Course in the programme	This course gives learners basic foundation knowledge in mathematics as an introduction to advanced courses in engineering mathematics and other Engineering courses.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		76	118
Credit Value	3				
Pre-requisite (if any)	None				

Course Objective	The overall objective of this course is to enable students to acquire an understanding of the fundamentals of pure mathematics, and lay a firm foundation for the study of advanced engineering mathematics and its applications.
Synopsis	This course introduces learners to logical mathematical logical relations as used to represent physical phenomena, fundamental algebraic skills and applications in engineering, polynomials, trigonometric and hyperbolic functions as well as concept of scalars and vectors in engineering
Course Learning Outcomes	On completion of this course, the learner will be able to: 1. Apply logical and algebraic skills in solving mathematical problems related to engineering. 2. Prove different integer relations in algebraic structures; 3. Manipulate the Pythagorean identities. 4. Perform operations on vectors, and use the vectors to find distances.
Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in	15	X	X		
Task 1: Assignment (Individual)	10		X	X	
CAT 2: Sit in	15			X	X
Task 2: Assignment (Group)	10			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK2
CO2	PO1	
CO3	PO1, PO2	
CO4	PO2	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Algebra:** Sets, unions, intersections, complements; Algebraic structures such as rational indices, multiplication, addition and partial fractions.	6	3		15	
	CAT 1-SIT IN				1	1
2	**Polynomial functions:** constant, linear, quadratic, division, remainder factor; functions and mappings;	6	3		15	

		inverse, constant, step, even, odd, composite.					
		TASK 1: Individual assignment				1	1
	3	**Trigonometry**: trigonometric and hyperbolic functions, logarithmic and exponential functions.	4	2		10	
	4	**Vectors**: scalars and vectors, components, addition, multiplication, vector spaces. Ratio theorem, scalar and vector products, unit vectors, geometric interpretations, applications to mechanics.	6	3		15	
		CAT2 – Sit in				1	1
	5	**Matrices**: matrix algebra, determinants, rank of a matrix, transpose, inverse of an n x n matrix, eigenvalues, eigenvectors. Solution of linear equations, Crammer's rule, elementary row operations; Gauss' elimination method; lower-upper decomposition. Solutions of homogenous equations.	6	3		15	
		TASK 2: Group Assignment				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts

1. Dettman, J. W. (2013). Mathematical methods in physics and engineering. Courier Corporation.
2. Riley, K. F. (1974). Mathematical methods for the physical sciences: an informal treatment for students of physics and engineering. Cambridge University Press.
3. Barnett, R. A. (2010). College algebra with trigonometry. McGraw Hill Higher Education.
4. Backhouse, J. K., Horril, P. J. F., & Houldsworth, S. P. T. (1985). Pure mathematics. Longman.

Supplementary Texts	1. Riley K.F., Hobson M.P., Bence, S. (2000). Mathematical methods for physics and engineering Cambridge University press. 2. Scott C.H. (1979), College algebra with applications Winthrop Publishers, Inc. 3. Stroud, K. A. (1995). Engineering Mathematics: 4th Edition.
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Engineers and The World				
Course Code	TEC 110				
Course Convener Name Room No. Email	TBD				
Year	1				
Semester	1				
Rationale for the inclusion of the Course in the programme	The course introduces engineering students to a global understanding of the role of an engineer in the society and the impact of engineering on the socio-economic system and development. The course will provide an overview of the social dimension of the engineering profession including the common societal issues that are encountered in engineering practice and the need for sustainable development. Students will also learn about life as an engineering student.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28			68	96
Credit Value	2				
Pre-requisite (if any)	None				
Course Objective	The objectives of this course are to enable learning about; 1. Engineering Profession in a global society 2. Impact of engineering and technology on society and the environment 3. Interrelations between engineering and the socio-economic aspects of development in promoting sustainable development 4. Engineering Professionalism and life as an engineering student				
Synopsis	This course gives an overview of the social dimension of the engineering profession including the common societal issues that are encountered in engineering practice and the need for sustainable development.				
Course Learning Outcomes	By the end of the course, the learner should be able to; 1. Explain the duty of an engineer in a global society 2. Identify the impact of the engineering profession on society 3. Apply concepts of sustainability to analyze the interactions between engineering and the economic, social, and cultural aspects of society				

	4. Recognize key aspects of life as an engineering student
Mode of Delivery	1. Lectures 2. In-class discussions 3. Group activities/tasks 4. Portfolio project 5. Self-guided learning 6. Class presentations 7. Case studies
Assessment method-CO Mapping	(see table below)

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10		X	X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK7, WK9
CO2	PO7	
CO3	PO6	
CO4	PO11	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Engineering profession and society: The duty of an engineer in communities, towns, cities and metropolises; Impact of engineering and technology on society and the environment.	6			12	
	Task 1: Assignment				1	1
2	Socio-economic system and development: Components of a socio-economic system, role of engineering in the economic, social, and societal aspects of development, Emerging trends.	6			12	
	In-Class Test 1				1	1

	3	Environmental stewardship and sustainability: Concepts of environmental stewardship and sustainable development, Engineer's responsibility for the environment, sustainability and climate change.	6			12	
	4	Engineering Professionalism: Trustworthiness, moral responsibility, personal integrity, accountability, and Conflict of interest.	4			8	
		In-Class Test 2				1	1
	5	Life as an engineering student: well-being, group dynamics, conflict resolution, time management, planning, problem solving and academic honesty.	6			12	
		Task 2- Group Work				1	1
	Final Exam					2	2
			28			**62**	**6**

Course Texts	1. Bell, S. (2011). Engineers, Society and Sustainability; (ESS) Synthesis, Morgan & Claypool Publishers
Supplementary Texts	1. Fleddermann, C.B. (2012). Engineering Ethics, 4th edition. Pearson Prentice Hall.: Upper Saddle River, New Jersey, USA, ISBN-10: 0-13-214529- 2. Cathleen L. (2013), Engineering in Society. Royal Academy of Engineering 3. James G. (2008) The Ethics of Climate Change: Right and Wrong in a Warming World, Continuum Publishers, New York, USA.
Other additional information:	Lecture notes, Websites etc.

<table>
<tr><td>Course Name</td><td colspan="5">Introduction to Material Science</td></tr>
<tr><td>Course Code</td><td colspan="5">CPE 111</td></tr>
<tr><td>Course Convener Name
Room No.
Email</td><td colspan="5">Mr Wiseman Tumbo Ngigi
TBD
wisemanngigi@mu.ac.ke</td></tr>
<tr><td>Year</td><td colspan="5">1</td></tr>
<tr><td>Semester</td><td colspan="5">1</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">Chemical and process engineers are involved in the design of equipments for the conversion of raw materials into finished products. This course introduces the concept of material selection and application which is quite important to the chemical engineer because during equipment design, the chemical engineer must select suitable materials of construction for each equipment involved in the production process.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td>12</td><td>87</td><td>141</td></tr>
<tr><td>Credit Value</td><td colspan="5">4</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">None</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objectives of this course are to enable learning about;
1. Structure and nature of engineering materials
2. The properties of engineering materials.
3. Property testing of materials
4. Selection of engineering materials for specific applications</td></tr>
<tr><td>Synopsis</td><td colspan="5">This course introduces the basic structure of engineering materials and relates the properties of a material to its structure. In addition, material selection strategies are explained and a brief discussion on material testing is also included.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Describe structure and properties of engineering materials.
2. Distinguish different materials based on their properties and how they apply their area of application
3. Test the operation for engineering materials.
4. Select materials for specific applications based on their suitability strategies.</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. Lectures (hybrid)
2. Tutorials
3. Group Discussions
4. Laboratory Experiments</td></tr>
<tr><td>Assessment method-CO Mapping</td><td colspan="5">
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>15</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>10</td><td>X</td><td>X</td><td></td><td></td></tr>
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</td></tr>
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CAT 2 (Sit-In Test 2)	10			X	X
Laboratory Work (Group)	15			X	
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	**Programme Learning Outcome**	**Knowledge Profile**
CO1	PO1	WK1
CO2	PO1	
CO3	PO1, PO8	
CO4	PO1, PO8	

Content Outline of the Course and the SLT per Topic

No.	**Topic**	**Lecture**	**Tutorial**	**Lab**	**Self-Learning**	**FE/Q/MT**
1	Structure and Nature of Materials: Atoms and elements as building blocks. Periodic table of the elements.	4	2		10	
	Task 1: Assignment				1	1
2	Nature of engineering materials: metals, ceramics, polymers, composites.	6	3		15	
	In-Class Test 1				1	1
3	Properties of Engineering Materials: Physical properties, mechanical properties, Chemical properties, electrical properties.	6	3	6	21	
4	Mechanical Testing of Materials: Tensile test, compression test, hardness tests, impact tests, fatigue tests, creep test, fracture toughness tests, flexural test.	6	3	6	21	
	In-Class Test 2				1	1
5	Overview of Materials Selection: Ferrous and non-ferrous metals and alloys, plastics,	6	3		15	

		traditional ceramics, technical ceramics, glass, engineering gels (Portland cement, tar, bitumen), concrete, steel reinforced concrete, wood, organic and inorganic fibres, fibre reinforced plastics.					
	Final Exam					2	2
			28	14	12	87	5

Course Texts	1. Steimel, J. P. (2019). Materials Science and Engineering, USA, Pacific Open Texts. 2. Callister Jr D.W. & Rethwisch D.G. (2018). Materials Science and Engineering: An Introduction (10th edn.) New York: John Wiley and Sons.
Supplementary Texts	1. Gupta, K.M. (2014). Engineering Materials. USA: CRC Press. 2. Kelly, P.F. (2014). Properties of Materials. USA: CRC Press. 3. Ashby, F.M. & Jones, D.R.H. (2000). Engineering Materials 1: An 4. Introduction to their Properties and Applications. (2nd edn.). London: Butterworth Heinemann. 5. Vernon, J. (2003). Introduction to Engineering Materials. (4th edn.).London: Macmillan Press Ltd.
Other additional information:	Websites, Video link, Lecture Notes, etc

Course Name	Basic Engineering Mechanics				
Course Code	MPE114				
Course Convener Name Room No. Email	TBD				
Year	1				
Semester	1				
Rationale for the inclusion of the Course in the programme	Engineering mechanics forms the foundation of aerospace, mechanical or civil engineering, and is fundamental to important parts of biomedical engineering, chemical engineering, materials science, and other engineering disciplines.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14	6	82	130

<table>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Pre-requisite (if any)</td><td>None</td></tr>
<tr><td>Course Objective</td><td>The purpose of this course is to introduce learners to the concept of static and dynamics of mechanical components.</td></tr>
<tr><td>Synopsis</td><td>Engineering mechanics is the application of mechanics to solve problems involving common engineering elements. It studies forces and the resulting deformations, accelerations, motions, vibrations, and other responses they cause.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Discuss simple concepts in static and dynamics as encountered in solid mechanics and structures
2. Derive various motion parameters of a moving body for linear, rotational and oscillatory motion
3. Apply the theory of forces on structural systems
4. Solve dynamics equilibrium problems</td></tr>
<tr><td>Mode of Delivery</td><td>1. Lectures (hybrid)
2. Tutorials
3. Laboratories
4. Group activity/presentation/discussions</td></tr>
<tr><td>Assessment method-CO Mapping</td><td>
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<tr><td>CAT 1 (Sit-In Test 1)</td><td>10</td><td>X</td><td>X</td><td></td><td></td></tr>
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<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
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<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
<table>
<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/MT</th></tr>
<tr><td>1</td><td>Statics and dynamics: rigid body, deformed bodies, Free body diagram. Force systems: Dimensions and units of mechanics, composition and resolution. Resultant of a force system, Friction</td><td>6</td><td>3</td><td>3</td><td>18</td><td></td></tr>
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		and coefficient of friction.					
		Task 1: Assignment				1	1
	2	**Moments and couples**. addition and subtraction of couples, Equilibrium of particles and rigid bodies under a system of co-planar forces.	6	3		15	
		In-Class Test 1				1	1
	3	**Projectiles**. Momentum and impulse, simple cases of conservation of momentum. Conservation of energy. Kinetic energy of a rigid body. work and energy, power and efficiency.	6	3		15	
	4	**Center of gravity & centroid**, Centroids of lines, areas and volumes, Second moment of area and Radius of gyration, Parallel and perpendicular axis theorem, Moment of Inertia.	6	3		15	
		In-Class Test 2				1	1
	5	**Simple harmonic motion**: Oscillation of a simple pendulum, elastic string and springs. Motion in a circle.	4	2	3	13	
		Task 2: Group activity/presentation				1	1
		Final Exam				2	2
			28	**14**	**6**	**82**	**6**
Course Texts	1. Polyakhov, N. N., Yushkov, M. P., Zegzhda, S. A. (2021). Rational and Applied Mechanics: Volume 1. Complete General Course for Students of Engineering. Switzerland: Springer International Publishing. ISBN: 9783030640613						

	2. Hannah J. and Hillier, M. J. (1995), Applied mechanics 3rd edition, university of California, Long man Publishers.
Supplementary Texts	1. Meriam J. L., kraige, G. L. and Palm, W. J. (2002), Engineering Mechanics: Dynamics, volume 2, J. wiley publishers. 2. Rajput, R. K. (2007), Text book of Applied Mechanics, Laxmi Publishers.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	ENGINEERING DRAWING I				
Course Code	MPE116				
Course Convener Name **Room No.** **Email**	Mr. Lazarus Limo TBD lazaruslimo@gmail.com				
Year	1				
Semester	1				
Rationale for the inclusion of the Course in the programme	Drawing is one of the oldest forms of communicating, dating back even farther than verbal communication. An Engineering drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept into machines and machine parts, roads, buildings, bridges, dams, motors, generators, poles and other Engineering projects. This course is most useful to all Engineering disciplines.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	14	28		68	110
Credit Value	3				
Pre-requisite (if any)	None.				
Course Objective	The purpose of this course is to introduce learners to the basics of engineering drawing and Computer Aided Drafting.				
Synopsis	The course covers the basics of engineering drawing and Computer Aided Drafting				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Differentiate between first and third angle orthographic projections. 2. Draw orthographic projections and insert dimensions. 3. Interpret engineering drawings 4. Create a simple drawing using AutoCAD				

Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group activity/presentation/discussions

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
Task 2: Assignment (Individual)	10	X	X		
CAT 1 (Sit-In Test 1)	10	X	X		
CAT 2 (Sit-In Test 2)	10			X	X
Task 3: Assignment CAD (Group)	20				X
Final Examination	40	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK5
CO2	PO1, PO2	
CO3	PO2, PO3	
CO4	PO3, P05, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction to engineering drawing:** Drawing equipment and use of instruments, lettering and line work.	3	6		12	
	Task 1: Assignment				1	1
2	**Simple geometrical constructions.** Conventional representations. Dimensioning.	2	4		8	
	In-Class Test 1				1	1
3	**Orthographic projections:** first and third angle projection. Principal views of machine parts. Sectional views.	4	8		16	
	In-Class Test 2				1	1
4	**Free hand sketching**.	2	4		8	
5	**Computer aided drafting**: Basic CAD commands; Lines- types	3	6		12	

		of lines, circles, arcs, combining and modifying entities, layers, colour. Annotation; inserting text and dimensions. Properties; Line properties, colour change					
		Task 2: Group activity/presentation				1	1
	Final Exam					2	2
			14	**28**		**62**	**6**
Course Texts	1. Lakhwinder P. S., Harwinder S. 2021.Engineering Drawing: Principles and Applications. Cambridge University Press. ISBN 9781009032292 2. Ashleigh C.-F., Antonio R., Douglas &S. 2023. Technical Drawing 101 with AutoCAD: A Multidisciplinary Guide to Drafting Theory and Practice with Video Instruction. SDC Publications. ISBN 9781630574307						
Supplementary Texts	1. Reddy, K. V. (2016). Textbook of Engineering Drawing: With AutoCAD. India: BS Publications. ISBN 9789352300440. 2. Narayana, K. L. (2009). Machine Drawing. India: New Age International (P) Limited. ISBN 9788122419177.						
Other additional information:	Websites, Video link, Lecture Notes etc.						

Course Name	Physics for Engineers
Course Code	PHY105
Course Convener Name Room No. Email	TBC
Year	1
Semester	1
Rationale for the inclusion of the Course in the programme	The course equips first-year engineering students with foundational knowledge of electricity, magnetism, optics, modern physics, and sound. It fosters understanding of fundamental principles, enabling students to apply physics concepts to solve real-world engineering problems.

Total Student Learning Time (SLT)	Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
	28	14	12	94	148
Credit Value	4				
Pre-requisite (if any)	N/A				

Course Objective

The objectives of this course are to enable learning about;

1. The concepts of electricity and magnetism
2. The phenomena of particle and wave theories
3. The application of the concepts of modern physics.
4. The principles and applications of optics.

Synopsis

This course provides foundational knowledge in electricity, magnetism, optics, modern physics, and sound. It equips engineering students with essential physics principles to analyze, understand, and solve practical engineering challenges across various disciplines.

Course Learning Outcomes

On completion of this course, learners will be able to:

1. Explain the concepts of electricity and magnetism.
2. Calculate problems related to electricity, magnetism, optics, particle and wave theories
3. Apply the concepts of modern physics in the basic operation of simple appliances
4. Illustrate the principles and applications of optics.

Mode of Delivery

1. Lectures (hybrid)
2. Group activity/presentation/discussions/demonstrations/Practical

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Practical (Individual)	10	X			
Test 1: CAT 1 (Sit-In)	15	X	X		
Task 2: Practical (Group)	10			X	
Test 2: CAT 1 (Sit-In)	15			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK1
CO2	PO1	
CO3	PO1	
CO4	PO8, PO9	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Electricity and Magnetism**: Magnetic materials and their applications;	8	4	6	26	

		Direct and alternating current (AC/DC); Behavior and measurement of resistance, inductance, and capacitance (R, L, C); Diodes, rectification, and transistors;					
		Task 1: Practical				1	1
	2	**Optics:** Mirrors and lenses: review and defects; Types of microscopes and telescopes; Interference, diffraction, and polarization phenomena; Applications of particle and wave theories;	6	3		15	
		Test 1 CAT (Sit-In)				1	1
	3	**Sound:** Equation of wave motion; Velocity of sound in solids and fluids; Waves on a string and their behaviour; Ultrasonics and applications in technology;	8	4	6	26	
		Task 1: Practical				1	1
	4	**Modern Physics:** Bohr's theory and Heisenberg's quantum concept; Atomic spectra and X-rays; Nuclear structure, radioactivity, and applications; Nuclear fission, fusion, and reactors;	6	3		15	
		Test 2 CAT (Sit-In)				1	1

	Final Exam				2	2
		28	14	12	88	6
Course Texts	1. Fischer-Cripps, A.C. (2014). The Physics Companion. (2nd edn.). USA: CRC Press.					
Supplementary Texts	1. Pergament, M.I. (2014). Methods of Experimental Physics. USA: CRC Press. 2. Verma, H.C. (1998). Concepts of Physics, Part-2. New Delhi: Bharati Bhawan (P&D).					
Other additional information:	Websites, Video link, Lecture Notes etc.					

Course Name	Object Oriented Programming				
Course Code	CSC 211 (COE 120)				
Course Convener Name **Room No.** **Email**	Samwel Tarus TBD sktarus@mu.ac.ke				
Year	1				
Semester	1				
Rationale for the inclusion of the Course in the programme	This course introduces Object-Oriented Programming emphasizing an objects first approach with practical applications. Objects, methods and classes are studied in detail. Leaners design and implement an application based on object-oriented program principles, adopting these concepts to solve a wide variety of problems. This course therefore, is important to prospective chemical engineers because they require knowledge and competency of programming languages in order to operate chemical processes efficiently and optimally.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14	12	87	141
Credit Value	4				
Pre-requisite (if any)	CSC121				
Course Objective	The course provides learners with both theoretical and practical skills on principles of object oriented programming.				
Synopsis	The course covers Principles of object oriented programming, design patterns and applications,				

Course Learning Outcomes	On completion of this course, learners will be able to: 1. Explain the principles of object oriented programming 2. Construct exception-handling mechanisms. 3. Demonstrate composition as a reuse of the implementation. 4. Build object oriented programs
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group activity/presentation/discussions
Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK1, WK2
CO2	PO1, PO2	
CO3	PO2	
CO4	P08, PO9	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Overview of OOP:** Basic concepts (objects, classes, methods, attributes), Advantages of OOP over procedural programming, OOP principles.	2	2	1	5	
2	**Classes and Objects:** Defining classes and creating objects, Constructors and destructors, Instance variables and methods.	4	2	2	10	
	Task 1: Assignment				1	1
3	**Inheritance and Polymorphism:** Inheritance relationships and concepts, Method overriding and	4	2	2	10	

		polymorphism, Abstract classes and interfaces.					
	4	**Encapsulation and Access Control:** Access modifiers (public, private, protected), Encapsulation principles and data hiding, Getters and setters	3	1	1	10	
		In-Class Test 1				1	1
	5	**Abstraction and Interfaces:** Abstraction and modelling concepts, Interfaces and multiple inheritance, Implementing interfaces in different languages.	2	2	1	10	
	6	**Polymorphism and Dynamic Binding:** Dynamic method dispatch and late binding, Overloading and overriding methods, Polymorphism in practice	4	1	1	10	
	7	**Exception handling:** Definition, types, application etc.	2	1	1	4	
	8	**Multithreading:** definition, types, lifecycle etc. Object-Oriented Design Principles: SOLID principles (Single Responsibility, Open/Closed, Liskov Substitution, Interface Segregation, Dependency Inversion),.	2	1	1	4	
	9	**Design patterns and their applications:** Designing with UML, Unified Modeling Language (UML)	3	1	2	10	

		basics, UML diagrams for OOP design (class diagrams, sequence diagrams), Using UML in software development.					
		In-Class Test 2				1	1
	10	**Emerging Trends in OOP:** OOP in the context of modern software development, Evolution of OOP practices and languages, Ethical considerations and implications.	2	1		5	
		Task 2: Group activity/presentation				1	1
		Final Exam				2	2
			28	**14**	**12**	**76**	**6**

Course Texts	1. Balagurusamy, E. (2021). Object oriented programming with C++. 2. Balaguruswamy, E. (2014). Programming with Java-A Primer. McGraw-Hill Professionals. 3. Kanetkar, Y. (2019). Let Us C++: Dive into the nitty-gritties of C++ language and learn why programmers prefer OOPs and C++. BPB Publications. 4. McLaughlin, B., Pollice, G., & West, D. (2007). Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D. " O'Reilly Media, Inc.".
Supplementary Texts	1. Schildt, H. (2014). Java: the complete reference. McGraw-Hill Education Group. 2. Barnes, D. J., Kölling, M., & Gosling, J. (2006). Objects First with Java: A practical introduction using BlueJ (p. 520). Pearson/Prentice Hall. 3. Savitch, W. (2017). Java: An Introduction to Problem Solving and Programming, Student Value Edition Plus MyProgrammingLab with Pearson eText-Access Card Package. Pearson. 4. Niemeyer, P., & Knudsen, J. (2005). Learning java. " O'Reilly Media, Inc.".
Other additional information:	Websites, Video link, Lecture Notes etc.

Year One - Second Semester

Course Name	Engineering Statistics I
Course Code	STA102
Course Convener Name	Dr. Silver Keny

Room No. **Email**	TBD keny.silver.jeptoo@gmail.com
Year	1
Semester	2
Rationale for the inclusion of the Course in the programme	Statistics is an important subject in engineering as it finds wide applications in analysis in any industrial set up such as mechanical, electrical. Civil, chemical or textile. The course is useful to engineers, particularly those in plant operation, plant design or equipment testing and commissioning.

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120

Credit Value	3
Pre-requisite (if any)	N/A
Course Objective	This course aims to enable learning about; the various methods of sources of data collection; how to compare sets of data using different measures; Basic probability theory and probability distributions and the skills necessary for presenting and classifying data.
Synopsis	This course is designed to enable learners to acquire knowledge and develop skills on basic fundamentals to engineering statistics.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Explain the various methods of sources of data collection 2. Compare sets of data using different measures 3. Apply basic concepts of probability theory and probability distributions 4. Present data using appropriate technique
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group activity/presentation/discussions

Assessment method-CO Mapping

Distribution	(%)	**CO1**	**CO2**	**CO3**	**CO4**
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	**Programme Learning Outcome**	**Knowledge Profile**
CO1	PO1	WK2
CO2	PO1, PO2	
CO3	PO2, PO3	
CO4	PO3, P08, PO9	

Content Outline of the Course and the SLT per Topic	No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/ Q/MT
	1	**Sources and methods of data collection:** Representation of data; bar graphs, pie charts, frequency distributions, relative frequency distributions, histograms, cumulative frequency distribution curves (ogive), stem and leaf display.	6	3		15	
		Task 1: Assignment				1	1
	2	**Measures of central tendency:** Mode, median, mean, harmonic and geometric. Measures of location; quartiles, deciles, percentiles. Measures of dispersion; range, standard deviation, coefficient of variation.	6	3		15	
		In-Class Test 1				1	1
	3	**Skewness and Kurtosis:** Introduction to probability: *Basic* Probability: Definition and interpretation of probability; axioms of probability; basic properties of probabilities. Working with Probabilities; Counting / permutations and combinations; conditional probability; independence of events; Bayes' theorem.	8	4		20	
		In-Class Test 2				1	1
	3	**Concept of random variables:** Discrete random variables, probability	8	4		20	

		distribution and probability mass function, mean and variance of discrete random variables. Continuous random variables; probability distribution and probability density function of continuous random variables.						
		Task 2: Group activity/presentation				1	1	
		Final Exam				2	2	
			24	**12**		**76**	**6**	

Course Texts	1. Vijay, K. Rohatgi, Saleh, A.K.M.E. (2015). An introduction to probability and statistics, (3rd edn). John Wiley & sons. 2. Hogg, R.V., McKean, J.W. & Craig, A.T. (2003). Introduction to Mathematical Statistics, (6th edn), Prentice Hall.
Supplementary Texts	1. Irwin, M. and Marylees M. (2011). Mathematical Statistics, (7th edn). Prentice Hall. 2. Dennis, W., William, M. and Richard, L. S. (2007). Mathematical Statistics with Applications. P W S Publishers. 3. Matthew J. (2006). Hassett and Donald Stewart. Probability for Risk Management. ACTEX Publications. 4. Robert, V. H. and Elliot, A. T. (2005). Probability and Statistical Inference, (7th edn), Prentice Hall College Div.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Basic Engineering Mathematics II
Course Code	MAT103
Course Convener Name Room No. Email	TBC (School of Sciences & Aerospace Studies)
Year	1
Semester	2
Rationale for the inclusion of the Course in the programme	This course gives learners basic foundation knowledge in pure mathematics as an introduction to advanced courses in engineering mathematics and other Engineering courses.

Total Student Learning Time (SLT)	Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
	28	14		76	118
Credit Value	3				
Pre-requisite (if any)	MAT101				
Course Objective	The overall objective of this course is to enable students to acquire an understanding of the fundamentals of pure mathematics, and lay a firm foundation for the study of advanced engineering mathematics and its applications.				
Synopsis	The learners will be introduced to quadratic equations and complex numbers, Polar form *r,θ+ of a complex number and its algebra, Integration and differentiation, and mathematical series				
Course Learning Outcomes (COs)	On completion of this course, the learner will be able to: 1. Determine squire roots of a negative numbers using the concept of complex numbers. 2. Solve ordinary differential equations 3. Compute integrals of areas and volumes 4. Solve arithmetic, geometric, logarithmic and infinite series				
Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in	15	X	X		
Task 1: Assignment (Individual)	10		X	X	
CAT 2: Sit in	15			X	X
Task 2: Assignment (Group)	10			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK2
CO2	PO1	
CO3	PO1, PO2	
CO4	PO2	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q /MT

		1	**Complex numbers**: real and imaginary parts, solutions of quadratic equations with real coefficients, Argand diagram, Demoivre's theorem and its applications , exponential form of complex numbers, log of complex numbers, exponential form of circular functions, Euler's formula.	10	5		25	
			CAT 1-SIT IN				1	1
		2	**Integration:** Integration of areas and volumes, polar coordinates and areas of sectors. Evaluating the particular integral.	6	3		15	
			TASK 1: Individual assignment				1	1
		3	**Differentiation:** solution of first order differential equations by separable variable methods. Ordinary differential equations: Linear first order differential equations, General linear differential equations with constant coefficients. Alar - Cauchy differential equation.	6	3		15	
			CAT2 – Sit in				1	1
		4	**Series:** Arithmetic, geometric, logarithmic, infinite; summation of infinite series, convergence of infinite series, tests for convergence, McLaurin and Taylor series. Leibnitz's theorem for	6	3		15	

		differentiation; convergence of Power Series. Limiting values of functions. L'Hopital rule.					
		TASK 2: Group Assignment				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts	1. Mathews, J., & Howell, R. (2012). Complex analysis fo mathematics and engineering. Jones & Bartlett Publishers. 2. Johnson, P. S. (2019). Taylor and McLaurin Series. 3. Szewczak, Z. S. (2022). A. De-Moivre theorem revisited. Statistics & Probability Letters, 181, 109260. 4. Horan, R., & Lavelle, M. (2004). Indefinite Integration.
Supplementary Texts	1. Stein, E. M., & Shakarchi, R. (2010). Complex analysis (Vol. 2) Princeton University Press. 2. Hirst, D. M. (1976). Series, Taylor—McLaurin Series. In Mathematics for Chemists (pp. 139-152). Palgrave, London.
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Chemistry for Engineers				
Course Code	TEC112				
Course Convener **Name** **Room No.** **Email**	 Florence Ajiambo TBD famumbwe@gmail.com				
Year	1				
Semester	2				
Rationale for the inclusion of the Course in the programme	Engineering requires applied science, and chemistry is the center of all science. The more chemistry an engineer understands, the more beneficial it is Furthermore, a clear understanding of the underlying principles of the physical and chemical processes that chemical substances undergo and, thus, the consequences of those processes for different applications is of great importance in order to determine the most sustainable processes and materials.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**

	28	14	42	78	162

Credit Value	4
Pre-requisite (if any)	None
Course Objective	This course is designed to enable learners to acquire knowledge and develop skills on basic fundamentals to chemistry for engineers. The course will introduce students to matter, its classification, properties and electronic structure. The students will also get to learn and perform simple calculations for reacting and non-reacting systems. Application of chemistry in corrosion control and water treatment will also be analyzed as well as study of common organic compounds.
Synopsis	The course is intended to provide students with those principles of Chemistry that are relevant to Engineering. In particular, the contents of this subject are selected to introduce and enhance students understanding the structure and properties of matter as well as the changes, both physical and chemical changes, occurred within it.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Relate the properties of matter and their electronic structure 2. Perform simple calculations for reacting and non-reacting systems and on chemical kinetics and equilibrium 3. Analyze the chemistry behind corrosion of metals and water treatment 4. Evaluate the chemistry of common organic compounds of industrial importance.
Mode of Delivery	1. Lectures 2. Tutorials 3. Group Discussions 4. Practicals

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	10	X	X		
Task 2: Assignment (Individual)	10			X	X
CAT 2 (Sit-In Test 2)	10			X	X
Labaratory Exercises (Group)	10	X	X		X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK1
CO2	PO2	
CO3	PO2, PO2	
CO4	PO8, PO9	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT

	1	**Basic Chemical Concepts:** Atoms and the atomic theory, Chemical compounds and Stoichiometry	4	2	3	16	
	2	**The periodic table and the Electronic structure of Atoms** Chemical behaviour and periodic position of elements, Electronic configuration.	6	3	3	15	
	3	**Chemical Bonding**	2	1	3	5	
		Task 1: Assignment (Individual)				1	1
	4	**Chemical Kinetics and equilibrium energetic**, Principles of chemical equilibrium and aqueous solution chemistry	4	2	6	10	
	5	**Acids and Bases**	2	1	3	5	
		In-Class CAT 1				1	1
	6	**Applications** Basic Electrochemistry and corrosion of metals, Water and water Treatment, Hardness of water, Softening of water or water treatment, Boiler feed water, Potable (Drinking) Water. Wastewater treatment.	6	3	9	15	
		Task 2: Assignment (Individual)				1	1
	7	**Organic Chemistry:** Introduction to organic molecules, Their structure, sources and methods of isolation, Isomerism, Simple reactions of aliphatic	4	2	6	10	

	compounds, alcohols, aldehydes, ketones and carboxylic acids					
	In- Class CAT 2				1	1
	Labarotory Exercises (Group)					
Final Exam					2	2
		28	**14**	**12**	**76**	**6**

Course Texts	1. Petrucci, R.H. (2017). General Chemistry (2017), (11th Edn), Pearson Publishers 2. Pahari, A. & Chauhan, B. (2007). Engineering Chemistry, (1st Ed), Firewall Media 3. Fen, T. (2010). Chemistry for Engineers. London: Imperial College Press.
Supplementary Texts	1. Smith, J. (2013). Organic chemistry. New York: McGraw Hill Education. 2. Winter, A. (2005). Organic chemistry I for dummies. New York, NY: John Wiley & Sons. 3. Jain, P.C. & Jain, M. (2005). Engineering Chemistry, (15th Edn), Dhanpat Rai Publishing Co.
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Principles of Chemical Process Calculations				
Course Code	CPE122				
Course Convener Name **Room No.** **Email**	Mr Daudi Masinde TBD maasdaudi@yahoo.com				
Year	1				
Semester	2				
Rationale for the inclusion of the Course in the programme	Chemical process calculation provides the quantitative foundations for designing, analysing and improving industrial chemical processes across a wide range of sectors including petrochemicals, pharmaceuticals, energy, and materials production.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120
Credit Value	3				
Pre-requisite (if any)	None				

Course Objective	The objective of the course is to introduce chemical engineering students to the basic principles and calculation techniques used in the chemical industries. Students will learn to use and calculate process quantities important to chemical engineering unit operations and to use vapor pressures to calculate process quantities for ideal vapor-liquid equilibrium in multi-phase systems.
Synopsis	The course covers unit conversions, constants, different types of graphs, gas laws, vapor pressure, saturation and humidity.
Course Learning Outcomes	At the conclusion of this course the student should be able to: 1. Convert units from one base to the other, use log graphs and triangular diagrams, and lastly understand the relevance of chemical and physical constants of substances in Engineering 2. Use the Ideal Gas Law to demonstrate the relationship between temperature, pressure, and volume of an ideal gas as well as a real gas 3. Solve problems involving vapor pressure, saturation and humidity 4. Read and interpret humidity charts
Mode of Delivery	1. Lectures 2. Tutorials 3. Group Discussions

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	10	X	X		
CAT 2 (Sit-In Test 2)	10			X	
Task 2: Assignment (Individual)	10			X	X
Final Examination	60	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK4, WK6
CO2	PO1, PO2	
CO3	PO1, PO2	
CO4	PO1, PO2	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction:** Conversion of units, Dimensional consistency, Defining physical and chemical constants, Two-point linear interpolation, Log-log plots, Semi-log plots and Ternary plots (Grid, perpendicular, corner).	6	3		15	

		Task 1: Assignment (Individual)				1	1
	2	**Ideal Gases:** Ideal gas law, Ideal gas mixtures, Partial pressure (Raoult's Law), Standard and normal conditions, Real gases, Introduction to equations of state.	4	2		10	
		In-Class Test 1				1	1
	3	**Multiphase Equilibrium Part 1:** Phase diagrams and the phase rule, Single component two-phase systems (Vapor pressure, Clausius-Clapeyron Equation, Antoine Equation, Steam Tables), Two-component gas/single-component liquid systems (Saturation).	8	4		20	
		In-Class Test 2				1	1
	4	**Multiphase Equilibrium Part 2:** Two component gas/two component liquid systems, Multicomponent vapor-liquid equilibrium.	4	2		10	
	5	**Humidity** Psychometric charts and their applications	6	3		15	
		Task 2: Assignment (Individual)				1	1

	Final Exam				2	2
		28	14		76	6
Course Texts	1. Olaf, A. H., Kenneth M. W., and Roland, A. R. (1995). *Chemical Process Principles Part-I Material and Energy balances.* New Delhi: CBS Publishers and Distributors. 2. David, M. H. (1995). *Basic principles and calculations in chemical engineering.* India: Prentice Hall.					
Supplementary Texts	1. Don, W. G. and Robert, H. P. (1999). *Perry's Chemical Engineers' Handbook.* (8th ed.), New York: McGraw Hill					
Other additional information:	Websites, Video link, Lecture Notes etc.					

Course Name	Introduction To Engineering Safety & Profession				
Course Code	ITE 125				
Course Convener Name **Room No.** **Email**	Prof. John T. Githaiga TBD				
Year	1				
Semester	2				
Rationale for the inclusion of the Course in the programme	The Safety and Profession course equips first-year engineering students with foundational knowledge of engineering disciplines, professional roles, safety practices, societal responsibilities, and essential communication skills. It fosters awareness of health issues promoting responsible behaviour in both personal and professional contexts.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	-		68	96
Credit Value	2				
Pre-requisite (if any)	N/A				
Course Objective	The objectives of this course are to enable learning about; 1. Various engineering disciplines 2. The role of engineers in society 3. The tasks of the various engineers 4. Applications of various engineering concepts				
Synopsis	This course introduces engineering disciplines, professional roles, safety practices, communication skills, societal responsibilities, and health awareness in engineering.				

Course Learning Outcomes

On completion of this course, learners will be able to:

1. Explain the elements of engineering.
2. Discuss the role of an engineer in the society.
3. Categorize various tasks of an engineer
4. Formulate basic guidelines of safe operation of basic engineering installations

Mode of Delivery

1. Lectures (hybrid)
2. Group activity/presentation/discussions/Case studies

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Test 1: Quiz 1 (Individual)	10	X			
Task 1: Assignment (Individual)	20		X		
Test 2: Quiz 2 (Individual)	10			X	
Task 2: Assignment (Group)	20				X
Final Report	40	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK7, WK9
CO2	PO1	
CO3	PO1	
CO4	PO6	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**History of Engineering:** Ancient engineering practices; Key historical developments; Impact of industrial revolutions; Modern engineering innovations;	6			12	
	Test 1: Quiz				1	1
2	**Engineering Disciplines in the School:** Chemical & Process Engineering; Civil & Structural Engineering; Electrical & Communication Engineering;	4			8	

		Mechanical & Production Engineering; Industrial & Textile Engineering					
		Task 1 Assignment (Individual)				1	1
	3	**Engineer and Technologist:** Roles and responsibilities; Differences in education and training; Career pathways; Ethical considerations;	4			8	
		Test 2 - Quiz				1	1
	4	**Engineer in Society:** Engineering and public welfare; Sustainability in engineering; Ethical decision-making; Engineering regulations and standards;	6			12	
	5	**Safety Issues in Engineering:** Workplace safety protocols; Hazard identification techniques; Risk management practices; Accident prevention strategies;	4			8	
		Task 2: Group activity/presentation				1	1
	6	**Communication Skills in Engineering:** Technical writing; Oral presentations; Active listening techniques; Reading and interpreting technical documents;	4			8	

	Final Report				2	2
		28			62	6
Course Texts	1. Kaspura, A. (2017). The Engineering Profession: A Statistical Overview. Australia: Institution of Engineers Australia. 2. Martin, M.W., & Schinzinger, R. (2010). Introduction to Engineering Ethics. (2nd edn.). New York: McGraw- Hill. 3. Laws of Kenya. (2011). Engineers Act NO. 43 of 2011. Revised Edition 2012. Published by the National Council for Law Reporting.					
Supplementary Texts	1. Seebauer, E.G., & Barry, R.L. (2001). Fundamental of Ethics for Scientists and Engineers. New York: Oxford University Press. 2. Harris Jr., C.E., Pritchard, M.S., & Rabins, M.J. (2009). Engineering Ethics, Concepts, and Cases. (4th edn.). California: Wadsworth Learning. 3. Whitbeck, C. (2011). Ethics in Engineering – Practice and Research. (2nd edn.). Cambridge: Cambridge University Press. 4. Laws of Kenya. (2007). The Occupational Safety and Health Act, 2007. Published by the National Council for Law Reporting. 5. Laws of Kenya. (1999). Environmental Management and Co-Ordination Act Chapter 387. Revised Edition 2012. Published by the National Council for Law Reporting. 6. Abelson, P. (2004). HIV and AIDS: The Science Inside. USA: American Association for the Advancement of Science.					
Other additional information:	Websites, Video link, Lecture Notes etc.					

Course Name	Engineering Drawing II				
Course Code	MPE126				
Course Convener **Name** **Room No.** **Email**	Mr. Lazarus Limo TBD lazaruslimo@gmail.com				
Year	1				
Semester	2				
Rationale for the inclusion of the Course in the programme	Before an Engineer can manufacture any component s/he is required to visualize the end product and the intersection of the various components. This allows the estimation of the material requirements and the production processes necessary. The Engineer visualizes and communicates these information through Engineering drawing.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**

<table>
<tr><td></td><td>14</td><td>28</td><td></td><td>68</td><td>110</td></tr>
</table>

<table>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Pre-requisite (if any)</td><td>MPE116 Engineering Drawing I.</td></tr>
<tr><td>Course Objective</td><td>The purpose of this course is to enable the learner gain knowledge to clearly and accurately communicate through engineering drawing.</td></tr>
<tr><td>Synopsis</td><td>The course covers the knowledge required to visualize various engineering elements and how they interact with each other.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Describe the true shape and size of any surface inclined to the basic projection planes by the use of auxiliary views
2. Draw lines of intersection and development of geometric surfaces as part of the subject of description geometry
3. Construct 3D objects using isometric and oblique projections
4. Determine the path of any point of moving object and understand its practical application</td></tr>
<tr><td>Mode of Delivery</td><td>1. Lectures (hybrid)
2. Tutorials
3. Group activity/presentation/discussions</td></tr>
<tr><td>Assessment method-CO Mapping</td><td>
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Task 2: Assignment (Individual)</td><td>10</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>10</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>10</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 3: Assignment (Group)</td><td>20</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Final Examination</td><td>40</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
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</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1</td><td rowspan="4">WK3,WK5</td></tr>
<tr><td>CO2</td><td>PO1</td></tr>
<tr><td>CO3</td><td>PO1</td></tr>
<tr><td>CO4</td><td>PO1</td></tr>
</table>
</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
<table>
<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/MT</th></tr>
<tr><td>1</td><td>Auxiliary views: True length of a line, true shape of a surface, true inclination angles, 1st auxiliary view and 2nd auxiliary view</td><td>3</td><td>6</td><td></td><td>12</td><td></td></tr>
<tr><td></td><td>Task 1: Assignment</td><td></td><td></td><td></td><td>1</td><td>1</td></tr>
</table>
</td></tr>
</table>

	2	**Simple interpenetrations and developments**: pyramids, prisms, cylinders, cones, spheres, transition pieces. Further interpenetrations (use of auxiliary views).	3	6		12	
		In-Class Test 1				1	1
	3	Pictorial projections: **Isometric projections**; oblique projections;	3	6		12	
		In-Class Test 2				1	1
	4	**Loci constructions:** ellipse, parabola, hyperbola, helixes and epicycloids.	2	4		8	
	5	**Computer aided drafting:** Auxilliary views, Interpenetrations, Pictorial drawings, Loci.	3	6		12	
		Task 2: Group activity/presentation				1	1
	Final Exam					2	2
			14	**28**		**62**	**6**

Course Texts	1. Lakhwinder P. S., Harwinder S. 2021.Engineering Drawing: Principles and Applications. Cambridge University Press. ISBN 9781009032292 2. Ashleigh C.-F., Antonio R., Douglas &S. 2023. Technical Drawing 101 with AutoCAD: A Multidisciplinary Guide to Drafting Theory and Practice with Video Instruction. SDC Publications. ISBN 9781630574307
Supplementary Texts	1. Reddy, K. V. (2016). Textbook of Engineering Drawing: With AutoCAD. India: BS Publications. ISBN 9789352300440. 2. Narayana, K. L. (2009). Machine Drawing. India: New Age International (P) Limited. ISBN 9788122419177.
Other additional information:	Websites, Video link, Lecture Notes etc.

<table>
<tr><td colspan="2"></td></tr>
<tr><td>Course Name</td><td>Structured and Procedural Programming</td></tr>
<tr><td>Course Code</td><td>CSC 121 (COE 121)</td></tr>
<tr><td>Course Convener
Name
Room No.
Email</td><td>
Samwel Tarus

TBD
sktarus@mu.ac.ke</td></tr>
<tr><td>Year</td><td>1</td></tr>
<tr><td>Semester</td><td>2</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td>Programming languages are essential to any engineering discipline, chemical engineering not an exceptional. Structured and Procedural Programming provides the basis for learners to understand the basic functions for any programming language. This is in preparation for an advanced programming languages applicable commercially.</td></tr>
<tr><td>Total Student Learning Time (SLT)</td><td><table>
<tr><th>Lectures</th><th>Tutorial</th><th>PBL/Design /Lab</th><th>Self-Learning Including Prep Time</th><th>Total Learning Time</th></tr>
<tr><td>28</td><td>14</td><td>12</td><td>87</td><td>143</td></tr>
</table></td></tr>
<tr><td>Credit Value</td><td>4</td></tr>
<tr><td>Pre-requisite (if any)</td><td>None</td></tr>
<tr><td>Course Objective</td><td>The course provides learners with both theoretical and practical skills on principles of structured and procedural programming.</td></tr>
<tr><td>Synopsis</td><td>The course covers syntax, expressions, control flow, procedures, coding practices and style.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Evaluate expressions
2. Write programs using control structures
3. Demonstrate function definitions and applications
4. Write basic programs that utilize structured programming concepts.</td></tr>
<tr><td>Mode of Delivery</td><td>1. Lectures (hybrid)
2. Tutorials
3. Group activity/presentation/discussions</td></tr>
<tr><td>Assessment method-CO Mapping</td><td><table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>15</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>15</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Assignment (Group)</td><td>10</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
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Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile	

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK1, WK2
CO2	PO1, PO2	
CO3	PO2,	
CO4	P08, PO9	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction to Programming:** Overview of programming languages and their importance, History and features, of the programming languages, setting up a development environment for a programming language.	2	1		5	
2	**Syntax and Data Types**: language syntax, identifiers, and keywords, data types, variables, and constants, input and output using standard I/O functions	2	1	1	5	
3	**Operators and Expressions:** Types, precedence and associativity of operators, building expressions and evaluating them.	2	1	1	5	
	Task 1: Assignment				1	1
4	**Control Structures:** Conditional statements (if, else if, switch), jumping (break, goto, continue), Looping structures (for, while, do-while).	2	1	1	5	

	5	**Functions and Modular Programming:** Defining and using functions, Function prototypes and header files, communication in functions, Modular programming principles and benefits.	2	1	1	5	
		In-Class Test 1				1	1
	6	**Arrays and Strings:** Working with arrays, declaration, initialization, and accessing elements, handling strings and string manipulation functions, Multidimensional arrays	4	2	1	10	
	7	**Pointers and Memory Management:** Understanding pointers and memory addresses, Pointer arithmetic and arrays of pointers, Dynamic memory allocation and deallocation.	4	1	1	10	
	8	**Structures and Unions:** Defining and using structures, nested structures and arrays of structures, Unions and their differences from structures	2	1	1	4	
	9	**File Handling and I/O Operations:** Working with files: opening, reading, writing, and closing, Sequential and random access file handling,	1	1	1	3	

		Error handling and standard I/O streams.					
	10	**Preprocessor Directives and Macros:** Understanding preprocessor directives and their role, Creating and using macros for code optimization, Conditional compilation and header guards	1	1	1	3	
		In-Class Test 2				1	1
	11	**Advanced Topics and Programming Techniques**: Enumerations and type definitions, Recursion and recursive functions, Bitwise operators and manipulation	2	1	1	5	
	12	**Debugging and Error Handling:** Common programming errors and debugging techniques, Handling runtime errors and exceptions, Using debugging tools and techniques effectively	2	1	1	5	
	13	**Coding Practices and Style:** Writing clean, readable, and maintainable code, Coding conventions and best practices, Documentation and commenting standards.	2	1	1	5	
		Task 2: Group activity/presentation				1	1
		Final Exam				2	2
			28	**14**	**12**	**81**	**6**
Course Texts	1. Kernighan, B. W., & Ritchie, D. M. (2002). The C programming language. 2. Deitel, H. M., & Deitel, P. J. (2004). C: How to program. Pearson Educación. 3. Balagurusamy, E. (2016). Programming In Ansi C.						

Supplementary Texts	1. Martin, R. C. (2009). Clean code: a handbook of agile software craftsmanship. Pearson Education. 2. Kanetkar, Y. (2018). Let us C. BPB publications. 3. Dromey, R. G. (1982). How to solve it by computers. BRITISH LIBRARY CATALOGING.
Other additional information:	Websites, Video link, Lecture Notes etc.

Year Two - First Semester

Course Name	Electrical Engineering I				
Course Code	ECE210				
Course Convener **Name** **Room No.** **Email**	Eng. D. Samoita TBD dsamoita@gmail.com				
Year	3				
Semester	1				
Rationale for the inclusion of the Course in the programme	Modern chemical processes and industries are increasingly automated and rely on advanced electrical technology. This requires creating plans for equipment, systems and production methods, and necessitates regulation of electrical parameters and use of electrical energy to run the equipment managing the processes. Electrical Engineering knowledge allows chemical and process engineers to select, install, and troubleshoot these devices.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14	12	96	150
Credit Value	4				
Pre-requisite (if any)	PHY 105, MAT 103				
Course Objective	The objectives of this course are to enable learning about; 1. Basic laws in circuit theory such as Kirchhoff's laws and Superposition theorems. 2. Fundamentals of transformers equivalent Circuits and Testing. 3. Techniques for performance and characteristics of Electrical measuring instruments of voltage current and power. 4. Concepts of measurement of electrical quantities.				
Synopsis	This course facilitates learners to acquire fundamental knowledge, skills and attitudes on electrical engineering.				

<table>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Identify basic laws of circuit theory and calculations in Circuit theory such as Kirchhoff's laws and Superposition theorems.
2. Evaluate the fundamentals of Transformers, equivalent Circuits and Testing in single phase circuits.
3. Analyse techniques for performance and characteristics of Electrical measuring instruments of voltage current and power.
4. Develop, using the concepts of measurement of electrical quantities, the measuring instruments for voltage, current and power.</td></tr>
<tr><td>Mode of Delivery</td><td>1. Lectures (hybrid)
2. Tutorials
3. Group Discussions
4. Presentations
5. Laboratory Experiments
6. Demonstrations</td></tr>
<tr><td>Assessment method-CO Mapping</td><td>
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment</td><td>5</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Task 2: Assignment</td><td>5</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>10</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>Task 3: Assignment</td><td>5</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Laboratory Work (Group)</td><td>15</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
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<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1</td><td rowspan="4">WK3</td></tr>
<tr><td>CO2</td><td>PO1</td></tr>
<tr><td>CO3</td><td>PO1</td></tr>
<tr><td>CO4</td><td>PO1, PO8</td></tr>
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<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
<table>
<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/MT</th></tr>
<tr><td>1</td><td>Basic Circuit theory: Kirchhoff's Law, Thevenin's theorem, Superposition theorem, maximum transfer theorem, star-delta transformation.</td><td>6</td><td>3</td><td>3</td><td>18</td><td></td></tr>
<tr><td></td><td>Task 1: Assignment</td><td></td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td></td><td>In-Class Test 1</td><td></td><td></td><td></td><td>1</td><td>1</td></tr>
</table>
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</table>

	2	**A.C. circuits:** Behaviors of RC, RL and RLC.	8	4	3	23	
		Task 2: Assignment				1	1
	3	**Fundamentals of Transformers:** Equivalent circuits and testing - single phase only.	6	3	3	18	
		In-Class Test 2				1	1
	4	**Measurement of electrical quantity:** Concepts of measurement of electrical quantity, concepts of measurement systems, errors in measurement; sensitivity, resolution, precision and hysteresis, Performance, characteristics of measuring instruments; static and dynamic performance, basis of electrical measuring instruments for voltage current and power.	8	4	3	23	
		Task 3: Assignment				1	1
	Final Exam					2	2
			28	**14**	**12**	**89**	**7**
Core Reading Materials	1. Johnson, D. (2014), *Fundamentals of Electrical Engineering 1*, Open Stax, ISBN 13 978-1300160137. 2. Bird, J. (2013), *Electrical Circuit Theory and Technology*, Taylor & Francis ISBN-13: 978-1856177702.						
Recommended Reading Materials	1. Bird, J. (2007), *Electrical and Electronic Principles and Technology*, 4 edition Routledge; ISBN-13: 978-0080890562. 2. Texas Instruments, (2001), *Differential Op Amp Single- Supply Design Techniques*, Texas Instruments, ISBN-10: 0201610876, ISBN-13: 978-0201610871. 3. Theraja, B.L. (2008), *A Textbook on Electrical Technology*, Chand (S) & Co. ISBN-13 978-8121924412.						

Other additional information:	Websites, Video link, Lecture Notes, etc

Course Name	Numerical Methods				
Course Code	MAT206				
Course Convener Name Room No. Email	TBC (School of Sciences & Aerospace Studies)				
Year	2				
Semester	1				
Rationale for the inclusion of the Course in the programme	Numerical methods are applied in finding solutions to mathematical problems that cannot be solved analytically. It is therefore absolutely necessary to train engineers with good knowledge and skills in numerical methods for application in solving engineering problems in industry and research				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		76	118
Credit Value	3				
Pre-requisite (if any)	MAT101, MAT103				
Course Objective	The overall objective of this course is to enable students to acquire an understanding of the fundamentals of solving non-linear equations using numerical approximation with minimal errors.				
Synopsis	The learners will be introduced to interpolation used in approximating solutions of non-linear equations, Iterative techniques in the approximation of solutions to system of equations, and Numerical differentiation and integration methods				
Course Learning Outcomes (COs)	On completion of this course, the learner will be able to: 1. Interpolate linear and non-linear equations using numerical techniques 2. Apply numerical methods to find roots of polynomial equations 3. Determine approximate solutions to 1-d integral equations 4. Analyse errors and accuracy in mathematical iterations.				
Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.				

Assessment method-CO Mapping	(see table below)

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in	15	X	X		
Task 1: Assignment (Individual)	10	X	X		
CAT 2: Sit in	15			X	X
Task 2: Assignment (Group)	10			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK2
CO2	PO1, PO2	
CO3	PO2, PO2	
CO4	P01, PO2	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction to error analysis;** sources of errors, absolute and relative errors, errors bounds, errors propagation,	2	1		5	
2	**Finding the zeros of polynomial and transcendental equations.** Newton-Raphson, Secant and Regular- Falsi methods. Theorem on convergence and convergence rate. Simple iteration methods.	8	4		20	
	CAT 1-SIT IN				1	1
3	**Interpolation and differentiation**; Finite differences Operators, Shift Operator. Backward, Forward and central differences. Interpolation using Finite differences, Newton-Gregory backward and Forward methods. Everett's, Bessel's and Sterling	10	5		25	

		methods. Lagrange and Newton divided difference interpolation methods. Inverse interpolation. Numerical differentiation using finite differences.					
		TASK 1: Individual assignment				1	1
	4	**Introduction to integration;** Newton-cotes methods; Trapezoidal rule; Simpson's rule; 3rd and 8th rule Weddle's rule, Boole's rule.	8	4		20	
		CAT2 – Sit in				1	1
		TASK 2: Group Assignment				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts	1. S.C. Chapra and R.P. Canale Numerical Methods for Engineers (6th Edition) McGraw-Hill 2. Mark Emberee, Numerical Analysis I, Rice University, 2012 3. Jan Awrejcewics, Numerical Analysis: Theory and Application, InTec, 2011
Supplementary Texts	1. G. Birkhoff & G Rota, Ordinary Differential Equations, 3rd Ed, Wiley, 1978. 2. C.T. Kelley, Siam. Iterative Methods for Linear and Non-Linear Equations. 3. Douglas W. Harder. Numerical Analysis for Engineers, university of Waterloo, 2010
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Engineering Mathematics I
Course Code	MAT207
Course Convener Name Room No. Email	TBC (School of Sciences & Aerospace Studies)
Year	2
Semester	2

<table>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">This course enables learners to develop an understanding of the operation and applications of Laplace transforms, Fourier series and vectors in solving engineering problems. Also, it prepares the learners to solve functions of several variables that are commonly used to describe chemical engineering processes involving kinetics, multiple phase flow etc.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>76</td><td>118</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">MAT 101, MAT 103</td></tr>
<tr><td>Course Objective</td><td colspan="5">The overall objective of this course is to enable students to acquire knowledge and skills to perform mathematical operations using Laplace transforms, Fourier series, vectors and multivariate functions</td></tr>
<tr><td>Synopsis</td><td colspan="5">The learners will be introduced to arithmetical tasks related to multivariate functions and vectors. They will practice formulating Laplace Transforms and their inverse as well as Fourier analysis of equations describing engineering processes.</td></tr>
<tr><td>Course Learning Outcomes (COs)</td><td colspan="5">On completion of this course, the learner will be able to:
1. Assess Fourier series, its application in solving differential equations using Dirichlet's conditions.
2. Apply Laplace transform techniques, including differentiation, integration, and inverse transforms, for solving and analyzing differential equations.
3. Solve functions of several variables, including limits, continuity, differentiability, and total derivatives.
4. Analyze vectors, including gradients, divergence, curl, line, surface, and volume integrals</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">Blended learning that incorporates both physical and online sessions</td></tr>
<tr><td>Assessment method-CO Mapping</td><td colspan="5">
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>CAT 1: Sit in</td><td>15</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 2: Sit in</td><td>15</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Assignment (Group)</td><td>10</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td colspan="5">
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1, PO2</td><td rowspan="4">WK2</td></tr>
<tr><td>CO2</td><td>PO1, PO2</td></tr>
<tr><td>CO3</td><td>PO2, PO2</td></tr>
<tr><td>CO4</td><td>PO2</td></tr>
</table>
</td></tr>
</table>

Content Outline of the Course and the SLT per Topic	No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
	1	**Fourier series**: Periodic functions, odd and even functions; expansion of functions in Fourier series over full and half range; Dirichiet's conditions;	6	3		15	
	2	**Differentiation and integration of Laplace transform;** inverse Laplace transform; application to solution of differential equations. Convolution theorem.	8	4		20	
		CAT 1-SIT IN				1	1
	3	**Functions of several variables**: limits, continuity, differentiability, total derivatives, Taylor's and Mean-Value Theorem, tangent planes, critical maxima, minima; saddle points, change of variables, Jacobian, implicit functions.	6	3		15	
		TASK 1: Individual assignment				1	1
	4	**Vector analysis**: Gradients, divergence and curl; line, surface and volume integrals. Green's Divergence and Stoke's theorems; curvilinear coordinate system.	8	4		20	
		CAT2 – Sit in				1	1
		TASK 2: Group Assignment				1	1
		Final Exam				2	2

		28	14		76	6

Course Texts	1. Erwin Kreyszig (2011). *Advanced Engineering Mathematics*, 10th Edition, John Wiley & Sons. 2. Dennis G. Zill (2011). *Advanced Engineering Mathematics*, 4th Edition, Jones & Bartlett Learning.
Supplementary Texts	H. Anton & C. Rorres (2005). *Elementary linear algebra*, 9th Edition, John Wiley & Sons
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Atomic Structure and Bonding				
Course Code	SCH211				
Course Convener Name **Room No.** **Email**	School of Science TBD				
Year	2				
Semester	1				
Rationale for the inclusion of the Course in the programme	The course will facilitate the learner to acquire knowledge, skills, and attitudes on properties of matter in terms of atomic structure and bonding. This course helps chemical engineering students understand fundamentals of materials structures.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		82	124
Credit Value	3				
Pre-requisite (if any)	None				
Course Objective	This course is designed to give learners an understanding of structure of the atom and bonding using various principles such as Quantum number and Heisenberg Uncertainty Principle. Covalent and hydrogen bonds using Valence bond theory and molecular orbital theory for simple molecules and ions will also be covered. The course will also cover solid state theory and various types of insulators.				
Synopsis	The course covers essential concepts in the structure of the atom and bonding, periodic table, hybridization and Schrodinger equation.				

Course Learning Outcomes	On completion of this course, learners will be able to: 1. Describe concepts in atomic structure and bonding 2. Classify elements into groups and periods 3. Illustrate molecular orbital diagrams for molecules 4. Derive Schrodinger equation from first principles
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group activity/presentation/discussions
Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK1
CO2	PO1	
CO3	PO1, PO2	
CO4	PO2	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Structure of the atom and bonding:** The Bohr atom; dependence of the energy levels of the hydrogen atom on the principle quantum number. The wave nature of matter and de Broglie's relation; Heisenberg Uncertainty Principle. Introduction to wave equations of electrons; Schrödinger equation, Bonn interpretation of the wave function, probability density, normalization. Quantum numbers including spin; radial and angular	10	5		25	

		functions, charge clouds and orbitals. Energy levels; electron configurations and the periodic table. Many-electron atoms; need for Slater effective atomic numbers, penetration and shielding.					
		Task 1: Assignment				1	1
	2	**Covalent and hydrogen bonds:** Construction and use of hybrid orbitals; Valence bond theory and molecular orbital theory for simple molecules and ions. Resonance; Linear combination of atomic orbitals. Molecular orbital theory for H_2, N_2, O_2, F_2, NO, CO, HF.	8	4		20	
		In-Class Test 1				1	1
	3	**The solid state:** Crystal geometry and structure; Lattice energy calculations. Solvation energies and Born Haber cycle. Metallic bonding	4	2		10	
		In-Class Test 2				1	1
	4	**Insulators:** semi-conductors, Defects in crystalline solids, The bond theory of metals. Complex ions; definitions and examples of acids and bases, coordinate bond. Fajans rules.	6	3		15	
		Task 2: Group activity/presentation				1	1
		Final Exam				2	2

		28	14		76	6

Course Texts	1. Ebbing, G. (2014). General Chemistry. 10th edition. ISBN 13: 9781285762159. 2. Petrucci, R., Herring, F. G., Madura. J. D., and Bissonnette, C. (2010). General Chemistry: Principles and Modern Applications. 10th Edition. ISBN 13: 978-0132064521. 3. Madura, J. D., Herring, F. G., Petrucci, R. H., and Bissonnette, C. (2017). General Chemistry
Supplementary Texts	1. Atkins, P. W. (2006). Inorganic Chemistry. 4th edition. ISBN: 9780199264636. 2. Bursten, B. E., Woodward, P. M., Brown, T. L., Stoltzfus, M. W., LeMay, H. E., and Murphy, C. J. (2017). Chemistry: The Central Science. United Kingdom: Pearson Education, Limited. ISBN: 9781292221229, 1292221224. 3. Eldredge, P., and Averill, B. (2007). Chemistry: Principles, Patterns, and Applications. United Kingdom: Pearson Benjamin Cummings. ISBN: 9781292221229, 1292221224.
Other additional information:	Journals 1. Practice, 16(3), 654-669. 2. Nanoscale, 13(20), 9303-9314

Course Name	Particle Technology I				
Course Code	CPE225				
Course Convener **Name** **Room No.** **Email**	TBD				
Year	2				
Semester	1				
Rationale for the inclusion of the Course in the programme	Particulate systems are often encountered in many industrial operations. Regardless of the type of manufacturer or product being made, one of the most basic processing activities in the industry involves reducing a material's particle size, or even size enlargement. Some examples of such crucial processes include crushing ores in mining operations, grinding grains for flour, or reducing active pharmaceutical ingredients to a fine powder for medications. Though the equipment and methods may differ, particle size reduction is a cornerstone of many industries. This course is useful to learners because it provides solid foundation in terms of understanding the properties of particulate systems, bulk handling and processing equipment encountered in an industrial set up. The knowledge and skills developed in the course are core to what engineers do and prepared learners for professional practices and advanced courses in related field of study.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**

	28	14		78	120
Credit Value	3				
Pre-requisite (if any)	None				
Course Objective	Objective of this course is to introduce learners to develop knowledge and conceptual understanding of particle properties and behaviours, various handling methods and industrial particulate processing operations.				
Synopsis	The course covers properties and size analysis of solid particles, size reduction and enlargement process, Mechanism of solid-fluid separation, Problems involving size change and handling and processing of bulk solid particles.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Characterize and classify particles in terms of their basic physical properties 2. Perform basic design calculations and analysis of typical industrial processes involving particulate matters. 3. Analysis of typical particulate processes, such as mixing, size reduction and enlargement, storage and transport of powders. 4. Select appropriate bulk solid handling, size reduction and solid-gas separation equipment for a specific application.				
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group activity/presentation/discussions 4. Demonstrations 5. Formative and summative assessments				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Quiz	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Tutorial Group Assignment	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK4, WK6
CO2	PO2	
CO3	PO2	
CO4	P08	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT

	1	**Particle characteristics:** particle size, composition and shape. Size analysis: mean particle size, shape factors, sphericity, mixed particle size analysis-screen analysis and size separation: capacity and types of screens, mesh number and particle size distribution, different types of screening, number of particles in a mixture, effectiveness of screens, separation efficiency and industrial screening equipment, motion of screen, grizzlies, gyratory screens, vibrating screens and trommels, Sub sieve analysis – Particle size measurement techniques-Air permeability method, sedimentation, permeability, electronic particle counter, and elutriation methods.	6	3		15	
		Task 1: Quiz				1	1
	2	**Solids handling:** storage, conveyers, packaging.	2	1		5	
		In-Class Test 1				1	1
	3	Particle size classification: introduction, classifiers, principles and equipment.- gravity settling, elutriator, double con classifier,	6	3		15	

		mechanical classifier, electrostatic.					
	3	**Size reduction:** Introduction – types of forces used for communition, criteria for communition, characteristics of communited products, laws of size reduction, work index, energy utilization, methods of operating crushers – free crushing, choke feeding, open circuit grinding, closed circuit grinding, wet and dry grinding, equipment for size reduction – Blake jaw crusher, gyratory crusher, smooth roll crusher, tooth roll crusher, imp actor, attrition mill, ball mill, critical speed of ball mill, ultra-fine grinders and cutters.	6	3		15	
		In-Class Test 2				1	1
	4	**Size enlargement:** objectives of size enlargement, mean size, principles and methods of size enlargement, growth mechanism, granulation, compaction (tableting), pelletization, extrusion, tableting, sintering, capsulation and briquetting), spray drying and prilling.	6	3		15	
		Task 2: Tutorial Group Assignment				1	1
		Solid-gas separation: centrifugal separation (cyclone separators),	2	1		5	

		electrostatic and bag filters, scrubbers.					
	Final Exam					2	2
			28	**14**		**76**	**6**
Course Texts	1. J.M. Coulson and J.F. Richardson (2002) Chemical engineering: Particle technology and separation processes, Vol 2, Butterworth-Heinemann Limited. 2. Ladslav Svarovsky. (2000). Solid-Liquid Separation, 4th Edition. Butterworth-Heinemann Limited. ISBN 0 7506 4568 7						
Supplementary Texts	1. Geankoplis, C.J. (2013). Transport Processes & Separation Process Principles (includes Unit Operations). Pearson Education Limited. ISBN:9781292026022, 1292026022. 2. Enrique Ortega-Rivas. (2012). Unit Operations of Particulate Solids: Theory and CRC Press: Practice. Taylor & Francis Group. ISBN:978-1-4398-4907-1						
Other additional information:	Websites, Video link, Lecture Notes etc.						

Course Name	Mechanics of Machines I				
Course Code	MPE214				
Course Convener **Name** **Room No.** **Email**	Dr. Stephen Kimutai TBD mantuikong@gmail.com				
Year	2				
Semester	1				
Rationale for the inclusion of the Course in the programme	Machines consist of a combination of bodies connected in such a manner as to enable the transmission of forces and motion. The behaviour and performance of these machines can be analysed by application of the principles of mechanics which is the subject of this course. The course is useful to all Engineering disciplines.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	14	28		82	124
Credit Value	3				
Pre-requisite (if any)	MPE 114, Basic Engineering Mechanics.				
Course Objective	The purpose of this course is to provide the learner with knowledge of the principles, systems and methods of mechanical power transmission.				
Synopsis	The course covers the basics of various drives and transmission systems and the individual components involved				

Course Learning Outcomes

On completion of this course, learners will be able to:

1. Explain the various types and modes of mechanical power transmission systems
2. Outline various drives and transmission systems
3. Analyse the mechanics and functioning of belts drives, pulleys, screw threads, clutches, brakes, power screws, gears and gear box
4. Design basic drives and power transmission systems

Mode of Delivery

1. Lectures (hybrid)
2. Tutorials
3. Group activity/presentation/discussions

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
Task 2: Assignment (Individual)	10	X	X		
CAT 1 (Sit-In Test 1)	10	X	X		
CAT 2 (Sit-In Test 2)	10			X	X
Task 3: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK1, WK3
CO2	PO1, PO2	
CO3	PO2, PO3	
CO4	PO2, P03, P08	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Vehicle propulsion and Braking**: tractive and traction resistance. Types of power transmission systems,	6	3		15	
	Task 1: Assignment				1	1
2	**Friction and applications to**: friction plane, screw threads, types and analysis of brakes and clutches	6	3		15	
	In-Class Test 1				1	1
3	**Belt drive** (flat, rope and V), Open and crossed belt drive, ratio of tensions, effect of centrifugal tension and condition for maximum	6	3		15	

	power transmission in belts.					
4	**Coupling:** rigid couplers, flexible connectors, direct contact. Chains and Sprockets, Couplings.	4	2		10	
	In-Class Test 2				1	1
5	**Gears:** Gear profile and gear geometry; spur gears, spiral gears, pinion and rack. Types of Gear Trains: simple, compound and epicyclic, gear boxes, differential units, Gearboxes, Determination of speed and torque.	6	3		15	
	Task 2: Group activity/presentation				1	1
Final Exam					2	2
		28	**14**		**76**	**6**

Course Texts	1. Talpasanu, I., Talpasanu, A. (2019). Mechanics of Mechanisms and Machines. United States: CRC Press. ISBN: 9780429675713. 2. Cleghorn, W. L., Dechev, N. (2015). Mechanics of Machines. United Kingdom: Oxford University Press.
Supplementary Texts	1. Khurmi, R.S. and Gupta, J.K. (2006), theory of machines text book, Tata McGraw Hill. 2. Sarkar B. K. (2002), Theory of machines 3rd edition, Tata McGraw Hill. 3. Brar, J. S. and Bansal, R. K. (2004), theory of machines text book, Tata McGraw Hill.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Carbonyl Chemistry
Course Code	SCH221
Course Convener **Name** **Room No.** **Email**	School of Science TBD
Year	2

<table>
<tr><td>Semester</td><td colspan="5">2</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">The course will equip the learners with knowledge, skills and attitude on the structure and reactivity of organic molecules, chirality, substitution and addition reactions.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>82</td><td>124</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">None</td></tr>
<tr><td>Course Objective</td><td colspan="5">This course is designed to introduce learners to carbonyl compounds, their derivatives and their reactions. The course will also cover reactions involving the α carbon including α-hydroxy carbocations, conjugate addition, molecular orbitals of enolate ions, formation of enols and their stability. Learners will be exposed to practical in the laboratory.</td></tr>
<tr><td>Synopsis</td><td colspan="5">The course covers physical and chemical properties of aldehydes and ketones, nucleophilic addition to the carbonyl group, nucleophilic substitution reactions at the carbonyl group and enolate chemistry.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Explain physical and chemical properties of Aldehydes and Ketones
2. Predict products obtained nucleophilic addition to the carbonyl group
3. Discuss Nucleophilic substitution reactions at the carbonyl group
4. Draw reaction mechanisms of reactions of enolate chemistry</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. Lectures (hybrid)
2. Tutorials
3. Group activity/laboratory practicals</td></tr>
<tr><td>Assessment method-CO Mapping</td><td colspan="5">
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>15</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>15</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Lab Tests (Group)</td><td>10</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td colspan="5">
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1</td><td rowspan="4">WK1</td></tr>
<tr><td>CO2</td><td>PO1</td></tr>
<tr><td>CO3</td><td>PO1, PO2</td></tr>
<tr><td>CO4</td><td>PO1, P02</td></tr>
</table>
</td></tr>
</table>

Content Outline of the Course and the SLT per Topic	No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
	1	**Introduction to carbonyl compounds:** Aldehydes, ketones and carboxylic compounds and its derivatives. Structure and properties of Aldehydes and Ketones; sp2-hybridization, bond angle, physical properties.	4	2		10	
		Task 1: Assignment				1	1
	2	**Reactions of the carbonyl group:** Nucleophilic addition to the carbonyl group; attack of cyanide, hydride and organometallic reagents on aldehydes and ketones, angle/geometry of nucleophilic attack on carbonyls, addition of water to aldehydes and ketones, formation of acetals and hemiacetals (acid and base catalysis), reversible additions to aldehydes and ketones, equilibria in carbonyl addition reactions. Nucleophilic substitution at the carbonyl group; carboxylic acid derivatives, acidity of carboxylic acids, reactions of acid derivatives, Fischer esterification, reaction of amines with carbonyl compounds.	10	5		25	

	In-Class Test 1				1	1
3	**Reactions involving the α carbon:** α-hydroxy carbocations; stability of protonated aldehydes / ketones; conjugate addition; 1,2 addition vs 1,4 addition. enolates; molecular orbitals of enolate ions, bronsted basicity of enolate ions, formation of enols, stability of enols, mechanisms of enolization, reactions of enolate ions (kinetic versus thermodynamic control)	6	3		15	
	In-Class Test 2				1	1
4	**Practicals including:** reactions of ketones, aldehydes and carboxylic acids. Chemical methods of distinguishing the carbonyl compounds.	8	4		20	
	Task 2: Group activity/presentation				1	1
	Final Exam				2	2
		28	**14**		**76**	**6**

Course Texts	1. Stoker, S. H. and Belmont, C.A. (2013). General, Organic, and Biological Chemistry. Cengage Learning. ISBN: 9781133103943 2. Timberlake, K. C. (2012). Chemistry: An Introduction to General, Organic, and Biological Chemistry. Prentice Hall. ISBN: 9780321719430 3. Graham, S. T. W., Fryhle, C. B. and Johnson, R. G. (2011). Study guide and solutions manual to accompany Organic Chemistry. John Wiley & Sons publishers. ISBN: 9780470478394
Supplementary Texts	1. Wade, L.G. and Simek, J.W. (2010). Solutions manual for use with Organic chemistry. 6th ed. Pearson / Prentice Hall. ISBN: 0131478826 2. Graham, S. T. W. (2008). Study guide and solutions manual to accompany Organic Chemistry. John Wiley & Sons publishers. ISBN: 9780470050989. 3. Stoker, S. H. and Belmont, C.A. (2010). General, Organic, and Biological Chemistry. Cengage Learning. ISBN: 9780547152813

Other additional information:	Journals 1. Chemical Society Reviews, 50(1), 243-472. 2. Green Chemistry, 23(1), 77-118.

Year Two - Second Semester

Course Name	Electrical Engineering I				
Course Code	ECE220				
Course Convener Name **Room No.** **Email**	ENG. D. SAMOITA dsamoita@gmail.com				
Year	3				
Semester	2				
Rationale for the inclusion of the Course in the programme	Modern chemical processes and industries are increasingly automated and rely on advanced electrical technology. This requires creating plans for equipment, systems and production methods, and necessitates regulation of electrical parameters and use of electrical energy to run the equipment managing the processes.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		84	126
Credit Value	3				
Pre-requisite (if any)	ECE 210 – Electrical Engineering I				
Course Objective	The objectives of this course are to enable learning about; 1. Basic principles of electrical energy generation. 2. Fundamental concepts of electrical energy transmission and distribution. 3. Operation of basic electrical machines & their applications. 4. Electrical distribution				
Synopsis	This course facilitates learners to acquire knowledge, skills and attitudes on electrical energy generation, transmission and distribution, electrical machines and their applications.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Explain different methods of electrical energy generation. 2. Interpret the basic concepts of electrical energy transmission and distribution. 3. Solve problems involving the basic operation of different types of electrical machines and their applications. 4. Design an electrical distribution for a simple set-up.				
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group Discussions 4. Presentations 5. Laboratory Experiments 6. Demonstrations				

Assessment method-CO Mapping	(see table below)

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
Task 2: Assignment	10			X	
CAT 2 (Sit-In Test 2)	15			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK3
CO2	PO1	
CO3	PO1	
CO4	PO1, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Electrical energy generation:** Various methods of generation including; thermal, hydropower, wind power, solar power and nuclear (only the block schematic and brief comparative study).	6	3		15	
	Task 1: Assignment				1	1
2	**Electrical energy transmission and distribution:** D.C and A.C (both single and three phases) systems, power factor and its correction.	6	3		15	
	In-Class Test 1				1	1
3	**Electrical machines and applications:** D.C. machines, types of D.C. motors and Generators, their characteristics.	6	3		15	
	Task 2: Assignment				1	1
4	**Starting and speed control** of D.C. motors.	4	2		10	

	In-Class Test 2				1	1
5	**Three phase A.C motors:** Induction motors construction principles, starting and speed control, synchronous motors construction principles and starting.	6	3		15	
	In-Class Test 2				1	1
Final Exam					2	2
		28	**14**		**77**	**7**

Core Reading Materials	1. Verma, M. and Singh, Y. (2015), *Fundamentals of Electrical Engineering*, University Science Press, ISBN: 9380386761. 2. Blume, S.W. (2016), Electric *Power Systems Basics for Nonelectrical Professionals* Wiley Interscience, ISBN: 976-0-470-12987-4.
Recommended Reading Materials	1. Hughes, E. (2008), *Electrical Technology*, 11th Ed. Pearson Education (Singapore)Pte Ltd ISBN: 81-7808-798-7. 2. Theraja, B.L. (2005), *Electrical Technology*, S.K Chand, ISBN: 81-219-2440-5. 3. Rajput, R.K. (2004), *Electrical Technology*, Laxmi Publications, ISBN: 978-93-81159-52-1.
Other additional information:	Websites, Video link, Lecture Notes, etc

Course Name	Engineering Statistics II				
Course Code	STA202				
Course Convener **Name** **Room No.** **Email**	Dr. Silver Keny TBD keny.silver.jeptoo@gmail.com				
Year	2				
Semester	II				
Rationale for the inclusion of the Course in the programme	Statistics is an important subject in engineering as it finds wide applications in analysis in any industrial set up such as mechanical, electrical. Civil, chemical or textile. The course is useful to engineers, particularly those in plant operation, plant design or equipment testing and commissioning.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120
Credit Value	3				
Pre-requisite (if any)	STA102				

Course Objective

This course enables learning about; the concepts of estimation and hypothesis testing, the probability distributions and their use in solving problems, simple linear regression for building empirical models to engineering and scientific data for making prediction and statistical techniques in Quality Control processes and basic statistical software – Excel and R-programming.

Synopsis

This course facilitates learners to acquire knowledge, skills and attitudes on engineering statistics.

Course Learning Outcomes

On completion of this course, learners will be able to:

1. Describe the concepts of estimation, its applications and hypothesis testing in decision making.
2. Evaluate engineering problems using probability distributions.
3. Apply simple linear regression in building empirical models to engineering and scientific data and to make a prediction.
4. Solve statistical and quality control problems using appropriate software and statistical techniques.

Mode of Delivery

1. Lectures (hybrid)
2. Tutorials
3. Group activity/presentation/discussions

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK2
CO2	PO1, PO2	
CO3	PO2,	
CO4	PO2, P08	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT	
1	**Theoretical probability distributions:** theoretical discrete probability distributions (Binomial and Poisson), Theoretical continuous probability distributions (Normal).	6	3		15		
	Task 1: Assignment				1	1	
2	**Statistics and sampling distribution:** Elementary treatment for large and small samples.	6	3		15		
	In-Class Test 1				1	1	
3	**Inferential statistics:** Estimation of parameters (point and interval	8	4		20		

		estimation), Statistical Tests and Decisions (Testing hypotheses about parameters and making decisions: Z, t, F and Chi-square); Method of least squares and curve fitting.						
		In-Class Test 2				1	1	
	4	**Regression and correlations:** linear regression, correlation coefficient of determination, testing significance of an observed sample correlation coefficient, testing significance of an observed sample regression coefficient. Application of statistics in quality control.	8	4		20		
		Task 2: Group activity/presentation				1	1	
		Final Exam				2	2	
			28	**14**		**76**	**6**	

Course Texts	1. Jay, L. D. (2004). Probability and Statistics for Engineering and the Sciences, Brooks/Cole Publishing, Belmont, USA. 2. Mario F. Triola (2001), Elementary Statistics, Addison- Wesley Publishing Company
Supplementary Texts	1. Sheldon, R. (2005), A First Course in Probability, (7th edn), Prentice Hall, 2. Morris, H. D. (1989), Probability and Statistics. Addison, Wesley Publishing Company, Reading, USA.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Engineering Mathematics II
Course Code	MAT208
Course Convener Name Room No. Email	TBC (School of Sciences & Aerospace Studies)
Year	2
Semester	2
Rationale for the inclusion of the Course in the programme	This course enables learners to develop an understanding of the operation and applications of ODEs and PDEs in solving engineering problems. It prepares the learners to solve ODEs and PDEs that are commonly used to describe chemical engineering processes involving kinetics, multiple phase flow etc.

Total Student Learning Time (SLT)	Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
	28	14		76	118
Credit Value	3				
Pre-requisite (if any)	MAT 101, MAT 103				
Course Objective	The overall objective of this course is to enable students to acquire advanced understanding of ordinary and partial differential equations and their practical applications in engineering.				
Synopsis	The learners will be introduced to Linear Differential Equations, Partial Differential Equations, Heat Conduction and Diffusion Equations, Laplace's Equation and Solutions in Different Coordinates				
Course Learning Outcomes (COs)	On completion of this course, the learner will be able to: 1. Solve linear differential equations utilizing generalized power series techniques. 2. Evaluate PDEs and the application of separation of variables to solve the one-dimensional wave equation. 3. Analyze and solve problems related to heat conduction and diffusion equations 4. Solve Laplace's equation in different coordinate systems				
Mode of Delivery	Blended learning that incorporates both physical and online sessions				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in	15	X	X		
Task 1: Assignment (Individual)	10	X	X		
CAT 2: Sit in	15		X	X	X
Task 2: Assignment (Group)	10			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK2
CO2	PO1, PO2	
CO3	PO2	
CO4	PO2	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q /MT
1	**Differential Equations**: Solutions of linear differential equations; Airy's equation; Legendre's equation; solutions using generalized power series. Bessel's functions.	8	4		20	

	2	**Partial differential equations**; linear first-order homogeneous partial differential equations; classification of second-order linear homogeneous partial differential equations; one-dimensional wave equation; method of separation of variables applied to the wave equation.	10	5		25	
		CAT 1-Sit In				1	1
	3	**Heat conduction**, and diffusion equations	4	2		10	
		TASK 1: Individual assignment				1	1
	4	**Laplace's equation**. Solution in polar, cylindrical and spherical coordinates.	6	3		15	
		CAT 2 – Sit in				1	1
		TASK 2: Group Assignment				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts	1. Erwin Kreyszig (2011). *Advanced Engineering Mathematics*, 10th Edition, John Wiley &Sons. 2. Dennis G. Zill (2011); *Advanced Engineering Mathematics*, 4th Edition, Jones & Bartlett Learning.
Supplementary Texts	Stanley J. Farlow (1993). Partial Differential Equations for Scientists and Engineers, Dove
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Solid & Structural Mechanics I
Course Code	MPE 222
Course Convener **Name** **Room No.** **Email**	TBD TBD TBD
Year	2
Semester	2

Rationale for the inclusion of the Course in the programme	The Solid and Structural Mechanics is a crucial field of study in engineering and materials science. It involves understanding how solid materials respond to external forces and loads. Concepts such as stress, strain, and elasticity help engineers make informed decisions about material selection, geometry, and structural integrity. It also helps in predicting and preventing failures by studying stress concentration, fracture mechanics, and fatigue.

Total Student Learning Time (SLT)

Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
28	14	6	82	130

Credit Value	3
Pre-requisite (if any)	None
Course Objective	The purpose of this course is to introduce learners to the concept of application of stress and strain of solid members for mechanical structural integrity maintenance.
Synopsis	This course gives students an understanding of stress, strain, tension and compression. Key topics covered include tensile testing, properties of materials, stress-strain relationships, axial loading, thin-walled pressure vessels, torsion, and bending of beams.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Describe the concepts of mechanics of materials; 2. Solve problems of stress/strain, torsion, bending moments and shearing forces in beams; 3. Plot the distribution of shear stresses in loaded beams. **4.** Apply strength of materials principles in design of mechanical components.
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Laboratories 4. Group activity/presentation/discussions

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1 (Sit-In Test 1)	10	X	X		
CAT 2 (Sit-In Test 2)	10			X	X
Labs	20	X	X	X	X
Task 1: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK3, WK4
CO2	PO1	
CO3	PO3	
CO4	PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT

1	**Introductory concepts of mechanics of materials**: loading, static and dynamic forces. Stress and strain in tension and shear: definition of stress, uniaxial tension/compression. Members with variables cross-section: compound members. Elastic constants.	8	4		20		
	Task 1: Assignment				1	1	
2	**Torsion analysis:** Solid circular shafts, hollow circular shafts, thin-walled tubes, plastic torsion. Bending moments and shearing forces	8	4	3	23		
	In-Class Test 1				1	1	
3	**Types of beams and loadings**, Shear Force (S.F.) and Bending Moment (B.M.) diagrams, relation to intensity of force.	6	3		15		
4	**Simple bending theory:** review of geometric properties, stresses due to pure bending, plastic bending. Shear formula: stresses due to shear.	6	3	3	18		
	In-Class Test 2				1	1	
	Task 2: Group activity/presentation				1	1	
Final Exam					2	2	
		28	**14**	**6**	**82**	**6**	

Course Texts	1. Craig, R. R., Taleff, E. M. (2020). Mechanics of Materials. United Kingdom: Wiley. 2. Haddad, Y. (2013). Mechanical Behaviour of Engineering Materials: Volume 2: Dynamic Loading and Intelligent Material Systems. Germany: Springer Netherlands.
Supplementary Texts	1. Case, J., Chilver, A. H. (2013). Strength of Materials and Structures: An Introduction to the Mechanics of Solids and Structures. India: Elsevier Science. 2. Prakash D.S. Rao. (2017). Strength Of Materials: A Practical Approach (vol. I). India: Universities Press (India) Pvt. Limited.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Physical Chemistry				
Course Code	CPE221				
Course Convener Name **Room No.** **Email**	TBD anthonymuliwa@mu.ac.ke				
Year	2				
Semester	2				
Rationale for the inclusion of the Course in the programme	Physical chemistry underpins many of the greatest challenges facing society today, from climate change to energy security to accessible clean water. This course provides the student with an in-depth understanding of the basic principles of physical chemistry which govern the energy-conversion processes, light-matter interactions, and physicochemical transformations that are central to tackling these challenges. This course therefore is useful to learners planning a professional career in chemistry, a related science, the health professions, or engineering.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	124
Credit Value	3				
Pre-requisite (if any)	TEC112 Chemistry for Engineers, Calculus				
Course Objective	This course introduces students to the core area of physical chemistry, based around the themes of systems, states and processes. The course highlights the relationship between physical phenomena and the molecular structure and reactions underpinning materials.				
Synopsis	The course covers kinetic molecular theory of gases, thermochemistry, chemical equilibria and Gibbs free energy, photochemistry, capillary, colloids and thermodynamic functions of a surface layer.				
Course Learning Outcomes	On successful completion of this course, learners will be able to: 1. Explain the distribution of molecular speeds using kinetic-theory of gases 2. Use mathematical expressions to compute Gibb's free energy change, equilibrium constant, chemical potentials and extend of a reaction. 3. Apply the concepts of chemical equilibrium and the response of chemical equilibria to changing conditions, such as temperature and pressure. 4. Illustrate the mechanisms of photochemical and thermal reactions and capillary action.				
Mode of Delivery	1. Lectures 2. Tutorials 3. Group discussions				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Quiz	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Tutorial Group Assignment	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK1
CO2	PO2, PO2	
CO3	PO1, PO2	
CO4	PO1, PO2	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Introduction, branches of physical chemistry, Kinetic-Molecular theory of gases: characteristics of gases, assumptions, translational KE, fundamental eqn of kinetic theory of gases, ideal gas eqn, rms, the Distribution of the Components of Molecular Speeds description by Gaussian Distribution, Maxwell-Boltzmann distribution, Distribution of the Components of Molecular Speeds described by a Gaussian distribution and Maxwell-Boltzmann Distribution Integrals that occur frequently in the kinetic theory of gases	6	3		15	
	Task 1: Quiz				1	1
2	Thermochemistry: definitions, enthalpy, entropy, std enthalpy changes, enthalpy of physical change, enthalpies of transition, enthalpies of chemical	4	2		10	

			change (reaction, combustion etc.), Hess's Law, std enthalpy of formation, reaction enthalpy in terms of enthalpies of formation, Enthalpies of formation and molecular modelling, temperature-dependence of reaction enthalpies						
			In-Class Test 1				1	1	
		3	Free energy and chemical equilibria: Gibbs energy change, chemical equilibrium relation to Gibbs free energy and extend of reaction, equilibrium constant (function of temp), Le Chatelier's principle, Standard Gibbs Energies of Formation use in Calculation of Equilibrium Constants, standard chemical potentials.	6	3		15		
		3	Photochemistry: introduction, photochemical reactions, steps, types, characteristics, laws of photochemistry: Grotthus-Draper Law (or) The Principle of Photochemical Activation, Stark-Einstein Law of Photochemical Equivalence (or) Principle of Quantum Activation, Lambert's Law, Beer's Law, Quantum Yield (Or) Quantum Efficiency, causes, Processes of photochemical reactions, Energy Transfer In Photochemical Reactions: Photosensitizations and	6	3		15		

		Quenching, photophysical processes: Fluorescence Phosphorescence, Types of transitions Chemiluminescence. Examples and applications of Photochemical reaction						
		In-Class Test 2				1	1	
	4	Thermodynamic functions of a surface layer. Surface energy, Wettability & Capillary Pressure, Young's equation (1805), angle of contact, wetting and non-wetting fluids, Laboratory Determination. Intermolecular forces: adhesive and cohesive forces, surface tension, surface energy, Excess pressure inside a spherical soap bubble, Excess pressure inside a liquid drop or an air bubble in water, Capillary action: Rise of liquid in a capillary tube	4	2		10		
		Task 2: Tutorial Group Assignment				1	1	
		Liquid-liquid phase boundaries, Colloids.	2	1				
	Final Exam					2	2	
			28	**14**		**76**	**6**	

Course Texts	1. Donald A. McQuarrie and John D. Simon. 1997. Physical Chemistry; A molecular Approach, University Science Books. ISBN 0-935702-99-7 2. Peter Atkins and Julio de Paula. Atkins' Physical Chemistry, 8th Edition, W. H. Freeman and Company, New York ISBN: 0-7167-8759-8
Supplementary Texts	Ira N. Levine. Physical Chemistry, 6th Edition McGraw-Hill, New York : ISBN 978–0–07–253862–5
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Principle of Mass and Energy Balance
Course Code	CPE222
Course Convener	

Name **Room No.** **Email**	Mr Daudi Masinde SR3 maasdaudi@yahoo.com
Year	2
Semester	1
Rationale for the inclusion of the Course in the programme	Mass balance equips an engineer with tools that enables them to relate the amount(s) of product(s) produced from a process to the reactant(s) fed. On the other hand, energy balance calculations are needed to estimate the energy requirements of a process.

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120

Credit Value	3
Pre-requisite (if any)	CPE 122
Course Objective	To aid the learner in understanding the underlying principles that govern the conservation of mass and energy and apply them in the design, construction, operation, analysis, optimization and maintenance of various unit operations.
Synopsis	The course covers the fundamentals of mass and energy balance derived from the laws of conservation. This allows the student to solve material and energy balance separately or simultaneously.
Course Learning Outcomes	At the conclusion of this course the student should able to: 1. Define the laws of conservation of matter and energy 2. Implement the general mass balance equation for steady and unsteady flow systems. 3. Apply the energy balance equation on open and closed systems 4. Simultaneously solve mass and energy balance problems
Mode of Delivery	1. Lectures 2. Tutorials 3. Group Discussions

Assessment method-CO Mapping

Distribution	**(%)**	**CO1**	**CO2**	**CO3**	**CO4**
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	10	X	X		
CAT 2 (Sit-In Test 2)	10		X	X	
Task 2: Assignment (Individual)	10			X	
Final Examination	60	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	**Programme Learning Outcome**	**Knowledge Profile**
CO1	PO1, PO2	WK4, WK6
CO2	PO1, PO2,	
CO3	PO1, PO2,	
CO4	PO1, P02	

Content Outline of the Course and

No.	**Topic**	**Lectur e**	**Tutorial**	**Lab**	**Self-Learning**	**FE/Q/ MT**

the SLT per Topic		**MASS BALANCE**					
	1	**Introduction:** Two-point linear interpolation, Recap (Mass, volume, moles, flow rate, specific gravity, molarity etc).	1	0.5		2.5	
	2	**Fundamentals of Mass Balance:** Types of processes and systems, General strategy for solving mass balance equations (MBEs), Solving MBEs for single units (Mixer, extractor, membrane separator, distillation column, adsorber, crystallizer) Solving MBEs for multiple units.	4	2		10	
		Task 1: Assignment (Individual)				1	1
	3	**Specialized Processes:** Recycle, bypass and purge and their industrial applications.	2	1		5	
		In-Class Test 1				1	1
	4	**MBEs for Processes involving Reactions:** Chemical reaction stoichiometry (Extent of reaction, conversion, yield, selectivity), MBEs for single and multi-reaction processes.	6	3		15	
		ENERGY BALANCE					
	5	**Fundamentals of Energy Balance:** Forms of energy, Transfer of energy, 1st Law of thermodynamics, Energy balance for closed and open systems.	6	3		15	
		In-Class Test 2				1	1
	6	**Steam Tables:** Water phase diagrams, Reference states, State properties, Steam tables.	3	1.5		7.5	
		Task 2: Assignment (Individual)				1	1

	7	**Energy Balance** Non-reactive species, Reactive species, Combined mass and energy balance.	6	3		15	
		Final Exam				2	2
			28	**14**		**76**	**6**

Course Texts	1. Himmelblau Mautner David, Riggs James B. (2012), Basic Principles and Calculations in Chemical Engineering, 8th Edition, ISBN 9780132346603. 2. Felder Richard (2005), Elementary Principles of Chemical Processes, 3rd Edition, ISBN 978-0471687573.
Supplementary Texts	1. Reclaitis, G.V., (1983), Introduction to Material and Energy Balances, John Wiley and Sons. 2. Middleman, S. (1998), An Introduction to Mass and Heat transfer: principles of analysis and design, John Wiley & Sons. 3. Green, D.W. and Perry, R.H. (1999) Perry's Chemical Engineers' Handbook, (8th edn.), McGraw Hill.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Introduction to Fluid Mechanics				
Course Code	CSE224				
Course Convener Name **Room No.** **Email**	TBD				
Year	2				
Semester	2				
Rationale for the inclusion of the Course in the programme	This course is designed to train learners to acquire knowledge, skills and attitudes on fundamental principles of fluid mechanics.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14	12	92	146
Credit Value	4				
Pre-requisite (if any)	None				
Course Objective	The objectives of this course are to enable learning about; 1. Classification of fluids by their properties 2. Flow regimes and computation of energy exchanges 3. Hydrostatic and hydrodynamic forces on bodies 4. Principles of energy and momentum exchange in flow measurement.				
Synopsis	The course will enable learners to understand fundamental concepts of fluid mechanics and applications in practice.				

Course Learning Outcomes

By the end of the course, the learner should be able to;

1. Relate fluids by their characteristics;
2. Compare flow regimes and fluid forces acting on bodies;
3. Apply conservation laws to compute the energy exchanges in flow and discharge.
4. Illustrate how the conservation laws are applicable in flow measurement devices

Mode of Delivery

1. Lectures
2. Tutorials
3. Laboratory
4. Case studies
5. Group Discussions
6. Presentations

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	10	X	X		
CAT 2 (Sit-In Test 2)	10			X	X
Laboratory Practical	10		X	X	X
Final Examination	60	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK4, WK6
CO2	PO2	
CO3	PO1, PO2	
CO4	PO6	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Physical properties of fluids:** density, compressibility, viscosity. **Types of flow:** laminar, turbulent, steady, unsteady, uniform, non-uniform.	4	2		10	
	Individual Task 1				1	1
2	**Fluid statics:** hydrostatic pressure, forces and centres of pressure on plane and curved surfaces. Capillarity: forces, free surface curvature. Floating bodies: buoyant force, centre of buoyancy, stability, metacentre	6	3	3	18	
	In-Class Test 1				1	1

	3	Kinematics: velocity and velocity field, stream lines and stream tubes, volumetric flux, forced vortex Fluid dynamics: control and material volume, advection,	6	3	3	18	
	4	**Conservation of mass:** incompressibility, conservation of volume. **Conservation of energy:** kinetic and potential energy; pressure, friction and shaft power; kinetic energy factor; Bernoulli's and modified Bernoulli's equation; energy and hydraulic grade lines; fluid friction, head loss, Darcy's equation, losses in pipes, pipe bends and pipe fittings.	6	3	3	18	
		In-Class Test 2				1	1
	5	**Applications of the conservation laws:** Pitot tubes, orifices, nozzles, Venturi meters, notches, time to empty tanks, siphons, flow over weirs and under sluice gates, impact and deflection of jets.	6	3	3	18	
	Final Exam					2	2
			28	**14**	**12**	**87**	**5**

Course Texts	1. Robert, W., Fox, A. T., McDonald, P. and Pritcard, J. (2020), Introduction to Fluid Mechanics, 10th Edition, Wiley Publishers 2. Ward-Smith. J. (2018). Mechanics of Fluids, (9th Edn). eBook ISBN9781315272542. https://doi.org/10.1201/9781315272542. 3. Currie, I.G. (2016), Fundamental Mechanics of Fluids, (4th Edn.), CRC Press
Supplementary Texts	1. Frank, M. W. (2016) Fluid Mechanics, (8th Edn.), Mc Graw-Hill Education 2. Massey, B.S. & Ward-Smith, A.J. (2012), Mechanics of Fluids, (9th Edn.), Taylor & Francis 3. Douglas, J.F., Gasiorek, J.M. & Swaffield, J.A. (2011), Fluid Mechanics, (6th Edn.), Prentice-Hall Publishers

	4. Munson, Y. and Okiishi, (2010) Fundamentals of Fluid Mechanics, Wiley Publishers 5. Edward, J., Shaughnessy, I. M., Katz, J., Schaffer, P. (2005), Introduction to Fluid Mechanics, Oxford University Press, New-York. 6. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). London: Butterworth-Heinemann Linacre House.
Other additional information:	Websites, Video link, Lecture Notes, etc

Course Name	Particle Technology I				
Course Code	CPE225				
Course Convener Name Room No. Email	TBD				
Year	2				
Semester	2				
Rationale for the inclusion of the Course in the programme	Particulate systems are often encountered in many industrial operations. Regardless of the type of manufacturer or product being made, one of the most basic processing activities in the industry involves reducing a material's particle size, or even size enlargement. Some examples of Such crucial processes include crushing ores in mining operations, grinding grains for flour, or reducing active pharmaceutical ingredients to a fine powder for medications. Though the equipment and methods may differ, particle size reduction is a cornerstone of many industries. This course is useful to learners because it provides solid foundation in terms of understanding the properties of particulate systems, bulk handling and processing equipment encountered in an industrial set up. The knowledge and skills developed in the course are core to what engineers do and prepared learners for professional practices and advanced courses in related field of study.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120
Credit Value	3				
Pre-requisite (if any)	None				
Course Objective	Objective of this course is to introduce learners to develop knowledge and conceptual understanding of particle properties and behaviours, various handling methods and industrial particulate processing operations.				
Synopsis	The course covers properties and size analysis of solid particles, size reduction and enlargement process, Mechanism of solid-fluid separation, Problems involving size change and handling and processing of bulk solid particles.				

<table>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Characterize and classify particles in terms of their basic physical properties
2. Perform basic design calculations and analysis of typical industrial processes involving particulate matters.
3. Analysis of typical particulate processes, such as mixing, size reduction and enlargement, storage and transport of powders.
4. Select appropriate bulk solid handling, size reduction and solid-gas separation equipment for a specific application.</td></tr>
<tr><td>Mode of Delivery</td><td>1. Lectures (hybrid)
2. Tutorials
3. Group activity/presentation/discussions
4. Demonstrations
5. Formative and summative assessments</td></tr>
<tr><td>Assessment method-CO Mapping</td><td>
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Quiz</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>15</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>15</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Tutorial Group Assignment</td><td>10</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1</td><td rowspan="4">WK4, WK6</td></tr>
<tr><td>CO2</td><td>PO2</td></tr>
<tr><td>CO3</td><td>PO2, PO3</td></tr>
<tr><td>CO4</td><td>P02, PO3</td></tr>
</table>
</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
<table>
<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/MT</th></tr>
<tr><td>1</td><td>Particle characteristics: particle size, composition and shape. Size analysis: mean particle size, shape factors, sphericity, mixed particle size analysis-screen analysis and size separation: capacity and types of screens, mesh number and particle size distribution, different types of screening, number of particles in a mixture, effectiveness of screens, separation efficiency and industrial screening equipment, motion of screen, grizzlies, gyratory</td><td>6</td><td>3</td><td></td><td>15</td><td></td></tr>
</table>
</td></tr>
</table>

		screens, vibrating screens and trommels, Sub sieve analysis – Particle size measurement techniques-Air permeability method, sedimentation, permeability, electronic particle counter, and elutriation methods.					
		Task 1: Quiz				1	1
	2	**Solids handling:** storage, conveyers, packaging.	2	1		5	
		In-Class Test 1				1	1
	3	Particle size classification: introduction, classifiers, principles and equipment.- gravity settling, elutriator, double con classifier, mechanical classifier, electrostatic.	6	3		15	
	3	**Size reduction:** Introduction – types of forces used for communition, criteria for communition, characteristics of communited products, laws of size reduction, work index, energy utilization, methods of operating crushers – free crushing, choke feeding, open circuit grinding, closed circuit grinding, wet and dry grinding, equipment for size reduction – Blake jaw crusher, gyratory crusher, smooth roll crusher, tooth roll crusher, imp actor, attrition mill, ball mill, critical speed of ball mill, ultra-fine grinders and cutters.	6	3		15	
		In-Class Test 2				1	1

4	**Size enlargement:** objectives of size enlargement, mean size, principles and methods of size enlargement, growth mechanism, granulation, compaction (tableting), pelletization, extrusion, tableting, sintering, capsulation and briquetting), spray drying and prilling.	6	3		15	
	Task 2: Tutorial Group Assignment				1	1
	Solid-gas separation: centrifugal separation (cyclone separators), electrostatic and bag filters, scrubbers.	2	1		5	
	Final Exam				2	2
		28	**14**		**76**	**6**

Course Texts	1. J.M. Coulson and J.F. Richardson (2002) Chemical engineering: Particle technology and separation processes, Vol 2, Butterworth-Heinemann Limited. 2. Ladslav Svarovsky. (2000). Solid-Liquid Separation, 4th Edition. Butterworth-Heinemann Limited. ISBN 0 7506 4568 7
Supplementary Texts	1. Geankoplis, C.J. (2013). Transport Processes & Separation Process Principles (includes Unit Operations). Pearson Education Limited. ISBN:9781292026022, 1292026022. 2. Enrique Ortega-Rivas. (2012). Unit Operations of Particulate Solids: Theory and CRC Press: Practice. Taylor & Francis Group. ISBN:978-1-4398-4907-1
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Engineering Thermodynamics
Course Code	CPE227
Course Convener Name **Room No.** **Email**	Mr Wiseman Tumbo Ngigi TBD wisemanngigi@mu.ac.ke
Year	2
Semester	2
Rationale for the inclusion of the Course in the programme	Thermodynamics is a key component of many fields of science and engineering. This course focuses on the application of thermodynamic principles to materials and processes encountered by chemical engineers. The course introduces basic concepts and definitions in thermodynamics, such as open and closed systems; extensive and intensive properties; equilibrium states, quasi-equilibrium processes, and cycles. It lays a foundation for learners to understand the key concepts in the subsequent thermodynamics' courses

Total Student Learning Time (SLT)	Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
	28	14		76	118
Credit Value	3				
Pre-requisite (if any)	TEC112- Chemistry for Engineers.				
Course Objective	The objectives of this course are to enable learning about; 1. Thermodynamic concepts and definitions 2. The first law ot thermodynamics 3. The second law of thermodynamics and entropy 4. Equations of state				
Synopsis	This course introduces the basic definitions and concepts of engineering thermodynamics. In addition, it introduces the concepts of heat, work, first and second law of thermodynamics to the analysis of thermodynamics systems.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Explain thermodynamic concepts and definitions 2. Analyze problems involving first law in non-flow and flow processes 3. Apply first and second law to heat engines 4. Determine property changes through thermodynamic relationships				
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Presentations				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK4, WK9
CO2	PO1, PO2	
CO3	PO1, PO2, PO8	
CO4	PO1, PO2, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Basic definitions and concepts, energy and work.	6	3		15	

	Task 1: Assignment				1	1
2	First law, enthalpy, heat capacity and phase rule. First law application to flow and non-flow processes.	6	3		15	
	In-Class Test 1				1	1
3	PVT behavior of pure substances, virial, ideal, cubic equations of state, generalized correlations.	6	3		15	
4	Second law and entropy, Kelvin-Plank and Clausius statements, reversibility, conversion of heat into work, Carnot cycle, thermodynamic temperature scale, entropy change for an ideal gas.	6	3		15	
	In-Class Test 2				1	1
5	Thermodynamic property diagrams and steam tables.	4	2		10	
	Task 2: Assignment (Group)				1	1
Final Exam					2	2
		28	**14**		**76**	**6**

Course Texts	1. Smith, J.M., Van Ness H.C., Abbott, M.M., Swihart, M. (2021). Introduction to Chemical Engineering Thermodynamics. (9th edn.). New York: Mc Graw Hill. 2. Yan, C.Y. (2022). Introduction to Engineering Thermodynamics, USA, BCcampus
Supplementary Texts	1. Michael J. M., Howard N. S., Daisie D. B. (2011). Fundamentals of engineering thermodynamics, New York, NY: John Wiley & Sons. 2. Rogers, G.F.C., Mayhew, Y. R. (2007), Engineering Thermodynamics: Work and Heat Transfer. (4th edn). Prentice Hall. 3. Stanley I Sandler (2006) Chemical, Biological, and Engineering Thermodynamics, 4th Edition, John Wiley & Sons.
Other additional information:	Websites, Video link, Lecture Notes, etc

Course Name	Workshop Practice
Course Code	CPE230

Course Convener Name **Room No.** **Email**	TBD
Year	2
Semester	3
Rationale for the inclusion of the Course in the programme	Workshop practice is an interdisciplinary course which enables learners to familiarize with safety practices in engineering laboratories and workshops and use of basic hand tolls and machines. Practically, all Engineering projects are executed by people with different expertise, and therefore, through this course, learners are trained on how to apply engineering knowledge to solve complex engineering problems as a team. Learners are also introduced to systematic gathering of data and scientific interpretation of results.

Total Student Learning Time (SLT)

Lectures	Lab Experiments	Industrial Visits	Self-Learning Including Prep Time	Student Learning Time
12 weeks				

Credit Value	6
Pre-requisite (if any)	All Second Year Courses (refer to curriculum) plus Online Safety Course
Course Objective	The objective this course is to impart training to learner to develop engineering thinking, psychomotor and affective skills at an engineering work place. The course inculcates teamwork, leadership and communication attributes for learners in physical work and hard labour during laboratory experiments and workshop tasks in addition to some amount of value addition by being exposed to interdisciplinary engineering domains.
Synopsis	The course introduces learner to safety in engineering laboratories and workshops, competence in performing engineering tasks such as execution of laboratory experiments and safe handling and use of tools and equipment, exposure to industrial processes through industrial visits, and technical report writing and presentations.
Course Learning Outcomes	Upon successful completion of this course, learners will be able to: 1. Recognize various safety guidelines in engineering operations 2. Execute laboratory experiments and engineering tasks safely using SOPs 3. Compare various industrial processes 4. Write and present technical report
Mode of Delivery	1. Laboratory Experiments- open-ended 2. Supervision/Consultations 3. Problem Based Learning 4. Industry Based Learning/visits 5. Active Learning 6. Presentations

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Laboratory experiments/workshop/Report	60	X	X		X
Oral Presentations	15		X	X	X
Attendance	5	X	X	X	X
Industrial visits report	20			X	

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO6	WK3, WK4, WK6, WK9
CO2	PO4, PO8	
CO3	PO3	
CO4	PO8, PO9	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture/consultations	Project/Lab/Group discussions	Self-Learning
1	The General Laboratory Safety training and Standard operating procedures for laboratories, safe handling and use of engineering tools and equipment			
2	Soap making, Liquid Detergent making, synthesis of Biodiesel from sunflower oil, Glycerol purification, steam extraction (Essential oil), Soxhlet extraction, Batch Distillation and Continuous Distillation.			
3	Executable Mechanical, Electrical and Civil Engineering Laboratory Tasks - TBD		12 weeks	
4	Data collection and analysis, Report writing and presentation, Technical Report Writing Skills: Types of technical reports, Report structure and organization, writing style and tone, Graphics and visual aids, Editing and proofreading			
5	Industrial Visits: Visits to various industries to observe manufacturing processes and safety measures in practice.			

		12 weeks
Course Texts	Raghuwanshi, B.S. (1998). Workshop Technology: Vol. I & II, New Delhi: Dhanpat Rai and sons.	
Supplementary Texts	Chaudhary, H. (1998). Elements of Workshop Technology. New Delhi: Media Promoters & publishers.	
Other additional information:	Websites, Video link, Lecture Notes etc.	

Year Three – First Semester

Course Name	Analytical Chemistry				
Course Code	CPE311				
Course Convener Name **Room No.** **Email**	Mr Daudi Masinde T22 maasdaudi@yahoo.com				
Year	3				
Semester	1				
Rationale for the inclusion of the Course in the programme	Analytical Chemistry allows us to separate, identity and quantify matter and its constituents making it instrumental in regards to laboratory work. It plays a vital role in drug manufacture, food production, environmental monitoring and forensic science.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28			60	88
Credit Value	2				
Pre-requisite (if any)	TEC112				
Course Objective	To acquaint the students with the fundamentals of Analytical Chemistry. This primarily includes educating the learner on the underlying theoretical basis of analytical techniques and assessing an appropriate analytical method for a specific purpose.				
Synopsis	The course introduces the learner to common analytical techniques such as pH measurements and buffers, volumetric and gravimetric methods, and different types of chromatographic methods.				
Course Learning Outcomes	At the conclusion of this course the student should be able to: 1. Explain the fundamentals of analytical chemistry and steps of a characteristic analysis. 2. Define the different gravimetric and volumetric methods. 3. Describe how to identify unknown compounds by spectroscopic and mass spectrometric methods 4. Solve problems using data acquired from chromatographic techniques				

Mode of Delivery	1. Lectures. 2. Group Discussions
Assessment method-CO Mapping	see table below

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1 (Sit-In Test 1)	20	X	X		
Task 1 (Case Study 1)	20		X	X	
Final Examination	60	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1,	WK1, WK2
CO2	PO1, PO3 PO6	
CO3	PO1, P03, PO6	
CO4	PO1, PO3, PO6	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction:** Classification of analytical chemistry (Quantitative and qualitative methods), Steps in a typical quantitative analysis, Error determination and classification, Accuracy and precision.	4			8	
2	**pH Measurements:** Ionic theory, Dissociation, Buffer solutions, Common ion effect.	4			8	
3	**Principle of Volumetric Analysis:** Molarity, Normality calculations and various concentration conversions, Indicators, Complex Ion Titrations.	5			10	
4	**Principle of Gravimetric Analysis:** Steps in gravimetry, Precipitation method, Volatilization method.	5			10	

		CAT 1 (Sit-In Test 1)				1	1
	5	**Instrumental Method Analysis Part 1:** Electrochemical methods (Potentiometry, conductometry, coulometry, electrogravimetry), Spectrometric methods (Infrared absorption and molecular spectroscopy).	5			10	
		Task 1 (Case Study 1)				1	1
	6	**Instrumental Method Analysis Part 2:** Chromatographic methods (Gas chromatography, high-performance liquid chromatography, thin-layer chromatography, and paper chromatography), Principles of Electron microscopy and XRD analysis.	5			10	
		Final Exam				2	2
			28			**60**	**4**

Course Texts	1. Ritgen, U. (2023). Analytical Chemistry I, Springer Berlin, Heidelberg 2. Hage, D.S. and Carr, J.R. (2010). Analytical Chemistry and Quantitative Analysis, (1st edn.), Pearson
Supplementary Texts	1. Dara, S.S. (2011) A textbook on Experiments and Calculations in Engineering Chemistry, S. Chand and Co. New Delhi. 2. Fifield, F.W. and Kealey, D. (2000). Principles and Practice of Analytical Chemistry, 5th ed., Blackwell Science Ltd.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Fluid Mechanics I
Course Code	CPE312

<table>
<tr><td>Course Convener Name
Room No.
Email</td><td colspan="5">Dr. Anthony Muliwa

TBD
anthonymuliwa@mu.ac.ke</td></tr>
<tr><td>Year</td><td colspan="5">3</td></tr>
<tr><td>Semester</td><td colspan="5">1</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">The knowledge of fluid mechanics plays a crucial role in Chemical and Process Engineering because the majority of chemical processing operations are conducted either partly or totally in the fluid phase. Examples of such operations includes biochemical, chemical, power generation and conversion, materials processing and manufacturing, food production, plumping and water supply, fermentation, mining, petroleum, pharmaceuticals, polymer, and waste-processing industries etc. This course equips chemical engineering learners with necessary knowledge and skills which would enable them to design appropriate fluid flow systems that can operate effectively, less costly and in a safe and sustainable manner.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>82</td><td>124</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">Fluid Mechanics</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objectives of this course are to enable learning about;
1. Steady flow of incompressible fluids
2. Frictional losses in flow
3. Unsteady flow
4. Pumping of fluids</td></tr>
<tr><td>Synopsis</td><td colspan="5">This course introduces learners to fluid flow in pipes, head loss in pipes, fluid flow measurements and instruments, and fluid transportation (pumps)</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Discuss basic concepts of pipe (conduit) flow e.g. components, regimes, velocity and flow rate etc.
2. Calculate Reynolds number, friction factor, pressure drop and power requirements in single phase flow for fully developed laminar and turbulent flows.
3. Analyze fluid flow in piping networks and pumping systems.
4. Select pump type and size to meet the specific pumping requirements.
5. Compare and select to suitable device for flow measurement in closed channels and troubleshoot any problems in flow meters.</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. Lectures (hybrid)
2. Tutorials
3. Group discussions
4. Flipped learning</td></tr>
</table>

Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4	CO5
Task 1: Assignment (Individual)	10	X				
CAT 1 (Sit-In Test 1)	15		X	X		
CAT 2 (Sit-In Test 2)	15				X	X
Task 2: Assignment (Group)	10				X	
Final Examination	50		X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK3, WK6
CO2	PO1, PO2	
CO3	PO1, PO2,	
CO4	PO1, PO2,	
CO5	PO1, PO2,	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Steady flow of incompressible fluids in closed conduits:** pipe system, viscous flow in circular pipes, flow regimes, shear stress and velocity distribution for laminar flow, Reynolds Number, volumetric flow rate, momentum balance, relation of pressure drop and velocity losses, Hagen-Poiseulle equation, entrance, developing and developed flow, friction dissipation, maximum velocity, kinematic energy per unit mass, Turbulent flow: velocity profile, intensity, time scale, shear stress, power law	6	3		15	
	Task 1: Assignment (individual)				1	1
2	**Friction losses in flow**: dimensionless groups, head-loss in conduit, friction factors for fully developed flow (Fanning, Darcy and Moody), Estimation of friction factor from	6	3		15	

	correlations and charts. frictional losses in pipes and fittings. Major losses, Minor losses: Losses in sudden expansions and contractions, entrance and outlet losses, beds, valves, loss coefficient and equivalent length for pipe components.						
	In-Class Test 1				1	1	
2	**Measurement of Fluid Flow:** Importance, Devices based on Bernoulli principle:- Orifice plate, venturies, notches, pitot tubes, rotameter, nozzles, notch or weir.	4	2		10		
3	Unsteady flow, time of emptying of vessels, water hammer.	2	1		5		
	Group Assignment				1	1	
4	**Multiple Pipe Systems**: Pipes in series and parallel, pipe networks.	2	1		5		
	Pumping of Fluids: introduction, Pumps, classification of pumps, centrifugal pump, impellers, theoretical considerations, pump selection, pump characteristics, cavitation, pump systems (series and parallel), NPSH, system and pump performance curves, affinity laws for centrifugal pump (specific and family of geometrically similar pumps), pump scale-up, pump calculation.	8	4		20		
	In-Class Test 1				1	1	
Final Exam					2	2	
		28	**14**		**76**	**6**	

Course Texts	1. Philip M. Gerhart, Andrew L. Gerhart, John I. Hochstein. Munson. (2020). Young and Okiishi's Fundamentals of Fluid Mechanics, 9th Edition. Wiley International. ISBN: 1119597307,9781119597308. 2. J.M. Coulson and JF Richardson with JR Buckhurst and JH Harker. (2003). Fluid Flow, Heat Transfer and Mass Transfer. 6th Edition. Butterworth-Heinemann. 9780750644440. 3. B. S. Massey, Ward-Smith AJ (2006) Mechanics of Fluids, 8th Edition, Taylor & Francis
Supplementary Texts	1. Frank M White (1999), Fluid Mechanics, 4th Ed., WCB/ Mc Graw-Hill 2. Irving H. Shames (1992), Mechanics of Fluids, 3rd Ed., McGraw-Hill, Inc. 3. Edward J. Shaughnessy, Ira M. Katz, James P. Schaffer (2005), Introduction to Fluid Mechanics, Oxford University Press, New-York. 4. Noel De Nevers, Fluid Mechanics for Chemical Engineers 5. Currie I.G., Fundamental Mechanics of Fluids, McGraw Hill, Inc
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Heat Transfer				
Course Code	CPE313				
Course Convener **Name** **Room No.** **Email**	 Samuel Sarmat Technology Building (TBD) samuelsarmat@gmail.com				
Year	3				
Semester	1				
Rationale for the inclusion of the Course in the programme	Heat Transfer is a core course in chemical engineering that is crucial in the industry for the use and design of heat exchangers. It helps in energy saving in an industrial set up in the use of the techniques of pinch technology. The knowledge of the application of dimensionless numbers in scale up of pilot plant operations to full-ledged industrial operations is also key.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		85	127
Credit Value	3				
Pre-requisite (if any)	CPE222- Principles of mass and energy balance, CPE 227-Engineering Thermodynamics				
Course Objective	The objectives of this course are to enable learning about; 1. The basic laws of heat transfer 2. Problems involving steady state heat conduction in simple geometries 3. The fundamentals of conduction, convective and radiation heat transfer process. 4. Problems involving conduction, convection and radiation heat transfer				
Synopsis	This course applies the concepts of heat flux and temperature gradients to compute the area of heat exchange systems needed for heat exchange operations and also application of the knowledge of materials and energy balance for the analysis of steady and non-				

	steady heat exchange processes and systems. Individual and overall heat transfer coefficients once computed helps to compute the resistance to heat transfer processes in multi-layer systems. Conduction, convection and radiation modes of heat transfer are crucial components in the design of corresponding equipment in an industrial set up.
Course Learning Outcomes	By the end of the course, the learner should be able to; 1. Explain the modes of heat transfer in solids, liquids and gases. 2. Interpret dimensionless groups used in heat transfer. 3. Derive and apply equations governing conduction, convection and radiation 4. Solve heat transfer problems.
Mode of Delivery	1. Lectures 2. Tutorials 3. Group discussions
Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4
Continuous Assessment Tests and Tasks (CATTs)	40	X	X	X	X
Final Examination	60	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK3, WK6
CO2	PO2	
CO3	PO2	
CO4	PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Heat transfer in Solids, liquid, gases.	2	1		5	
2	Thermal conduction in steady state: One-dimensional conduction, Thermal resistance, Temperature-dependent thermal conductivity and Two-dimensional conduction.	6	3		15	
	Task 1				**1**	**1**
3	Convection heat transfer: Continuity, momentum and energy	6	3		15	

	equation, Boundary layers					
4	Dimensionless groups for convection, Turbulence and time-averaged equations, Forced and Free convection.	6	3		15	
	Task 2				**1**	**1**
5	. Heat transfer during phase change: evaporation boiling, condensation and sublimation.	2	1		5	
6	Radiation heat transfer: Black and grey bodies, radiation emitters, reflectors, absorbers and transmitters. Gas and vapour radiation. Radiation equation.	6	3		15	
	Group work				**1**	**1**
Final Exam					2	2
		28	**14**		**80**	**5**

Course Texts	1. John H Lienhard IV, Dr. John H Lienhard V, (2019). A Heat Transfer Textbook, (5th Ed.). Dover Publications 2. Holman, J.P. (2009). Heat Transfer. (10th Ed.). McGraw-Hill Education.
Supplementary Texts	1. Yunus A. Cengel (2004). Heat Transfer- A Practical Approach. (2nd Ed.) New York: Mc Graw-Hill. 2. Vedat S. Arpaci, Ahmet Selamet, Shu-Hsin Kao (2000). Introduction to Heat Transfer. New Jersey: Prentice Hall New. 3. Kurt C. Rolle, (2019). Thermodynamics and Heat Power. (6th Ed.). Pearson.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Particle Technology II
Course Code	CPE 315
Course Convener Name **Room No.** **Email**	Dr. Anthony Muliwa TBD anthonymuliwa@mu.ac.ke
Year	3
Semester	1

Rationale for the inclusion of the Course in the programme	Particle technology is an important subject in chemical engineering as it finds wide applications in process industries such as chemical, pharmaceutical, food and metallurgy whereby solid-liquid separation is inevitable. This course is most useful to chemical engineers and process engineers, particularly those in plant operation, plant design or equipment testing and commissioning.
Total Student Learning Time (SLT)	**Lectures**: 28; **Tutorial**: 14; **PBL/Design /Lab**: ; **Self-Learning Including Prep Time**: 78; **Total Learning Time**: 120
Credit Value	3
Pre-requisite (if any)	Particle Technology I, Principles of Mass and Energy balance
Course Objective	The course provides learners with balanced theoretical and practical tools to understand the principles of operation and important aspect of solid-liquid separation equipment. Relevant industrial operations such as sedimentation, centrifugation and filtration and fluidization is well covered with a strong emphasis placed on the use of equipment rather than on its design, although the latter is not ignored.
Synopsis	The course covers sedimentation with thickener and clarifier design, filtration and constant pressure and volume, fixed bed and fluidized beds.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Recognize various solid-liquid separation techniques 2. Derive equations for various solid-liquid separation calculations. 3. Solve problems related to sedimentation, centrifugation, filtration, fluidization and mixing using provided data or information. 4. Select appropriate solid-liquid separation equipment for particular application
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group activity/presentation/discussions

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK3, WK4
CO2	PO1, PO2	
CO3	PO2, PO3	
CO4	PO3, P08	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT

		1	**Solid-liquid separation**: principles of gravity sedimentation, factors, industrial applications, clarification and thickening, thickener design –solid fluxes, concentration, overflow and underflow.	6	3		15		
			Task 1: Assignment				1	1	
		2	**Centrifugal separation:** introduction, types of centrifugation, centrifugal fields, applications of centrifugation, shape of free surface of liquid, sedimentation in a centrifugal field equations, capacity, mechanical design, centrifugal equipment	4	2		10		
			In-Class Test 1				1	1	
		3	**Liquid filtration:** introduction, types of filtration, filtration theory, incompressible and compressible cake filtration, cake thickness and volume of filtrate, constant rate filtration, constant pressure filtration, filter aid and filter media, filtration through cloth and cake combined, filtration equipment selection and sizing techniques: filter press, rotary drum filters, Types of filters and sizing techniques.	8	4		20		
			In-Class Test 2				1	1	
		4	**Deep bed Filtration:** flow through packed beds, fluidized beds Darcy's law, Darcy-Carman and Kozeny	4	2		10		
		5	**Mixing and agitation:** Mixing of liquids and	6	3		15		

		solids, types of mixers, Mixing mechanism, Power requirement of selected mixers					
		Task 2: Group activity/presentation				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts	1. J.M. Coulson and J.F. Richardson (2002) Chemical engineering: Particle technology and separation processes, Vol 2, Butterworth-Heinemann Limited. 2. Ladslav Svarovsky. (2000). Solid-Liquid Separation, 4th Edition. Butterworth-Heinemann Limited. ISBN 0 7506 4568 7
Supplementary Texts	1. Geankoplis, C.J. (2013). Transport Processes & Separation Process Principles (includes Unit Operations). Pearson Education Limited. ISBN:9781292026022, 1292026022. 2. Enrique Ortega-Rivas. (2012). Unit Operations of Particulate Solids: Theory and CRC Press: Practice. Taylor & Francis Group. ISBN:978-1-4398-4907-1
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Chemical Engineering Thermodynamics I				
Course Code	CPE317				
Course Convener Name Room No. Email	TBD				
Year	3				
Semester	1				
Rationale for the inclusion of the Course in theprogramme	Chemical Engineering Thermodynamics is one of the core thematic areas in chemical engineering that is widely exploited in chemical, food, pharmaceutical, fuels and biological processes among others. The knowledge and skills gained, such as thermodynamic property relationships help learners to determine heat and work quantities for design and operate flow, refrigeration and liquefaction processes more effectively at an industrial scale.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120
Credit Value	3				
Pre-requisite (if any)	CPE 227- Engineering Thermodynamics				
Course Objective	This course aims to equip the learner with the fundamental knowledge of 1st and 2nd laws of thermodynamics in determining thermodynamic properties of pure fluid in order to calculate heat and work quantities for industrial processes. Learners apply the concepts of mathematical models and design equations are applied to design and optimise power plants, refrigeration and liquefaction processes.				

Synopsis	This course applies the concepts of 1st and 2nd laws of thermodynamics. Moreover, mathematical models and design equations are applied to design and optimise power plants, refrigeration and liquefaction processes.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Apply 1st and 2nd thermodynamic laws to flow processes 2. Estimate thermodynamic properties for a pure fluid 3. Use the thermodynamics property relations to compute heat and work requirements for thermal engines 4. Solve problems for real fluids using equation of state
Mode of Delivery	1. Lectures 2. Tutorials
Assessment method-CO Mapping	(see table below)

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15		X	X	
CAT 2 (Sit-In Test 2)	15				X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK3, WK4
CO2	PO1, PO2	
CO3	PO2, PO3, PO5	
CO4	PO2, PO3, PO5	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Fundamental property relations:** Thermodynamic properties of pure fluids, thermodynamic relationships for homogeneous system of constant composition.	4	2		10	
2	**Residual properties**. Residual properties in zero-limit pressure, enthalpy and entropy from residual properties, residual properties from rhe virial and cubic equations of state.	2	1		5	
3	**Two-phase systems:** Temperature dependence of the vapour pressure of liquids, corresponding – states correlations by vapour pressure, two-	4	2		10	

	phase liquid/vapour systems.					
4	**Duct flow of compressible fluids and turbines:** Pipe flow, nozzles, throttling process, turbines (expanders).	4	2		10	
5	**Compression processes:** Compressors, pumps.	4	2		10	
6	**Steam Power Plant**: Rankine cycle, regenerative cycle.	4	2		10	
7	**Internal combustion engines, jet and rocket engines**: Otto engine, diesel engine, gas-turbine engine, jet and rocket engines.	2	1		5	
8	**Refrigeration and liquefaction:** Carnot refrigerator, vapour-compression cycle, choice of refrigerant, absorption refrigeration, heat pump, liquefaction processes.	4	2		10	
Final Exam					8	6
		28	**14**		**78**	**6**

Course Texts	1. Smith, J.M., Van Ness H.C., Abbott, M.M., Swihart, M. (2021). Introduction to Chemical Engineering Thermodynamics. (9th edn.). New York: Mc Graw Hill. 2. Yan, C.Y. (2022). Introduction to Engineering Thermodynamics, USA, BCcampus
Supplementary Texts	1. Michael J. M., Howard N. S., Daisie D. B. (2011). Fundamentals of engineering thermodynamics, New York, NY: John Wiley & Sons. 2. Rogers, G.F.C., Mayhew, Y. R. (2007), Engineering Thermodynamics: Work and Heat Transfer. (4th edn). Prentice Hall. 3. Stanley I Sandler (2006) Chemical, Biological, and Engineering Thermodynamics, 4th Edition, John Wiley & Sons.
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Fundamentals of Computer Aided Drawing
Course Code	CPE318
Course Convener Name	TBD

<table>
<tr><td>Room No.
Email</td><td colspan="5"></td></tr>
<tr><td>Year</td><td colspan="5">3</td></tr>
<tr><td>Semester</td><td colspan="5">1</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">Computer Aided is one of the supplementary thematic areas in chemical engineering that is widely exploited in all process industries. The knowledge and skills gained help learners to undertake flow sheet process design.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>26</td><td>13</td><td>8</td><td>73</td><td>120</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">MPE116, MPE126</td></tr>
<tr><td>Course Objective</td><td colspan="5">The aim of the course is to:
1. Make the students to enumerate the fundamentals of engineering drawing using computer aided drawing (CAD) tools
2. Cause them to draw in two- and three-dimensional representation of a part, the multi-view drawing practices and dimensioning and tolerances sign; sectional and auxiliary views
3. Lead them to make intersection of solids and planes and development of surfaces
4. Focus on teamwork skills and the drawing.</td></tr>
<tr><td>Synopsis</td><td colspan="5">This course applies the process simulation techniques using a process flow sheet simulation application. Moreover, simulation models are applied in the design and operation of unit operations and unit processes.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Identify CAD tools for manipulating and modifying drawing elements.
2. Draw common geometrical shapes in multi-views and isometric views of objects by applying constraints, international standards and conventions in drawing practices.
3. Apply visualization skills to determine intersection of solids and planes and develop surfaces of intersected objects.
4. Develop assembly drawings.</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. Lectures
2. Tutorials
3. Laboratory</td></tr>
<tr><td>Assessment method-CO Mapping</td><td colspan="5"><table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Continuous Assessment Tests and Tasks (CATTs)</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table></td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td colspan="5"><table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1, PO2</td><td rowspan="4">WK2, WK4</td></tr>
<tr><td>CO2</td><td>PO1, PO2</td></tr>
<tr><td>CO3</td><td>PO2, PO3, PO5</td></tr>
<tr><td>CO4</td><td>PO2, PO3, PO5</td></tr>
</table></td></tr>
</table>

Content Outline of the Course and the SLT per Topic	No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
	1	**Basics of drawing and CAD:** Alphabet of lines, letterings, paper sizes. Dimensioning, dimensioning of angles and arcs; scale drawing, fillets and rounds, finish marks, fits and tolerances, dimensioning and tolerancing problems. Geometrical constructions, polygons, solids, circles and arcs, curves, ellipse, parabola, hyperbola, spline, helix, and involutes	6	3	0	15	
	2	**Types of views:** First and third angle projections, multi-view projection, isometric views, freehand technical sketching and shape description. Sectional views, section symbols, section lining, full section, half section, broken section, revolved section, removed section, offset, ribs in section, aligned section, sectional problems. Auxiliary views, partial views.	4	2	0	10	
	3	**Drafting Aids in CAD:** Using the Grid and Snap. Drawing preferences. Manipulating and modifying drawing elements. Delete, copy, rotation. Geometric Array	4	2	2	12	
	4	**Constructing element and Constraints:** Advanced 2D drafting. Grouping elements. Fillet, chamfering and offset, Dimension.	4	2	2	12	

		Entity trimming and division 2D Sketch analysis. Basic 3 D modelling using extrude, revolve and Loft Features 3D manipulation tools. Project 3D, Rectangular and Circular Pattern, Fillet, Chamfering and draft					
	5	**Projection view arrangement criteria:** Generation the projection View from 3 D model. Intersections, development, drawing symbols: mechanical and electrical symbols. Threads: thread symbols, drawing of bolts and nuts, fasteners, screws and rivets, springs, thread and fasteners problems	4	2	2	12	
	6	**Assembly:** Assembly and detail drawings, title and record stripes, parts list, simplified drafting, assembly sectioning, working drawing problems	4	2	2	12	
	Final Exam					0	6
			26	**13**	**8**	**73**	**6**

Course Texts	1. Kshirsagar, M. (2021). Autodesk AutoCAD 2021: Learn CAD With Ease (For Beginners). Independently Published. ISBN-13: 979-8713641214 2. Gieseke, F, E., Mitchhell, A., Spemce H. C., Ilan, L. H., John, T. D., James, E. N., & Shawna, L. (2004). Technical Drawing, (13th Edn), Prentice Hall.
Supplementary Texts	1. Alibre Drafting Manual V9.0 Alibre Drafting Manual V9.0 2. AutoCad Software Manual Version 2005. 3. Boundy, A. W. (2006). Engineering Drawing, (6th Ed.). McGraw-Hill. 4. Cecil H. Jensen, Jay D Helsel, Donald D. Voisinet, (1996). Computer-Aided Engineering Drawing using AutoCAD, (2nd Ed.) McGraw-Hill. 5. Zeid, I. (2005). Mastering CAD/CAM, Mc Graw-Hill
Other additional information:	AutoCAD, Websites, Video link, Lecture Notes etc

Course Name	Chemical Engineering Practicals I
Course Code	CPE 310

<table>
<tr><td>Course Convener Name
Room No.
Email</td><td>TBD</td></tr>
<tr><td>Year</td><td>3</td></tr>
<tr><td>Semester</td><td>1</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td>Laboratory experiments are important in chemical and process engineering. Laboratory experiments enable learners to develop critical thinking and practical skills. In addition, they enhance mastery of courses that have executable experiments. The experimental component of various courses offered in third year; first semester is done under chemical engineering practicals I</td></tr>
<tr><td>Total Student Learning Time (SLT)</td><td><table>
<tr><th>Lectures</th><th>Consultations</th><th>PBL/Design /Lab</th><th>Self-Learning Including Prep Time</th><th>Total Learning Time</th></tr>
<tr><td>1</td><td>13</td><td>24</td><td>43</td><td>81</td></tr>
</table></td></tr>
<tr><td>Credit Value</td><td>2</td></tr>
<tr><td>Pre-requisite (if any)</td><td>Analytical Chemistry, Fluid Mechanics I, Heat Transfer, Particle Technology II, Chemical Engineering Thermodynamics I</td></tr>
<tr><td>Course Objective</td><td>The objectives of this course are to enable learning about;
1. Selection of equipment's and reagents required for a given experiment
2. Safe execution of laboratory experiments
3. Operation of equipments used to carry out an experiment
4. Report writing and presentation</td></tr>
<tr><td>Synopsis</td><td>The learners are expected to perform at least two executable experiments in Analytical Chemistry, Fluid Mechanics I, Heat Transfer, Particle Technology II and Chemical Engineering Thermodynamics I, write a report and make a presentation of his/her findings to the departmental academic and technical staff panel.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Describe the procedures to characterize internal combustion engines, fluidized bed and solid-liquid systems
2. Calculate the pressure drop in filtration, mixing power requirements, heat resistance through various media and radiative heat fluxes
3. Apply analytical techniques in complexometric, optics, chromatography, spectroscopy, potentiometry and conductometry to solve scientific problems.
4. Write a technical report on the experiments done for oral presentation</td></tr>
<tr><td>Mode of Delivery</td><td>1. Group Discussions
2. Lab sessions
3. Oral presentations
4. Demonstrations</td></tr>
<tr><td>Assessment method-CO Mapping</td><td><table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Oral Presentation</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Final Report</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table></td></tr>
</table>

<table>
<tr><td rowspan="5">Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>Course Learning Outcome</td><td colspan="2">Programme Learning Outcome</td><td colspan="4">Knowledge Profile</td></tr>
<tr><td>CO1</td><td colspan="2">PO2</td><td colspan="4" rowspan="4">WK3, WK4, WK8, WK9</td></tr>
<tr><td>CO2</td><td colspan="2">PO2, PO3 PO4</td></tr>
<tr><td>CO3</td><td colspan="2">PO2, PO4</td></tr>
<tr><td>CO4</td><td colspan="2">P08</td></tr>
<tr><td rowspan="4">Content Outline of the Course and the SLT per Topic</td><td>No.</td><td>Topic</td><td>Lecture</td><td>Consultations</td><td>Lab</td><td>Self-Learning</td><td>FE/Q/MT</td></tr>
<tr><td>1</td><td>CPE311: pH measurements, buffers and indicators; basic and complex ion titrations; potentiometric titrations; chromatographic methods)</td><td rowspan="3">1</td><td rowspan="3">13</td><td rowspan="3">24</td><td rowspan="3">42</td><td rowspan="3"></td></tr>
<tr><td>2</td><td>CPE312: Measure the dynamic and kinematic viscosity of liquids; Determine the friction factor both for Laminar Flow and Turbulent Flow; Determine the coefficient of discharge of Venturi meter and Orifice meter; Identify the type of Flow through Reynolds Number; Verify the Bernoulli's Theorem; Osborne Reynolds' Demonstration (laminar, transitional, and fully turbulent flows in a pipe); Determination of friction losses in pipes; Calculation of head loss; Determination of the operational characteristics of centrifugal pumps when they are configured as a single pump, pumps in series, and pumps in parallel.</td></tr>
<tr><td>3</td><td>CPE 313: To undertake at least two experiments to determine the: overall</td></tr>
</table>

		thermal conductance and plot the temperature distribution in case of a composite wall; thermal conductivity of a liquid; temperature distribution along the length of a pin fin under free and forced convection; heat transfer coefficient of vertical cylinder in natural convection; Stefan Boltzmann constant						
	4	CPE315: Determination of pressure drop in fixed beds; Determination of minimum fluidization velocity; Calculation of the pressure drop in filtration; Mixing power requirements						
	5	CPE 317: Determine the following: Specific latent heat of vaporization using an electric heater; VLE curve for CC_4-toluene mixture; Residual properties; COP for the refrigeration machine and compare with COP for the Carnot refrigeration cycle machine.						
		Task 1: Oral presentation				1		
		Final Report						
			1	**13**	**24**	**43**		
Course Texts	1. Dara, S.S. (2011) A textbook on Experiments and Calculations in Engineering Chemistry, S. Chand and Co. New Delhi. 2. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). London: Butterworth-Heinemann Linacre House.							

Supplementary Texts	1. Warren, M. (2005). Unit operations of chemical engineering. (7th edn.). New York: McGraw Hill Chemical Engineering Series. 2. Richardson, J.F., Harker, J.H. and Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2. (5th edn.). Oxford: Butterworth-Heinemann Linacre House. 3. Yunus S. C. (1998). Heat Transfer- A Practical Approach. New York: Mc Graw-Hill.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Basic Electronics				
Course Code	ECE310				
Course Convener Name **Room No.** **Email**	Dr SO OBURA TBD oburastevine@mu.ac.ke				
Year	3				
Semester	1				
Rationale for the inclusion of the Course in the programme	Chemical processes and industries are increasingly automated and rely on advanced technology. This requires creating plans for equipment, systems and production methods, and necessitates the use of electronic devices like sensors and actuators to monitor variables such as temperature, pressure, flow rates, and chemical concentrations in processes. Basic electronics knowledge allows chemical and process engineers to select, install, and troubleshoot these devices.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		87	129
Credit Value	3				
Pre-requisite (if any)	PHY 105, TEC 112, ECE 210				
Course Objective	The objectives of this course are to enable learning about; 1. Semiconductors and the importance of semiconductor doping 2. Solid-state electronic devices and their capability to regulate electrical properties 3. Operational amplifiers and their application in mathematical operations and signal amplification 4. Digital logic and operation of digital systems. 5. Design techniques and technical analysis of different logic circuits.				
Synopsis	This course presents the foundational knowledge of electronic components, circuits, and systems. It explains the operation of electrical devices and introduces design and analysis of simple circuits.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Relate conduction of semiconductor materials to their doping levels 2. Analyse simple electronic circuits with solid-state devices 3. Design operational amplifier circuits for basic mathematical operations 4. Determine the operation and output of different systems of logic gates 5. Use the basic building blocks to design different levels of simple logic circuits.				

Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group Discussions 4. Presentations 5. Laboratory Experiments 6. Demonstrations
Assessment method-CO Mapping	see table below

Distribution	(%)	CO1	CO2	CO3	CO4	CO5
Task 1: Assignment	5	X				
Task 2: Assignment	5		X			
CAT 1 (Sit-In Test 1)	10	X	X			
Task 3: Assignment	5			X		
Task 4: Assignment	5			X		
CAT 2 (Sit-In Test 2)	10			X	X	X
Final Examination	50	X	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK3
CO2	PO1	
CO3	PO1, PO8	
CO4	PO1, PO8	
CO5	PO1, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
	Analogue Electronics					
1	**Conduction in semiconductors:** Intrinsic and extrinsic conductivity, doping to obtain P & N type semiconductors, Majority and minority carriers.	2	1		5	
	Task 1: Assignment				1	1
2	**P-N junction**: Simple quantitative treatment of its characteristics, Qualitative treatment of various transistors and avalanche effects.	2	1		5	
	Task 2: Assignment				1	1
3	**Bipolar transistor**: Basic features of its construction, simple treatment of its operation and	6	3		15	

	characteristics, single transistor voltage amplifier with and without stabilisation of operating point.					
4	**Operational Amplifiers**: Main features of operational amplifiers, Application in inverting and non-inverting amplifiers, current to voltage, converters, summing amplifiers, differential amplifiers, integrators and differentials.	6	3		15	
	In-Class Test 1				1	1
Digital electronics						
5	**Logic gates**: with simple diode/transistor examples, TTL and CMOS logic families and their main features	4	2		10	
	Task 3: Assignment				1	1
6	**Simple combinational logic:** two state signal	4	2		10	
	Task 4: Assignment				1	1
7	**Logic devices and circuits**: Logic minimization techniques, Memory circuits, registers and commuters	4	2		10	
	In-Class Test 2	28	14		1	1
Final Exam					2	2
		28	**14**		**79**	**8**

Core Reading Materials	1. Westcott, S., Riescher, J. and Westcott, R. (2023), Basic Electronics: Theory and Practice. Mercury Learning and Information, (4th Ed.) ISBN-10: 1683929586 ISBN-13: 978-1683929581. 2. Hughes, E. (2006), Electrical and Electronic Technology, (8th Ed.), Pearson Education, ISBN: 81-7758-899-0.
Recommended Reading Materials	1. Grob, B. (1997), Basic Electronics, (8th Ed.) McGraw Hill, ISBN-10: 002802253X, ISBN-13:978-0028022536. 2. Malvino, A. (1998), Electronic Principles, (6th Ed.) Career Education, ISBN-10: 0028028333, ISBN-13:978-0028028330.
Other additional information:	Websites, Video link, Lecture Notes, etc

Course Name	Economics For Engineers				
Course Code	ECO330				
Course Convener Name **Room No.** **Email**	TBD				
Year	3				
Semester	2				
Rationale for the inclusion of the Course in the programme	The course enables engineers to analyze complex economic decision-making problems in several core engineering disciplines. It introduces fundamental concepts of engineering economics, shows ways to calculate time value of money using cash-flow diagrams as well as explains the procedure for making economy studies to select the best alternative. It also elaborates various methods to make replacement and retention decisions, calculate depreciation costs, evaluate public sector projects, perform economy studies considering inflation, arrive at make or buy decisions etc.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		76	124
Credit Value	3				
Pre-requisite (if any)	None				
Course Objective	This course aims to equip the learner with economic principles and their relevance to engineering decision-making.				
Synopsis	The course introduces fundamental concepts of engineering economics, shows ways to calculate time value of money using cash-flow diagrams as well as explains the procedure for making economy studies to select the best alternative. It also elaborates various methods to make replacement and retention decisions, calculate depreciation costs, evaluate public sector projects, perform economy studies considering inflation, arrive at make or buy decisions etc.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Describe the fundamental theories and concepts of economics. 2. Assess economic tools of analysis suitable for formulating and solving contemporary engineering issues. 3. Apply knowledge of the economic to understand how engineering systems work. 4. Formulate economic models in project analysis and interpretation of economic performance				
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group discussions 4. Flipped learning				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15		X	X	
CAT 2 (Sit-In Test 2)	15				X
Task 2: Assignment (Group)	10				X
Final Examination	50		X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK3
CO2	P01, PO10	
CO3	PO1, PO10	
CO4	PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction to Economics and Engineering:** Definition of economics and engineering; Scarcity and opportunity cost; micro vs. macroeconomics; Economic models and tools for analysis.	6	3		15	
2	**Microeconomic Principles for Engineers:** Supply and demand analysis; Market structures and competition; Cost-benefit analysis; Marginal analysis; Environmental and social considerations in engineering decision-making.	4	2		10	
3	**Macroeconomic Principles for Engineers:** Economic growth and development; International trade and globalization; Monetary and fiscal policy; Energy and sustainability.	4	2		10	
4	**Applications of Economics in Engineering:** Supply chain management and	6	3		15	

			optimization-Inventory management-Lean production and just-in-time manufacturing-Logistics and transportation; Risk management and analysis-Risk identification and assessment- Risk mitigation strategies-Decision analysis and uncertainty modelling; Project planning and scheduling- Cost estimating and budgeting- Performance measurement and control;						
		5	**Innovations in engineering-** Technology adoption and diffusion-Intellectual property and patents- research and development investment and innovation strategies.	4	2		10		
		6	**Case Studies and Applications:** Case studies on the application of economics in engineering projects-Examples of successful and failed projects-Comparison of different decision-making frameworks; Guest lectures from industry professionals- Experts in supply chain management, risk management, and engineering project management-Engineers who have applied economic principles in their work; Project-based assignments-Group projects on supply chain optimization, risk	4	2		10		

		management, and project planning; Conclusion and Future Directions- Review of course material and learning outcomes- Future trends and directions in economics and engineering-Wrap-up and course evaluation					
	Final Exam and Assessments					6	6
			28	**14**		**76**	**6**

Course Texts	1. David Romer (2018). Advanced Macroeconomics [5th ed.], McGraw-Hill 2. Sanjay Rode (2012). Advanced Macroeconomics. Ventus Publishing
Supplementary Texts	1. M. Blaug and P. Lloyd (2013). "Economics for Engineers: An Introduction." Routledge. 2. J. Callen (2017). "Economics for Engineers." John Wiley & Sons.
Other additional information:	Websites, Video link, Lecture Notes etc

Year Three – Second Semester

Course Name	Material Science				
Course Code	CPE321				
Course Convener Name **Room No.** **Email**	Dr. Cyprian Murutu TBD				
Year	3				
Semester	2				
Rationale for the inclusion of the Course in the programme	Material science is an important discipline in the development of reliable materials and structures. By understanding material behaviour and properties, they can be designed to meet safety and durability requirements. Material science and engineering drives innovation in both research and industry in everything from aerospace to medicine.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	124
Credit Value	3				
Pre-requisite (if any)	CPE 111 – Introduction to Material Science				

Course Objective	The objectives of this course are to enable learning about; 1. Crystalline structure of materials 2. Binary equilibrium diagrams 3. Heat treatment of steels 4. Corrosion and corrosion prevention
Synopsis	This course involves analysing the properties and structure of solid materials and the discovery and design of new solid materials not only in engineering but also in other fields of science like chemistry and physics.
Course Learning Outcomes	By the end of the course, the learner should be able to; 1. Describe the crystalline structure, crystal geometry and crystal defects of materials 2. Analyse phase diagrams of pure metals and binary phase diagrams. 3. Apply equilibrium diagrams in the design and selection of binary alloys. 4. Illustrate the strengthening of metals and alloys by cold working, precipitation hardening and martensitic transformation.
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group discussions 4. Flipped learning

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15		X	X	
CAT 2 (Sit-In Test 2)	15				X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK1, WK3, WK4
CO2	PO1, PO2	
CO3	PO1, PO2	
CO4	PO2, P08,	
CO5	PO2,PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Crystalline structure of materials:** Crystal patterns, allotropy, Miller indices, lattice defects, dislocation and slip mechanisms, grain microstructure.	8	4		20	
	Task 1: Assignment (individual)				1	1
2	**Binary equilibrium diagrams**: Construction of equilibrium phase diagrams; types of equilibrium diagrams,	6	3		15	

		the level rule, alloy theory, reasons of alloying. The Iron- carbon (Fe-C) phase diagram						
		In-Class Test 1				1	1	
	3	**Heat treatment of steels:** Isothermal and continuous cooling transformation (CCT) diagrams, technical heat treatment procedures, hardenability, factors affecting hardenability.	6	3		15		
		Task 2: Assignment (Group)				1	1	
		Introduction to corrosion and corrosion prevention: Types of corrosion, driving force for corrosion, types of galvanic cells, pourbaix diagrams, prevention methods, protective coatings.	8	4		20		
		In-Class Test 2				1	1	
	Final Exam					2	2	
			28	**14**		**76**	**6**	

Course Texts	**Core Reading Materials** 1. Steimel, J. P. (2019). Materials Science and Engineering, USA, Pacific Open Texts. 2. Callister Jr D.W. & Rethwisch D.G. (2018). Materials Science and Engineering: An Introduction (10th edn.) New York: John Wiley and Sons.
Supplementary Texts	1. Gupta, K.M. (2014). Engineering Materials. USA: CRC Press. 2. Kelly, P.F. (2014). Properties of Materials. USA: CRC Press. 3. Ashby, F.M. & Jones, D.R.H. (2000). Engineering Materials 1: An Introduction to their Properties and Applications. (2nd edn.). London: Butterworth Heinemann. 4. Vernon, J. (2003). Introduction to Engineering Materials. (4th edn.). London: Macmillan Press Ltd.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Fluid Mechanics II
Course Code	CPE322
Course Convener	

Name **Room No.** **Email**	Dr. Anthony Muliwa TBD anthonymuliwa@mu.ac.ke
Year	3
Semester	2
Rationale for the inclusion of the Course in the programme	The majority of fluid mechanics applications in chemical engineering practice are related to flow around stationary objects or via bounded ducts while designing processing equipment. This course, therefore prepares learners to acquire knowledge and skills to pursue a professional career in engineering such as aerodynamics, hydrodynamics, transportation, wind engineering and ocean engineering.

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	124

Credit Value	3
Pre-requisite (if any)	CPE 312-Fluid Mechanics I,
Course Objective	This course helps learners to critically analyse forces involved in external flows of fluid around bodies of different geometries encountered in many engineering applications.
Synopsis	This course covers flow around a submerged bodies, drag coefficients and their dependency on Reynold's number, Pressure waves, Navier-Stokes equations and boundary layer flows and compressible flows.
Course Learning Outcomes	Upon successful completion of this course, learners will be able to: 1. Illustrate the concept of drag forces and fluid flow around a solid body. 2. Derive the integral form of the continuity equation for a control volume involving rectangular and cylindrical polar coordinates. 3. Apply Navier-Stokes equations for rectangular, cylindrical and spherical coordinates to solve continuity and boundary layer problems involving 1-D, uniform and non-uniform, incompressible, steady and unsteady flows. 4. Analyze the flow regimes around a submerged body (over cylinders and spheres) and propagation of pressure waves in compressible flows.
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group discussions 4. Flipped learning

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK3, WK6
CO2	PO1, PO2	
CO3	PO2, PO3	
CO4	PO3, P08, PO9	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Flow around a submerged body:** general external flow characteristics, lift and drag concept, movement of solid bodies in a fluid, The drag coefficients and their dependency on Reynold's number. drag and lift coefficients, Friction Drag for Flow over a Flat Plate with Zero Incidence, Laminar and Turbulent BL over a Finite Flat Plate, Laminar-to-Turbulent Transition BL over a Finite Flat Plate, pressure drag, Combined Friction & Pressure Drag: for Flow over a Sphere or Cylinder, spherical and Characteristic Area in Drag Coefficient.	6	3		15	
	Task 1: Assignment (individual)				1	1
2	**Streamlining:** streamlined bodies, Comparison of flow separation and drag on blunt and streamlined shapes, Characteristics of Flow Past an Object: steady, viscous flow past a flat plate parallel to the upstream velocity (low, moderate and large Re), flow separation, Character of the steady, viscous flow past a circular cylinder.	2	1		5	

			In-Class Test 1				1	1	
		3	**Differential analysis of fluid flow:** finite control volume and differential analysis, conservation of mass, differential form of continuity equation (steady, unsteady and incompressible flow), Rectangular Coordinate System, mass flux through the control surface of a rectangular differential control volume, cylindrical polar coordinates, mass flux through the control surface of a cylindrical differential control volume, differential energy, the stream function,	6	3		15		
		4	**Conservation of linear momentum:** description of Forces Acting on the Differential Element, intensity of the force per unit area at a point in a body, normal and shearing stress (cubical and cylindrical elements), resultant body force, equation of motion, stress-deformation relationships, the Navier-Stokes equations for incompressible Newtonian fluids (cubical and cylindrical polar coordinates), Steady, Laminar Flow Between Fixed Parallel Plates (velocity profile and volumetric flow rate), Couette flow, Flow in the narrow gap of a journal bearing, Steady, Laminar Flow in Circular Tubes, parabolic velocity profile, Poiseuille's law,	6	3		15		

		Steady, Axial, Laminar Flow in an Annulus,						
	5	**The Boundary-Layer Concept:** Boundary layers, structure, thickness. Boundary layer flow, BL displacement thickness, BL momentum thickness, Prandtl/ Blasius Boundary Layer Solution, Momentum-Integral Boundary Layer Equation for a Flat Plate, Turbulent Boundary Layer Flow,	4	2		10		
		In-Class Test 2				1	1	
	6	**Compressible fluid flow:** compressibility and March number, review of ideal gas laws, speed of sound, wave propagation, 1D isentropic compressible flow, critical state, shock waves, operating a converged and diverged nozzle, chocked flow, pressure waves.	4	2		10		
		Group Assignment				1	1	
	Final Exam					2	2	
			28	**14**		**76**	**6**	

Course Texts	1. Philip M. Gerhart, Andrew L. Gerhart, John I. Hochstein. Munson. (2020). Young and Okiishi's Fundamentals of Fluid Mechanics, 9th Edition. Wiley International. ISBN: 1119597307,9781119597308. 2. Robert W.F., Alan T.M. and Philip J.P. (2004). Introduction to Fluid Mechanics, 6th edition, John Wiley and Sons Inc. ISBN 0-471-37653-1 3. J.M. Coulson and JF Richardson with JR Buckhurst and JH Harker. (2003). Fluid Flow, Heat Transfer and Mass Transfer. 6th Edition. Butterworth-Heinemann. 9780750644440.
Supplementary Texts	1. Frank M White (1999), Fluid Mechanics, 4th Ed., WCB/ Mc Graw-HillIrving H. Shames (1992), Mechanics of Fluids, 3rd Ed., McGraw-Hill, Inc. 2. Edward J. Shaughnessy, Ira M. Katz, James P. Schaffer (2005), Introduction to Fluid Mechanics, Oxford University Press, New-York. 3. Noel De Nevers, Fluid Mechanics for Chemical Engineers 4. Currie I.G., Fundamental Mechanics of Fluids, McGraw Hill, Inc 5. B. S. Massey, Ward-Smith AJ (2006) Mechanics of Fluids, 8th Edition, Taylor & Francis

Other additional information:	Websites, Video link, Lecture Notes etc.

<table>
<tr><td>Course Name</td><td colspan="5">Steam Plant</td></tr>
<tr><td>Course Code</td><td colspan="5">CPE323</td></tr>
<tr><td>Course Convener Name
Room No.
Email</td><td colspan="5">TBD</td></tr>
<tr><td>Year</td><td colspan="5">3</td></tr>
<tr><td>Semester</td><td colspan="5">2</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">Steam Plant course provides information on steam generation, types of boilers pertinent to engineering operations, and the various components commonly found on boilers. The knowledge and skills gained help learners to select and size steam boilers, understand safety in the boiler and boiler house, know safe and energy efficient operations of the boiler, boiler feed water and fuel management, heat recovery equipment and operation and maintenance practices (SOPs).</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>82</td><td>124</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">CPE221- Physical Chemistry and CPE313-Heat Transfer</td></tr>
<tr><td>Course Objective</td><td colspan="5">This course aims to equip the learner with the fundamental knowledge on principles of heat exchangers, fuel combustion, steam generation as well as boiler operations and efficiency. Learners apply the concepts of heat balance equation to evaluate theoretical and actual flame temperatures as well as to perform combustion calculations.</td></tr>
<tr><td>Synopsis</td><td colspan="5">This course generally applies the heat balance equation to evaluate theoretical and actual flame temperatures as well as to perform combustion calculations necessary for sizing steam boilers and their energy operation efficiency.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Discuss the principles of heat exchangers
2. Evaluate theoretical and actual temperatures using heat balance equation
3. Apply heat balance equations to perform combustion calculations
4. Appraise boiler operation and its efficiency.
5. Design various types of heat exchangers</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. Lectures
2. Tutorials</td></tr>
</table>

Assessment method-CO Mapping	**Distribution**	**(%)**	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
	Task 1: Assignment (Individual)	10	X				
	CAT 1 (Sit-In Test 1)	15		X	X		
	CAT 2 (Sit-In Test 2)	15				X	
	Task 2: Assignment (Group)	10				X	X
	Final Examination	50	X	X	X	X	

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile	**Course Learning Outcome**	**Programme Learning Outcome**	**Knowledge Profile**
	CO1	PO1, PO2	WK4
	CO2	PO2	
	CO3	PO2,	
	CO4	PO3	

Content Outline of the Course and the SLT per Topic	**No.**	**Topic**	**Lecture**	**Tutorial**	**Lab**	**Self-Learning**	**FE/Q/MT**
	1	**Heat Exchangers**: Classification of heat exchangers: recuperative, regenerative, shell and tube heat exchangers	6	3		15	
		Task 1: Assignment (individual)				1	1
	2	**Heat balance equation:** Temperature gradients for uniflow, counter flow and cross flow systems. Heat carriers	4	2		10	
	3	**Combustion:** Types of combustion chambers and performance. Speckled furnaces, zoned and non-zoned furnace models with and without recirculation	6	3		15	
		In-Class Test 1				1	1
	4	**Flame structure and stability:** Types of flame combustion in heterogeneous and homogeneous systems	4	2		10	
	5	**Burners:**	4	2		10	

	Combustion control systems.					
	In-Class Test 1				1	1
6	**Boilers**: Types, principles and operation, boiler water treatment and management, boiler efficiency	4	2		10	
	Task 2: Assignment (Group)				1	1
Final Exam					2	2
		28	**14**		**76**	**6**

Course Texts	1. Merritt, C. (2022). Process Steam Systems: A Practical Guide for Operators, Maintainers, Designers, and Educators. Wiley 2. Ganapathy, V. (2015) Steam Generators and Waste Heat Boilers for Process and Plant Engineers CRC Press Taylor & Francis Group, New York.
Supplementary Texts	1. Woodruff, E., Lammers, H. and Lammers, T. (2016), *Steam Plant Operations*, (10th Ed.). Mc-Graw-Hill Education. 2. Khurmi, R.S. and Gupta, J.K. (2012), A Texbook of Thermal Engineering, S. Chand & Co. Ltd., New Delhi
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Mass Transfer 1				
Course Code	CPE324				
Course Convener Name **Room No.** **Email**	Dr. Cyprian Murutu TBD				
Year	3				
Semester	2				
Rationale for the inclusion of the Course in the programme	Mass transfer is a core subject of chemical engineering. It equips the student to be able to operate and control various parameters related to mass transfer equipment.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		82	124
Credit Value	3				
Pre-requisite (if any)	CPE 122 – Principles of Chemical Process Calculations				
Course Objective	The objectives of this course are to enable learning about; 1. Diffusion mass transfer				

	2. Mass transfer coefficients 3. Equipment for Gas-liquid operations 4. Absorption and distillation
Synopsis	This course applies the concepts of diffusion and interphase mass transfer to the analysis of different unit operations.
Course Learning Outcomes	By the end of the course, the learner should be able to; 1. Discuss fundamental concepts of mass transfer 2. Calculate flux in a diffusion process. 3. Apply McCabe Theory plots to determine the theoretical number of plates 4. Design distillation and absorption processes using appropriate method.
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group discussions 4. Flipped learning

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK3, WK4
CO2	PO1, PO2	
CO3	PO2, PO3	
CO4	PO3, P08,	
CO5	PO3, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Diffusion.** The laws of mass transfer through diffusion. Steady state mass transfer models. Concept of mass transfer resistance.	6	3		15	
	Task 1: Assignment (individual)				1	1
2	**Mechanisms of mass transfer processes.** Coefficient of mass transfer. Fenske and Underwood equations. Molecular diffusion.	6	3		15	
	In-Class Test 1				1	1
3	**Rectification of binary systems.**	8	4		20	

	The McCabe-Thiele, Ponchon Savarit methods. Analytical determination of distillation tower plates. Efficiency of rectification column.						
	Task 2: Assignment (Group)				**1**	**1**	
	Absorption, Absorption in packed towers, co-current and counter-current absorption, ideal and non-ideal systems of absorption, minimum number of theoretical stages in absorption, effect of temperature on absorption.	8	4		20		
	In-Class Test 2				1	1	
Final Exam					2	2	
		28	**14**		**76**	**6**	

Course Texts	**Core Reading Materials** 1. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). Oxford: Butterworth-Heinemann Linacre House. 2. Mc Cabe, W.L., Smith, J.C. and Harriott, P., 2018. Unit operation of chemical engineering. McGraw-Hill. 3. Richardson, J.F., Harker, J.H. and Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2. (5th edn.). Oxford: Butterworth-Heinemann Linacre House.
Supplementary Texts	1. Warren, M. (2005). Unit operations of chemical engineering. (7th edn.). New York: McGraw Hill Chemical Engineering Series. 2. Treybal, R.E. (2004). Mass Transfer Operations. (3rd edn.). New York: McGraw Hill Chemical Engineering Series 3. Ray, A.K. ed., 2022. Coulson and Richardson's Chemical Engineering: Volume 2B: Separation Processes (Vol. 2). Elsevier.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Chemical Engineering Thermodynamics II
Course Code	CPE 327
Course Convener Name **Room No.** **Email**	TBD
Year	3

<table>
<tr><td>Semester</td><td>2</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td>Chemical Engineering Thermodynamics is one of the core thematic areas in chemical engineering that is widely exploited in chemical, food, pharmaceutical, fuels and biological processes among others. The knowledge and skills gained, such as estimation of solution properties and phase equilibria that help learners to design and operate unit operations and unit processes more effectively at an industrial scale.</td></tr>
<tr><td>Total Student Learning Time (SLT)</td><td><table>
<tr><th>Lectures</th><th>Tutorial</th><th>PBL/Design /Lab</th><th>Self-Learning Including Prep Time</th><th>Total Learning Time</th></tr>
<tr><td>28</td><td>14</td><td></td><td>82</td><td>124</td></tr>
</table></td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Pre-requisite (if any)</td><td>CPE 227- Engineering Thermodynamics, CPE 317- Chemical Engineering Thermodynamics II</td></tr>
<tr><td>Course Objective</td><td>This course aims to equip the learner with the fundamental knowledge of solution models in determining thermodynamic properties of mixtures in order to calculate low pressure phase and chemical reaction equilibria for industrial processes. Learners apply the concepts of mathematical models are applied to design and optimise unit operations and unit processes.</td></tr>
<tr><td>Synopsis</td><td>This course applies the concepts of solution model thermodynamics. Moreover, mathematical models are applied to design and unit operations and unit processes.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Distinguish systems of variable compositions
2. Determine fundamental equations that govern the estimation of solution properties
3. Apply phase equilibrium data to construct P-x-y, T-x-y diagram for ideal miscible vapour-liquid systems and non-ideal systems.
4. Appraise reacting systems by determining chemical reaction equilibrium constant and equilibrium composition</td></tr>
<tr><td>Mode of Delivery</td><td>1. Lectures
2. Tutorials
3. Flipped Classes
4. Active Based Learning</td></tr>
<tr><td>Assessment method-CO Mapping</td><td><table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>15</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>15</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Task 2: Assignment (Group)</td><td>10</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table></td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and</td><td><table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1, PO2</td><td rowspan="3">WK3, WK4</td></tr>
<tr><td>CO2</td><td>PO1, PO2</td></tr>
<tr><td>CO3</td><td>PO2, PO3</td></tr>
</table></td></tr>
</table>

Knowledge Profile	CO4	PO3, PO8					
Content Outline of the Course and the SLT per Topic	**No.**	**Topic**	**Lecture**	**Tutorial**	**Lab**	**Self-Learning**	**FE/Q/MT**
	1	**Systems of variable composition- ideal and non-ideal systems:** Open systems, chemical reaction in closed systems, Nature of equilibrium, phase rule – Duhem's theorem, VLE: qualitative behaviour.	2	1		5	
	2	**Gibbs Duhem equation:** Chemical potential and phase equilibria, partial properties, ideal –gas mixture model	2	1		5	
		Task 1: Assignment (individual)				1	1
	3	**Fugacity and fugacity coefficient for pure and mixtures:** Fugacity coefficients from generic equations of state, fugacity for pure liquid, fugacity coefficients from virial equation of state, generalised correlations for fugacity coefficient, ideal solution model, excess properties	4	2		10	
		In-Class Test 1				1	1
	4	**Activity coefficient:** Liquid phase properties from VLE data, excess Gibbs energy, data reduction, thermal consistency	4	2		10	
	5	**Low pressure phase equilibria for ideal and non-ideal systems:** Raoult's law, Henry's law, modified Raoult's	6	3		15	

	law, VLE from K-value correlations, Gamma/phi formulation of VLE, equilibrium and stability, liquid/liquid equilibrium					
6	**Properties of solutions, excess properties:** Models for excess Gibbs energy.	2	1		5	
	In-Class Test 2				1	1
7	**Property change in mixing:** Heat effects of mixing processes	2	1		5	
8	**Chemical reaction equilibria:** Application of equilibrium criteria to chemical reactions, standard Gibbs-energy change and equilibrium constant, temperature dependence and evaluation of the constant, relation of the constant to composition, equilibrium conversion for single and multiple reactions	6	3		15	
	Task 2: Assignment (Group)				1	1
Final Exam					2	2
		28	**14**		**76**	**6**

Course Texts	1. Smith, J.M., Van Ness H.C., Abbott, M.M., Swihart, M. (2021). Introduction to Chemical Engineering Thermodynamics. (9th edn.). New York: Mc Graw Hill. 2. Yan, C.Y. (2022). Introduction to Engineering Thermodynamics, USA, BCcampus
Supplementary Texts	1. Michael J. M., Howard N. S., Daisie D. B. (2011). Fundamentals of engineering thermodynamics, New York, NY: John Wiley & Sons. 2. Rogers, G.F.C., Mayhew, Y. R. (2007), Engineering Thermodynamics: Work and Heat Transfer. (4^{th} edn). Prentice Hall. 3. Stanley I Sandler (2006) Chemical, Biological, and Engineering Thermodynamics, 4^{th} Edition, John Wiley & Sons.
Other additional information:	Process Simulator, Websites, Video link, Lecture Notes etc

Course Name	Research Methods & Report Writing
Course Code	ITE327
Course Convener Name **Room No.** **Email**	Prof. Charles Nzila TBC charlesnzila@mu.ac.ke
Year	3
Semester	2
Rationale for the inclusion of the Course in the programme	This course equips students with essential skills for conducting scientific research, analyzing data, and effectively communicating findings. It fosters critical thinking, research design understanding, ethical practices, and proficient writing, crucial for academic and professional success across various fields.

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		82	124

Credit Value	3
Pre-requisite (if any)	N/A
Course Objective	The objectives of this course are to enable learning about; 1. Research concepts and methodologies 2. Research design, ethics and literature review process 3. Research measurement concepts, data collection and analysis techniques 4. Research project writing and reporting.
Synopsis	This course covers research methods, design, ethics, data analysis, and report writing, preparing students to conduct and present research effectively.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Discuss research concepts and methodologies as applied in engineering fields 2. Design ethical research engineering project from research gaps identified from literature reviews 3. Select appropriate technique and statistical tool for collecting and analyzing engineering data. 4. Develop and present an engineering project
Mode of Delivery	1. Lectures (hybrid) 2. Group activity/presentation/discussions/Case studies/Tutorials
Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4
Test 1: Quiz (Individual)	10	X			
Task 1: Assignment (project design)	10		X		
Test 2: CAT (sit-in)	10		X	X	
Task 2: Project presentation & Report	10				X
Final Examination	60	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile	

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO4, PO7	WK3, WK8
CO2	PO2, PO4	
CO3	PO4, PO5	
CO4	PO8, P09, PO10	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Research Methods Introduction**: Overview of the scientific method; Concept and process of scientific research; Qualitative research approaches; Quantitative research approaches; Importance of research in various fields;	8	4		20	
	Test 1: Quiz				1	1
2	**Research Design**: Types: experimental, correlational, observational; Strengths and limitations of designs; Design selection for research questions; Problem identification Situational analysis;	6	3		15	
	Task 1: Assignment (project design)				1	1
3	**Data Collection Methods:** Sampling methods; Surveys, interviews, observations, and experiments; Integrity in data collection; Data presentation techniques; Evaluation of collected data;	6	3		15	
	Test 2: CAT (Sit-In)				1	1
4	**Writing and Presenting Research**: Writing research project and reports;	8	4		20	

		Strategies for presenting research findings; Public speaking skills and persuasion; Report and seminar presentation; Non-verbal communication and effective speaking;					
		Task 2: Project Presentation & Report				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts	1. Thiel, D. V. (2014). Research methods for engineers. Cambridge: Cambridge University Press. 2. Dunn, P. F. (2010). Measurement and data analysis for engineering and science. New York: CRC Press. 3. Walker, R. (2011). Reliability in scientific research: Improving the dependability of measurements, calculations, equipment, and software. Cambridge: Cambridge University Press
Supplementary Texts	1. Kothari, C.R. (2009). Research Methodology: Methods and techniques. New Delhi: New Age International. 2. Jonker, J. & Pennink, B. (2009). The Essence of research methodology: A concise guide for Master and PhD students in management science. Heidelberg: Springer. 3. Yogesh, K. S. (2006). Fundamental of research methodology and statistics. New Delhi: New Age International. 4. Creswell, J. C., (2003). Research design, qualitative, quantitative and mixed methods approaches. New York, NY: Sage Publications.
Other additional information:	Websites, Video link, Lecture Notes etc.

CPE329 Process Measurements

Course Name	Chemical Engineering Practicals II
Course Code	CPE320
Course Convener Name **Room No.** **Email**	TBD
Year	3
Semester	2
Rationale for the inclusion of the Course in the programme	Laboratory experiments are important in chemical and process engineering. Laboratory experiments enable learners to develop critical thinking and practical skills. In addition, they enhance mastery of courses that have executable experiments. The experimental component of various courses offered in third year; second semester is done under chemical engineering practicals II

Total Student Learning Time (SLT)	Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
	1	13	24	43	81
Credit Value	2				
Pre-requisite (if any)	Material Science, Fluid Mechanics II, Steam Plant, Mass Transfer I, Chemical Engineering Thermodynamics II, Process Measurement and Instrumentation				

Course Objective

The objectives of this course are to enable learning about;

1. Selection of equipments and reagents required for a given experiment
2. Safe execution of laboratory experiments
3. Operation of equipments used to carry out an experiment
4. Report writing and presentation

Synopsis

The learners are expected to perform at least two executable experiments in Material Science, Fluid Mechanics II, Steam Plant, Mass Transfer I, Chemical Engineering Thermodynamics II, Process Measurement and Instrumentation, write a report and make a presentation of his/her findings to the departmental academic and technical staff panel.

Course Learning Outcomes

On completion of this course, learners will be able to:

1. Discuss the experimental set-up for distillation, absorption and electro-chemical potentials determination.
2. Determine the pressure drop and frictional losses in fluid flows, pumping duties and pumping capacities, diffusion coefficient of various substances, parameters governing heat transfer, parameters that support a flame
3. Perform heat treatments of steel, mass and energy balance in both batch and continuous distillation, mass and energy balance on an absorption process, treatment of boiler feed water, measurement of electro-chemical potential in electrodes undergoing corrosion.
4. Write a technical report on the experiments done for oral presentation

Mode of Delivery

1. Group Discussions
2. Lab sessions
3. Oral presentations
4. Demonstrations

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Group Oral Presentation	50	X	X	X	X
Final Report	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO2	WK3, WK4, WK8, WK9
CO2	PO2, PO4	
CO3	PO2, PO4	
CO4	P08	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Executable experiments in Material Science	1		3	42	

		2	Executable experiments in Fluid Mechanics II			3			
		3	CPE 323: To undertake at least two experiments to determine the: overall heat transfer coefficient for parallel flow and counter-current heat exchanger; heat transfer co-efficient for drop-wise and film-wise condensation process; the dryness of steam using steam throttling calorimeter; performance of a boiler.			6			
		4	CPE 324: Batch distillation of binary liquid mixture to study the effect of the reflux ratio on the distillate quality; Continuous distillation of binary mixture to identify the variation of distillate quality along the plates of the column.			3			
		5	CPE 327: Determine the following: Fugacity; Activity coefficient using Wilson equation; Property change of mixing – volume, enthalpy and entropy changes; Reaction equilibria – liquid phase. Gas phase (Le Chatelier principle), equilibrium constant.			6			
		6	CPE 329: Hydrostatic pressure measurement; Buoyant force measurement; Demonstration of Pascal's Law; Demonstration of pressure measurement			3			

		via different measuring instruments; Installation of pressure sensing devices; Measurement of the level of liquids and free-flowing solids; Fluid flow measurement via different techniques; Temperature measurement via different techniques; Liquid level measurement via different techniques					
		Task 1: Oral Presentation				1	
		Final Report					
			1	**13**	**24**	**43**	

Course Texts	1. Dara, S.S. (2011) A textbook on Experiments and Calculations in Engineering Chemistry, S. Chand and Co. New Delhi. 2. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). London: Butterworth-Heinemann Linacre House.
Supplementary Texts	1. Warren, M. (2005). Unit operations of chemical engineering. (7th edn.). New York: McGraw Hill Chemical Engineering Series. 2. Richardson, J.F., Harker, J.H. and Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2. (5th edn.). Oxford: Butterworth-Heinemann Linacre House. 3. Yunus S. C. (1998). Heat Transfer- A Practical Approach. New York: Mc Graw-Hill.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Industrial Attachment I
Course Code	CPE330
Course Convener Name **Room No.** **Email**	TBD
Year	3
Semester	3
Rationale for the inclusion of the Course in the programme	This course equips learners with professional work experience in an industrial environment. Learners integrate theoretical knowledge gained in the classroom with practical chemical engineering operations and allied industries. Through this course, learners undertake rigorous mentorship training under the guidance of an experienced

<table>
<tr><td></td><td>industrial supervisor/professional in a real engineering undertaking whereby they horn their technical competence and soft skills useful in any work experience. Industrial training is relevant since the students are able to show their skills and prepare for the real working environment in the near future.</td></tr>
<tr><td>Total Student Learning Time (SLT)</td><td>
<table>
<tr><th>Lectures</th><th>Tutorial</th><th>PBL/Design /Lab</th><th>Self-Learning Including Prep Time</th><th>Total Learning Time</th></tr>
<tr><td colspan="5">12 weeks</td></tr>
</table>
</td></tr>
<tr><td>Credit Value</td><td>6</td></tr>
<tr><td>Pre-requisite (if any)</td><td>CPE230, 1-Week online Safety Course</td></tr>
<tr><td>Course Objective</td><td>This course are to enable learners to: Integrate the knowledge they acquired in classroom and apply it in real work setting; appreciate work ethics and professionalism in real work environment; appreciate team work, group / organizational behaviour in a work environment, and develop an understanding of the operation of industry, based on which students can further plan their career.</td></tr>
<tr><td>Synopsis</td><td>This course is designed to enhance the undergraduate experience by providing the opportunity to engage in an industrial setting, learn new practical skills and/or research and design methodology.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Critically accomplish tasks at the workplace.
2. Describe the setting of the industry and the operation of the host company
3. Display commitment, ethics and professionalism in the industry.
4. Apply and integrate the knowledge acquired in the classroom at workplace
5. Display effective verbal and written communication and other soft skills that are required at workplace</td></tr>
<tr><td>Mode of Delivery</td><td>1. On the job training
2. Demonstrations
3. Lab sessions / plant operations
4. Special assignments by the industrial supervisor/mentor
5. Industrial supervisor/mentor consultations</td></tr>
<tr><td>Assessment method-CO Mapping</td><td>
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th><th>CO5</th></tr>
<tr><td>Task 1: University Supervisor Assessment</td><td>20</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Industrial Supervisor Assessment</td><td>20</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Task 3: Logbook Assessment</td><td>10</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Task 4: Final Written Report</td><td>40</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Task 5: Oral Presentation</td><td>10</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td rowspan="4">PO1- PO10</td><td rowspan="5">WK6</td></tr>
<tr><td>CO2</td></tr>
<tr><td>CO3</td></tr>
<tr><td>CO4</td></tr>
<tr><td></td><td></td></tr>
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</table>

Content Outline of the Course and the SLT per Topic	No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
		Pre-attachment training activities: Safety course, behaviour at work, communication and interpersonal skills etc.- 1-week prior to attachment commencement	12 weeks				
		Hands on training at the company attached under the guidance of the industrial mentor/supervisor e.g. operations, projects, troubleshooting, complex problems solving etc.					
		Keeping an updated training log book					
		Learner to contribute to the organization by joining activities and carrying out responsibilities given to them professionally.					
		University supervisor visits to discuss and review the industrial attachment with learners and mentors					
		Other professional training offered.					
		Writing a report summarising the learning during the industrial attachment (1 week after completion of attachment)					
		Giving a poster presentation on IA training (20 min) – 2nd week after semester commencement					
			12 weeks				
Course Texts	All the relevant printed material on industrial operations including machine operation manuals, quality control excerpts, any relevant core and recommended textbook, industrial project reports among other documentations						

Supplementary Texts	Daniel Alao. Everything Industrial Training
Other additional information:	Websites, Video link, Lecture Notes etc.

Year Four – Semester One

Course Name	Process Economics				
Course Code	CPE411				
Course Convener Name Room No. Email	TBD				
Year	4				
Semester	1				
Rationale for the inclusion of the Course in the programme	The course enables evaluation of various aspects of a project such as economic and profitability analysis as applied to chemical engineering processes and products. Estimation of capital investment, cost of production, depreciation, and cash flows. Discounted profitability analysis including net present value, internal rate of return and discounted payback period. Profitability decision making based on cost of capital and economic risk analysis. Chemical Engineering process optimization based on economic profitability. Students will connect economics and business principles to real chemical engineering processes, as previously learned in the core chemical engineering courses of fluid mechanics, heat and mass transfer, and separations				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		82	124
Credit Value	3				
Pre-requisite (if any)	ECO330- Economics for Engineers				
Course Objective	This course aims to equip the learner with the conceptual and methodological framework for evaluating the cost, revenue, profitability, and risk of chemical engineering processes and products.				
Synopsis	This course applies standard accounting procedures to discuss basics of process economics, principles of economic evaluation, costing of chemical process unit, evaluation of capital investment and manpower requirements.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Discuss technical concepts in economic analysis a chemical process industry 2. Estimate various costs for a chemical process unit 3. Perform an economic analysis of a chemical engineering design project 4. Value enterprise cost by evaluating capital investment and manpower requirements				

Mode of Delivery	1. Lectures 2. Tutorials 3. Active Based Learning
Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15		X	X	
CAT 2 (Sit-In Test 2)	15				X
Task 2: Assignment (Group)	10				X
Final Examination	50		X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK4
CO2	PO2	
CO3	PO2, PO5	
CO4	PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction to process economics**: capital costs, purchase cost of major plant items, cost indexes, factors influencing cost of product, process evaluation, and factored estimate method for capital cost of installed plant.	6	3		15	
2	**Total product cost:** breakdown of TPC (total product cost) into capital charges and repayment, depreciation, interest, overheads, manufacturing costs, and other contributory items. Estimation of itemized costs	4	2		10	
3	**Optimisation:** Optimisation of plant dimensions, operating conditions and the economics of alternatives. Additional costing data. Choice between plant items and complete plant on economic grounds	6	3		15	

	4	**Cumulative cash flow:** Time value of money	2	1		5	
	5	**Discounted cash flows:** Discounted cash flow calculations	6	3		15	
	6	**Plant location**: economic factors determining area and site selection, capital cost.	4	2		10	
	Final Exam and CATTs					6	6
			28	**14**		**76**	**6**

Course Texts	1. Sinnott, R.K. (2005). Coulson & Richardson, Chemical engineering, Vol. 6, (4th edn.). London: Elsevier Butterworth-Heinemann Linacre House. 2. Don, W. G. & Perry, R.H. (1999). Perry's Chemical Engineers' Handbook. (8th edn.). New York: McGraw Hill.
Supplementary Texts	1. Peters, M.S, & Timmerhaus, K.D. (1991). Plant Design and Economics for Chemical Engineers. (4th edn.). Mc Graw-New York: Hill, Inc. 2. James G. Speight. ()2005. Chemical process and design handbook. Mc Graw-New York: Hill, Inc.
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Mechanics Of Non-Newtonian Fluids				
Course Code	CPE412				
Course Convener Name **Room No.** **Email**	Samuel Sarmat Technology Building (TBD) samuelsarmat@gmail.com				
Year	4				
Semester	1				
Rationale for the inclusion of the Course in the programme	Mechanics of non-newtonial fluids is important in chemical engineering curriculum in the impartation of the knowledge and skills needed in the application of the production of fluid products in the beauty and cosmetic industries. This knowledge helps in the design of the chemical equipment used in the manufacture of these products and also in the scale up of fluid pipeline networks for transportation purposes.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	14	14		54	82
Credit Value	2				
Pre-requisite (if any)	CPE322-Fluid Mechanics II				

Course Objective	The objectives of this course are to enable learning about; 1. Characteristics of Newtonian and non-Newtonian fluids 2. Laws governing non- Newtonian fluids 3. Flow properties of non-Newtonian fluids 4. Problems in fluid flow peculiar to non-Newtonian fluid
Synopsis	The knowledge and skills obtained in the mechanics of non-newtonian fluids facilitates in the understanding of the measurement and computation of viscosities of non-newtonian fluids using viscometers and analytical techniques respectively. This knowledge also helps in the application of the characteristics & properties of non-newtonian fluids and in the design of corresponding chemical equipment. The models unique to power law and Bingham fluids are developed to display and appreciate the peculiarity of non-newtonian fluids. The theory of similarity and momentum transfer dimensionless numbers peculiar to these fluids are also used in the scale up of pipeline networks.
Course Learning Outcomes	By the end of the course, the learner should be able to; 1. Describe non-Newtonian and Newtonian fluids. 2. Analyze problems related to non-Newtonian fluids 3. Compute problems involving laminar and turbulent flow in non-Newtonian fluids 4. Design pipeline for non-Newtonian fluid
Mode of Delivery	1. Lectures 2. Tutorials 3. Group Discussions
Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK3, WK4
CO2	PO2	
CO3	PO2,	
CO4	PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Review of the characteristics of Newtonian fluids Introduction to non-Newtonian fluids	2	2		6	
2	**Task 1: Assignment (Individual)**				**1**	**1**
3	Relationship between Newtonian and non-Newtonian fluids: Power Law, Flow properties of non-Newtonian fluids,	4	4		12	

	pseudo dilatant, Bingham plastic. Visco-elasticity and its effects					
4	Pipeline design for non-Newtonian fluids	2	2		6	
5	**CAT 1 (Sit-In Test 1)**				**1**	**1**
6	Fully developed laminar flows and Pressure drop in non-Newtonian fluids	3	3		9	
7	**CAT 2 (Sit-In Test 2)**				**1**	**1**
8	Problems in flow measurement peculiar to non-Newtonian fluid	3	3		9	
9	**Group work**				**1**	**1**
Final Exam					2	2
		14	**14**		**48**	**6**

Course Texts	1. Douglas, J.F., Gasiorek, J.M. & Swaffield, J.A. (2011), Fluid Mechanics, (6th Edn.), Prentice-Hall Publishers 2. Massey, B.S. & Ward-Smith, A.J. (2012), Mechanics of Fluids, (9th Edn.), Taylor & Francis 3. Currie, I.G. (2016), Fundamental Mechanics of Fluids, (4th Edn.), CRC Press
Supplementary Texts	1. Frank, M. W. (2016) Fluid Mechanics, (8th Edn.), Mc Graw-Hill Education 2. Robert, W., Fox, A. T., McDonald, P. and Pritcard, J. (2020), Introduction to Fluid Mechanics, 10th Edition, Wiley Publishers 3. Munson, Y. and Okiishi, (2010) Fundamentals of Fluid Mechanics, Wiley Publishers 4. Edward, J., Shaughnessy, I. M., Katz, J., Schaffer, P. (2005), Introduction to Fluid Mechanics, Oxford University Press, New-York. 5. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). London: Butterworth-Heinemann Linacre House.
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Mass Transfer II
Course Code	CPE414
Course Convener Name Room No. Email	Prof. Eng. Milton M M'Arimi
Year	4
Semester	1
Rationale for the inclusion of the Course in the programme	Mass Transfer II is among the unit operation courses that are core in Chemical & Process Engineering. Through this course, knowledge and skills are gained on industrial application of; adsorption isotherms and kinetics, drying processes, humidification and

<table>
<tr><td></td><td>dehumidification, and crystallization operation. It helps learners to optimize the existing processes and design new units for commercial applications.</td></tr>
<tr><td>Total Student Learning Time (SLT)</td><td><table>
<tr><th>Lectures</th><th>Tutorial</th><th>PBL/Design /Lab</th><th>Self-Learning Including Prep Time</th><th>Total Learning Time</th></tr>
<tr><td>28</td><td>14</td><td></td><td>76</td><td>118</td></tr>
</table></td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Pre-requisite (if any)</td><td>CPE122- Principles of Chemical Process Calculations, CPE222- Principles of mass and energy balance, and CPE324-Mass Transfer I.</td></tr>
<tr><td>Course Objective</td><td>The objectives of this course are to enable learning about the concepts and principles in adsorption, crystallization, humidification, and drying. The enables application of mass transfer equations for adsorption, crystallization, humidification, and drying in solving of engineering problems. It enables building competence in the design of adsorption, crystallization and drying equipment.</td></tr>
<tr><td>Synopsis</td><td>This course applies the concepts of chemical reaction kinetics and materials balance to optimize unit operations in process engineering. Moreover, design equations are applied to size different process equipment in adsorption, drying, humidification and crystallization.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Identify equipment for undertaking adsorption, humidification, crystallization and drying operations
2. Analyse principles of adsorption, crystallization, and drying processes
3. Apply mass transfer equations to solve problems involving adsorption, crystallization, and drying.
4. Design appropriate equipment for adsorption, crystallization, and drying processes.</td></tr>
<tr><td>Mode of Delivery</td><td>Blended learning that incorporates both physical and online sessions shall be employed.</td></tr>
<tr><td>Assessment method-CO Mapping</td><td><table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>CAT 1: Sit in</td><td>15</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>CAT 2: Sit in</td><td>15</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Assignment (Group)</td><td>10</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table></td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td><table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1, PO2</td><td rowspan="4">WK4 & WK6</td></tr>
<tr><td>CO2</td><td>PO2,</td></tr>
<tr><td>CO3</td><td>PO1, PO2, PO3</td></tr>
<tr><td>CO4</td><td>PO2, PO3</td></tr>
</table></td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td><table>
<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q /MT</th></tr>
</table></td></tr>
</table>

1	**Adsorption**: Fundamentals of adsorption, Langmuir Isotherm derivation, Frendlich Isotherm, homogeneous adsorption, calculation of mass of adsorbent. Continuous adsorbents	10	5		25	
	CAT 1-Sit In				1	1
2	**Drying:** Classification of dryers. Wet and dry moisture content. Drying curves of solids. Determination of drying time for batch reactors.	6	3		15	
	Individual assignment				1	1
3	**Humidification and Dehumidification:** Terms and definitions. Psychrometric charts, application of psychrometric charts in drying.	6	3		15	
	CAT2 – Sit in				1	1
4	**Crystallization:** Industrial crystallizers, primary and secondary nucleation. Calculation of crystal yield. Fractional crystallization.	6	3		15	
	Group Assignment				1	1
Final Exam					2	2
		28	**14**		**76**	**6**

Course Texts	1. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). Oxford: Butterworth-Heinemann Linacre House. 2. Mc Cabe, W.L., Smith, J.C. and Harriott, P., 2018. Unit operation of chemical engineering. McGraw-Hill. 3. Richardson, J.F., Harker, J.H. and Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2. (5th edn.). Oxford: Butterworth-Heinemann Linacre House.
Supplementary Texts	1. Warren, M. (2005). Unit operations of chemical engineering. (7th edn.). New York: McGraw Hill Chemical Engineering Series. 2. Treybal, R.E. (2004). Mass Transfer Operations. (3rd edn.). New York: McGraw Hill Chemical Engineering Series 3. Ray, A.K. ed., 2022. Coulson and Richardson's Chemical Engineering: Volume 2B: Separation Processes (Vol. 2). Elsevier.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Introduction to Environmental Engineering
Course Code	CPE415
Course Convener Name Room No. Email	TBD
Year	4
Semester	1
Rationale for the inclusion of the Course in the programme	To be able ensure the long-term viability of societal development and the use of water, land, and air resources, this course is designed to train learners to acquire knowledge, skills and attitudes on environmental engineering.

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28		14	78	120

Credit Value	3
Pre-requisite (if any)	CPE325
Course Objective	The aim of this course is to enable learning about; Environmental policy and laws on industrial emissions in Kenya and other countries/regulatory bodies in the world; Impact of emissions from chemical process activities on the environment and communities; Principle of operation and design of air pollution control equipment; and Life cycle assessment (LCA) and environmental impact analysis.
Synopsis	This course introduces the role of environmental engineers in design of solutions to prevent future environmental damage as well as reduce and resolve existing pollution problems.
Course Learning Outcomes	At the end of this course the learner should be able to: 1. Describe the environmental regulation/policy and laws pertaining to Kenya and the global practices. 2. Evaluate the impact of emissions from chemical process activities on the environment. 3. Design appropriate air pollution control equipment such as scrubbers, filters. 4. Perform life cycle assessment (LCA) and environmental impact analysis.
Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.
Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1: Sit in	10	X	X		
Task 2: Assignment (Individual)	10			X	
CAT 2: Sit in	10			X	X
Task 3: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

<table>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
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<tr><td>CO3</td><td>PO1, PO4, PO6</td></tr>
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<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
<table>
<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/MT</th></tr>
<tr><td>1</td><td>Kenyan and international legislation; health and safety acts;</td><td>8</td><td></td><td>2</td><td>8</td><td></td></tr>
<tr><td></td><td>Individual Assignment</td><td></td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td>2</td><td>Mechanisms of air pollution; environmental effect of air pollution; natural, industrial, global and health related issues.</td><td>8</td><td></td><td>2</td><td>8</td><td></td></tr>
<tr><td></td><td>CAT 1 – Sit in</td><td></td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td>3</td><td>Greenhouse effect; principles of operation of air pollution control equipment;</td><td>8</td><td></td><td>6</td><td>10</td><td></td></tr>
<tr><td></td><td>Individual Assignment</td><td></td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td>4</td><td>Zero pollution concept.</td><td>4</td><td></td><td>4</td><td>8</td><td></td></tr>
<tr><td></td><td>CAT 2 – Sit in</td><td></td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td></td><td>Group assignment</td><td></td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td colspan="4">Final Exam</td><td></td><td>2</td><td>2</td></tr>
<tr><td></td><td></td><td>28</td><td></td><td>14</td><td>71</td><td>7</td></tr>
</table>
</td></tr>
<tr><td>Course Texts</td><td>1. L. W. Canter. 1997. 2nd Ed., Environmental Impact Assessment, McGraw-Gilbert, M. M. (2008). Introduction to environmental engineering and science. (3rd edn.). New Delhi: Prentice Hall.
2. Gerard, K. (1997). Environmental Engineering. New York: McGraw-Hill</td></tr>
<tr><td>Supplementary Texts</td><td>1. Martin, B. & Hocking, M.B. (2005) Handbook of Chemical Technology and Pollution Control. (3rd edn.). London: Elsevier Inc.
2. Parker, G. (2016). Environmental Engineering: Fundamentals and Applications. USA: CRC Press.
3. Spellman, F.R. (2015). Handbook of Environmental Engineering. USA: CRC Press.
4. Wang, K.L., Pereira, N. C. & Yung Tse, H. (2005). Advanced Air and Noise Pollution Control. New Jersey: Humana Press Inc.
5. Laws of Kenya. (1999). Environmental Management and Co-Ordination Act Chapter 387. Revised Edition 2012. Published by the National Council for Law Reporting.
6. Laws of Kenya. (2007). The Occupational Safety and Health Act, 2007. Published by the National Council for Law Reporting.</td></tr>
<tr><td>Other additional information:</td><td>Websites, Video link, Lecture Notes, EIA Legislative guidelines, etc</td></tr>
</table>

Course Name	Reactor Engineering I

Course Code	CPE416				
Course Convener **Name** **Room No.** **Email**	Samuel Sarmat Technology Building (TBD) samuelsarmat@gmail.com				
Year	4				
Semester	1				
Rationale for the inclusion of the Course in the programme	Reactor Engineering, I is one of the core thematic areas in chemical engineering. That is widely exploited in chemical, food, pharmaceutical, fuels and biological processes among others. The knowledge and skills gained, such as reactor kinetics and design equations helps learners to design reactors and conduct reactions more effectively at an industrial scale. The enzymatic kinetic model can be used to design an artificial kidney.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		82	124
Credit Value	3				
Pre-requisite (if any)	CPE222- Principles of mass and energy balance.				
Course Objective	This course aims to equip the learner with the fundamental knowledge on principles of elementary chemical kinetics for various reactions and aspects of reactor system design. Learners apply the concepts of mathematical models and design equations to design and optimise reactor systems.				
Synopsis	This course applies the concepts of chemical reaction kinetics, materials and energy balance to the analysis of chemical reacting systems. Moreover, mathematical models and design equations are applied to design different chemical reactor systems.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Discuss the principles of chemical process kinetics 2. Perform material and energy balances in a chemical reactor 3. Apply mathematical models to evaluate reactor performance 4. Design various types of chemical reactors				
Mode of Delivery	1. Lectures 2. Tutorials 3. Group discussions				
Assessment method-CO Mapping	(see table below)				

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1: Sit in	15	X	X		
CAT 2: Sit in	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO2	WK4, WK5, WK6
CO2	PO2, PO3	
CO3	PO2, PO3	
CO4	PO3, PO4	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Chemical Kinetics:** elementary reactions. Orders of reactions, rate laws and their determination. Reaction constants. Reaction mechanisms, steady state approximations. Complex and reversible reactions.	4	2		10	
2	Classification of chemical reactors. modes of operation.	2	1		5	
3	**Task 1**				1	1
4	Mathematical models and design equations for chemical reactors: Ideal flow chemical reactors; Ideal reactor performance.	6	3		15	
5	Mathematical models and design equations for chemical: Non ideal reactors. Batch, semi-batch, and continuous reactors.	6	3		15	
6	**Task 2**				1	1
7	Reactor systems: Multiple reactors and cascade reactors. Isothermal operations..	6	3		15	
8	Yield and selectivity: Series and mixed reactors	4	2		12	
9	**Group work**				1	1
Final Exam					2	2
		28	**14**		**77**	**5**

Course Texts

1. Froment, G.F., DeWilde, J. and Bischoff, K.B. (2011). Chemical reactor analysis and design, (2nd ed)., USA, Wiley and Sons.
2. Scott Fogler, H.S. (2005), Elements of chemical reaction engineering, (4th ed.), Prentice Hall.

Supplementary Texts	1. Davis, M.E. and Davis, R.J. (2003). Fundamentals of chemical reaction engineering, (1st Ed.), USA, McGraw Hill Inc. 2. Levenspiel, O. (1999). Chemical reaction engineering, (3rd ed.), USA, John Wiley & Sons.
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Chemical Engineering Design I				
Course Code	CPE418				
Course Convener Name Room No. Email	TBD				
Year	4				
Semester	1				
Rationale for the inclusion of the Course in the programme	Chemical Engineering Design is an essential component of curriculum as it equips learners with competence in material processing. Proper development of the products and processing of substances into different states requires design knowledge. This course therefore, enables learners to develop a process design of chemical processing plant which includes reaction engineering, separations, and issues around safety, ethics and environment. Learners also use simulation package for flowsheet preparation and design.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial/ Consultation**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	14	14	42	54	124
Credit Value	3				
Pre-requisite (if any)	CPE 318				
Course Objective	The objectives of this course are to enable learning about; Block diagrams, flowsheet symbols, and process flowsheets; Detailed mass and energy balance procedures for a complete process; Detailed process engineering design of major equipment and Engineering report writing.				
Synopsis	This course allows students to equip learners with elementary design principles for a chemical plant and to appreciate the relationship between various courses in the syllabus.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Develop block diagrams and process flowsheets using engineering symbols 2. Carry out mass and energy balance for steady state systems including recycle, multiple units, chemical reactions for the entire process plant. 3. Perform capstone design of various equipment used in chemical process plant. 4. Present the project results and evaluation through both oral presentation and report.				
Mode of Delivery	1. Blended learning 2. Project based learning 3. Case studies 4. Consultations 5. Technical seminar				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in (individual)	10	X	X		
Task 1: Group Assignment/Project	40	X	X	X	X
CAT 2: Sit in (Individual)	10			X	X
Final Examination	40	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO3	WK3, WK4, WK5, WK6
CO2	PO3, PO5	
CO3	PO1, PO2, PO5	
CO4	PO8, PO9, PO10	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial /Consultation	Lab/ PBL	Self-Learning	FE/Q/ MT
1	General scope of design: block diagrams flowsheets symbols, process flowsheets, engineering flowsheets, piping instrumentation diagram (PID), mechanical flow diagrams and utility flowsheets, Design of a complete process flowsheet.	14	14	42	42	
2	Principles of scale up and the use of pilot scale data.					
3	Detailed Mass and energy balance procedures for a complete process.					
4	Detailed process engineering design for a major equipment such as fluid transportation equipment and storage vessels, heat exchangers, reactors, distillation and absorption/adsorption columns.					
5	Detailed mechanical drawing outlining detailed operating procedures, safety and emergency procedures.					

	Final Exam				6	2
		14	**14**	**42**	**48**	**6**

Course Texts	1. Ghasem, N. & Henda, R. (2014). Principles of Chemical Engineering Processes: Material and Energy Balances. USA: CRC Press. 2. Sinnott, R.K. (2005). Coulson & Richardson, Chemical engineering, Vol. 6, (4th edn.). London: Elsevier Butterworth-Heinemann Linacre House.
Supplementary Texts	1. Don, W. G. & Perry, R.H. (1999). Perry's Chemical Engineers' Handbook. (8th edn.). New York: McGraw Hill. 2. Richardson, J.F., Harker, J.H. & Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2, (5th edn.). London: Butterworth-Heinemann Linacre House.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Process Modelling and Simulation				
Course Code	CPE419				
Course Convener Name Room No. Email	TBD				
Year	4				
Semester	1				
Rationale for the inclusion of the Course in the programme	Process Modelling and Simulation is one of the core thematic areas in chemical engineering that is widely exploited in all process industries. The knowledge and skills gained help learners to undertake flow sheet process simulation.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	6	12	74	120
Credit Value	3				
Pre-requisite (if any)	COE 120: Object Oriented Programming, MAT 206: Numerical Methods, CPE 221: Physical Chemistry, CPE 313: Heat Transfer, CPE 322: Fluid Mechanics II, CPE 324: Mass Transfer I, CPE 327: Chemical Engineering Thermodynamics II				
Course Objective	The aim of the course is to: 1. Steer the students to develop process models that can be used for design, control and optimization 2. Cause them to solve the mathematical models using object oriented programming 3. Make them apply model training, testing and validation techniques 4. Inoculate teamwork skills by using flow sheet simulation software to solve process problems.				
Synopsis	This course applies the concepts of process modelling techniques in addition of using a process flow sheet simulation application. Moreover, mathematical models are applied in the design and operation of unit operations and unit processes.				

Course Learning Outcomes	On completion of this course, learners will be able to: 1. Explain the systematic approach to model building for design, control and optimization. 2. Develop a computer program for application of model 3. Employ model training, testing and validation techniques 4. Use computer-aided analyses of large-scale chemical processes
Mode of Delivery	1. Lectures 2. Tutorials 3. Laboratory

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Continuous Assessment Tests and Tasks (CATTs)	60	X	X	X	X
Final Examination	40	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK2, WK4
CO2	PO1, PO2	
CO3	PO2, PO3, PO5	
CO4	PO2, PO3, PO5	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Classes of models, model of a typical system:** Types of models	4	2		10	
2	**Strategy for model development, procedure for model building:** Methodology in model development	4	2		10	
3	**Physico-chemical models:** Developing mathematical models for unit operations and unit processes	4	2		10	
4	**Numerical solution techniques for algebraic equations,**	6	0	2	14	

		polynomials, ODE and PDE: Root determination and digital integration					
	5	**Numerical simulation of a process system using programming language:** Write program computer using object oriented programming language	6	0	2	14	
	6	**Model training, testing and validation:** Use appropriate techniques	2	0	4	8	
	7	**Review of computational simulation applications:** Use a flow sheet simulation package	2	0	4	8	
	Final Exam					0	6
			28	**6**	**12**	**74**	**6**

Course Texts	1. Turton, R., Shaeiwit, J., Bhattachar, D., Whiting, W. (2018) Analysis, Synthesis, and Design of Chemical Processes (5th Ed.), Prentice Hall 2. Amiya, J.K. (2011) Chemical Process Modelling and Computer Simulation, (2nd Ed.) Prentice-Hall of India Private Ltd, New Delhi. 3. Amiya, J.K. (2009) Process Simulation and Control using Aspen. Prentice-Hall of India Private Ltd, New Delhi.
Supplementary Texts	1. Gaikwad, R.W. and Dhirendra, (2003) Process Modelling& Simulation, Central Techno Publications, Nagpur. 2. Michael, B. Cutlip, M. S. (2000) Problem Solving in Chemical Engineering with Numerical Methods, Prentice Hall PTR, London. 3. Steven, C. Chapra, Raymond P. Canale, (1998) Numerical Methods for Engineers 3rd Ed., McGraw-Hill, Boston. 4. Aspentech, (2001) Aspen Physical property methods and models 5. Aspen Plus (v8.4) simulation software 6. Hanyak, M.E, Chemical Process Simulation and the Aspen HYSYS v8.3 Software
Other additional information:	Process Simulator, Websites, Video link, Lecture Notes etc

Course Name	Chemical Engineering Practicals III
Course Code	CPE410
Course Convener Name Room No.	TBD

Email	
Year	4
Semester	1
Rationale for the inclusion of the Course in the programme	Laboratory experiments are important in chemical and process engineering. Laboratory experiments enable learners to develop critical thinking and practical skills. In addition, they enhance mastery of courses that have executable experiments. The experimental component of various courses offered in fourth year; first semester is done under chemical engineering practicals III

Total Student Learning Time (SLT)

Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
1	13	24	43	81

Credit Value	2
Pre-requisite (if any)	Mechanics of Non-Newtonian Fluids, Mass Transfer II, Reactor Engineering I
Course Objective	The objectives of this course are to enable learning about; 1. Adsorption isotherms, absorption, crystallization, drying 2. Factors affecting crystallization 3. Factors affecting drying 4. Rate constant and orders of various reacting systems
Synopsis	The learners are expected to perform at least two executable experiments in Mechanics of Non-Newtonian Fluids, Mass Transfer II and Reactor Engineering I, write a report and make a presentation of his/her findings to the departmental academic and technical staff panel.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Describe principles of absorption, crystallization and drying. 2. Analyze experimental data collected. 3. Apply experimental results to infer process performance. 4. Write a technical report on the experiments done for oral presentation
Mode of Delivery	1. Group Discussions 2. Lab sessions 3. Oral presentations 4. Demonstrations

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Oral Presentation	50	X	X	X	X
Final Report	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO2	WK3, WK4, WK8, WK9
CO2	PO2, PO4	
CO3	PO2, PO4	
CO4	P08	

Content Outline of the Course

No.	Topic	Lecture	Consultations	Lab	Self-Learning	FE/Q/MT

and the SLT per Topic	1	Executable experiments in Mechanics of Non-Newtonian Fluids					
	2	CPE 414: Determination of adsorption capacity of an adsorbent; Determination of Langmuir and Freundlich constants; Desorption studies; Determination of the suitability for application of Langmuir and Freundlich Isotherms; Breakthrough curves analysis; Drawing of solubility curves for given compounds; Determination of effect of temperature on solubility of selected compounds; Determination of the effect of impurity on the solubility of selected compounds; Determination of drying time for a batch compound	1	13	24	42	
	3	Executable experiments in Reactor Engineering I					
		Task 1: Oral Presentation				1	
		Final Report					
			1	**13**	**24**	**43**	

Course Texts	1. Dara, S.S. (2011) A textbook on Experiments and Calculations in Engineering Chemistry, S. Chand and Co. New Delhi. 2. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). London: Butterworth-Heinemann Linacre House. 3. Yunus S. C. (1998). Heat Transfer- A Practical Approach. New York: Mc Graw-Hill.
Supplementary Texts	1. Warren, M. (2005). Unit operations of chemical engineering. (7th edn.). New York: McGraw Hill Chemical Engineering Series. 2. Richardson, J.F., Harker, J.H. and Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2. (5th edn.). Oxford: Butterworth-Heinemann Linacre House.

Other additional information:	Websites, Video link, Lecture Notes etc.

Year Four – Second Semester

Course Name	Introduction to Biochemical Engineering				
Course Code	CPE422				
Course Convener Name Room No. Email	Prof. Eng. Milton M M'Arimi				
Year	4				
Semester	2				
Rationale for the inclusion of the Course in the programme	Bioprocess engineering is one of the emerging areas in chemical manufacturing sector. Through this course, knowledge, professional competences and skills in bioengineering are gained. It exposes the learners to fundamental knowledge in production of bio products.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		82	124
Credit Value	3				
Pre-requisite (if any)	TEC 112- Chemistry for Engineers, CHE 212-Organic Chemistry				
Course Objective	The objectives of this course are to enable learning about introduction to microbes used in microbiology, Microbial growth curve, microbial nutrients, measuring microbial growth, conditions necessary for growth curves, composition of carbohydrates and proteins, DNA & RNA, enzymes classification, primary and secondary metabolism, glycolysis, types of bioreactors and fermentation modes. The course enables computation of the kinetics of microbial growth, bioproduct formation and substrate consumption in bioprocesses. It builds the understanding of production processes for various commercial products using biochemical techniques.				
Synopsis	This course gives the fundamentals of bioprocess engineering. It is a link between basic sciences including biology, chemistry, mathematics, physics and biochemical engineering.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Compare the structure, classification of carbohydrates, proteins, DNA and RNA 2. Identify enzymes required for glycolysis process 3. Evaluate the microbial growth, substrate consumption and product formation using microbial kinetics 4. Select modes of fermentation for various bioprocess applications.				
Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.				

Assessment method-CO Mapping	see table below

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in	15	X	X		
Task 1: Assignment (Individual)	10		X		
CAT 2: Sit in	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK3
CO2	PO1	
CO3	PO3	
CO4	PO2, PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Bioengineering microbes**: occurrence and application in bioengineering, classifications, aukaryotes and prokaryotes, growth curve, factors of growth, measuring of growth rate, Monod Model.	6	3		15	
	CAT 1 – sit in				1	1
2	**Structures for biochemical basic compounds:** Mono, di and polysaccharides, Aldoses, ketoses, cellulose, starch, α & β conformations, Fisher, Haworth and chair conformations, proteins, DNA, RNA.	8	4		20	
	Individual Assignment				1	1
3	**Enzymes and Metabolism:** Classification of enzymes, Michael Mentens model, glycolysis cycle, enzymes in glycolysis cycle	6	3		15	
	CAT 2-Sit in				1	1
4	**Fermentation modes and growth kinetics:**	8	4		20	

		Batch, fed-batch, continuous fermentations, types of continuous fermentation modes, Derivation of generation equation for mass balance in a bioreactor and its application to derive equations for batch, fed-batch and chemostat. Application of microbial kinetics to determine substrate consumption, biomass formation, product formation and secondary substrate requirement for a fermentation.					
		Group Assignment				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts	1. Franco, R. (2022). Fermentation and Biochemical Engineering, USA, Kaufman Press Exclusive 2. Katoh, S., Horiuchi, J. and Yoshida, F. (2015). Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists, USA, Wiley-VCH
Supplementary Texts	1. Froment, G.F., DeWilde, J. and Bischoff, K.B. (2011). Chemical reactor analysis and design, (2nd ed)., USA, Wiley and Sons 2. Rao, D.G. (2010). Introduction to biochemical engineering, (2nd ed.). Tata McGraw Hill Education Private Limited. 3. Scott Fogler, H.S. (2005), Elements of chemical reaction engineering, (4th ed.), Prentice Hall.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Non-Fossil Energy Technologies
Course Code	CPE423
Course Convener Name Room No. Email	TBD
Year	4
Semester	2
Rationale for the inclusion of the Course in the programme	Non fossil energy technologies focuses on renewable and non-renewable energy sources (as relating to wind, solar, nuclear and biomass energy)

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	14	14		54	82

Credit Value	2
Pre-requisite (if any)	None
Course Objective	This course aims to equip the learner with the fundamental knowledge on non-fossil energy technologies
Synopsis	This course equips learner with knowledge and trends in non-fossil energy technologies
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Define the basic concept of non-fossil energies 2. Compare renewable energy development trends and policies 3. Appraise various renewable and non-renewable energy sources 4. Plan appropriate renewable energy system energy efficiency and environmental sustainability
Mode of Delivery	1. Lectures 2. Tutorials

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1: Sit in	15	X	X		
CAT 2: Sit in	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK4
CO2	PO2	
CO3	PO2,	
CO4	PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction to renewable and non-renewable energy sources:** (as relating to wind, solar, nuclear and biomass energy).	3	3		9	
2	**Biofuels:** power alcohol, biodiesel by etherification process, biodiesel by	3	3		9	

		hydrogenation process (supercetane)					
	3	**Biogas.** Biomass: agricultural waste, wood and charcoal. Wood pyrolysis and distillation	3	3		9	
	4	Trends in biomass energy development	2	2		6	
	5	Synthetic chemical fuels.	2	2		6	
	6	**Hydrogen fuel**:	1	1		3	
	Final Exam and CATTs					6	6
			14	**14**		**48**	**6**
Course Texts	Dan Meachen Rau, Alternative energy: Beyond Fossil Fuels						
Supplementary Texts	Gerald McNerney, Clean Energy Nation: Freeing America from the Tyrany of Fossil Fuels						
Other additional information:	Websites, Video link, Lecture Notes etc						

Course Name	Mass Transfer III				
Course Code	CPE424				
Course Convener Name Room No. Email	Prof. Eng. Milton M M'Arimi				
Year	4				
Semester	2				
Rationale for the inclusion of the Course in the programme	Mass Transfer III is among the unit operation courses that are core in Chemical & Process Engineering. Through this course, knowledge and skills are gained on industrial application of; solid-liquid extraction, liquid-liquid extraction, absorption, stripping and evaporation unit operations. It helps learners to optimize the existing processes and design new units for commercial applications.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		76	118
Credit Value	3				
Pre-requisite (if any)	CPE414- Mass Transfer II.				
Course Objective	The objectives of this course are to enable learning about the concepts and principles in leaching, absorption, desorption, liquid extraction and their applications in manufacturing processes. The builds competence in application of principles of leaching, liquid-liquid extraction, absorption, evaporation in optimization of existing processes and in design of new processes and units.				

Synopsis	This course applies the concepts of transport phenomena to optimize unit operations in process engineering. Moreover, design equations are applied to size different process equipment in liquid-liquid extraction, solid-liquid extraction.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Select equipment for application in evaporation, extraction and absorption 2. Analyze problems in evaporation, absorption and extraction 3. Apply theoretical principles to evaluate process performance in absorption, extraction and evaporation. 4. Design of evaporators, absorbers and extractors
Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in	15	X	X	X	X
Task 1: Assignment (Individual)	10		X	X	
CAT 2: Sit in	15	X	X	X	X
Task 2: Assignment (Group)	10			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK4 & WK6
CO2	PO2,	
CO3	PO1, PO2, PO3	
CO4	PO2, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Liquid-Liquid extraction**: Introduction to extraction, Ternary diagrams interpretation, phase rule, application of ternary diagrams, countercurrent extraction, Extraction with immiscible solvents, equipment for liquid-liquid extraction	10	5		25	
	CAT 1 – Sit in				1	1
2	**Solid-Liquid extraction:** Introduction to leaching, derivation of Kremser equation, application of Kremser equation in countercurrent leaching.	6	3		15	
	Individual assignment				1	1
3	**Evaporators:** Commercial evaporator	6	3		15	

		types and applications, single effect evaporators' economy and capacity calculation, Multi-effect evaporators types, economy and capacity calculation for multi-effect evaporators.					
		CAT 2- Sit in				1	1
	4	**Absorption:** Principles and industrial equipment for absorption, Mccabe Thiele, and Kremser equation application, Minimum solvent principle. HTU and NTU	6	3		15	
		Group assignment				1	1
		Final Exam				2	2
			28	**14**		**76**	**6**
Course Texts	1. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). Oxford: Butterworth-Heinemann Linacre House. 2. Mc Cabe, W.L., Smith, J.C. and Harriott, P., 2018. Unit operation of chemical engineering. McGraw-Hill. 3. Richardson, J.F., Harker, J.H. and Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2. (5th edn.). Oxford: Butterworth-Heinemann Linacre House.						
Supplementary Texts	1. Warren, M. (2005). Unit operations of chemical engineering. (7th edn.). New York: McGraw Hill Chemical Engineering Series. 2. Treybal, R.E. (2004). Mass Transfer Operations. (3rd edn.). New York: McGraw Hill Chemical Engineering Series 3. Ray, A.K. ed., 2022. Coulson and Richardson's Chemical Engineering: Volume 2B: Separation Processes (Vol. 2). Elsevier.						
Other additional information:	Websites, Video link, Lecture Notes etc						

Course Name	Industrial Pollution Control
Course Code	CPE425
Course Convener Name **Room No.** **Email**	TBD
Year	4
Semester	2

<table>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">Chemical and process engineers are involved in the conversion of raw materials into products and by products during their day-to-day operations. These operations produce wastes which are harmful to the environment. This course enables the learner to acquire knowledge and skills on how to manage land and water pollution.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>82</td><td>124</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">CPE 415: Introduction to Environmental Engineering</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objectives of this course are to enable learning about; Legislation and standard for discharge of physical, chemical and biological pollutants in Kenya and other countries; characterization of wastewater and pollution load estimation; wastewater treatment strategies: principles and design of process equipment; processes for wastewater and sludge management</td></tr>
<tr><td>Synopsis</td><td colspan="5">This course applies the concepts of environmental engineering in industrial wastewater pollution control. The course covers various Kenyan and International legislation and standards for discharge of chemical and biological pollutants, biological oxygen demand (BOD) and chemical oxygen demand (COD) concept in pollution load estimation and characterization of liquid and solid wastes. In addition, the course covers an introduction to life cycle assessment (LCA) and impact analysis.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Describe the legislation and standards for discharge of physical, chemical and biological pollutants in Kenya and global practices.
2. Characterize wastewater and estimate pollution load using BOD/COD concepts.
3. Apply design equations to size equipment for water treatment and sludge management
4. Select appropriate process for various wastewater treatment.</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. Lectures (hybrid)
2. Tutorials
3. Presentations</td></tr>
<tr><td>Assessment method-CO Mapping</td><td colspan="5">
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>15</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>15</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Assignment (Group)</td><td>10</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td colspan="5">
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1</td><td rowspan="4">WK4, WK5</td></tr>
<tr><td>CO2</td><td>PO1, PO3</td></tr>
<tr><td>CO3</td><td>PO1, PO3</td></tr>
<tr><td>CO4</td><td>PO6</td></tr>
</table>
</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td colspan="5">
<table>
<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/MT</th></tr>
</table>
</td></tr>
</table>

	1	Legislation and standard for discharge of chemical and biological pollutants	4	2		10	
	2	BOD/COD concept in pollution load estimation	4	2		10	
		Task 1: Assignment				1	1
	3	Characterization of liquid and solid wastes	6	3		15	
		In-Class Test 1				1	1
	4	Biodegradation systems; heavy metals removal; incineration	6	3		15	
	5	Introduction to life cycle assessment (LCA)	4	2		10	
		In-Class Test 2				1	1
	6	Impact analysis	4	2		10	
		Task 2: Group activity/ presentation)				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts	1. Parker, G. (2016). Environmental Engineering: Fundamentals and Applications. USA: CRC Press. 2. Spellman, F.R. (2015). Handbook of Environmental Engineering. USA: CRC Press. 3. Gerard, K. (1997). Environmental Engineering. New York: McGraw-Hill
Supplementary Texts	1. Gilbert, M. M. (2008). Introduction to environmental engineering and science. (3rd edn.). New Delhi: Prentice Hall. 2. Martin, B. & Hocking, M.B. (2005) Handbook of Chemical Technology and Pollution Control. (3rd edn.). London: Elsevier Inc. 3. Laws of Kenya. (1999). Environmental Management and Co-Ordination Act Chapter 387. Revised Edition 2012. Published by the National Council for Law Reporting. 4. Laws of Kenya. (2007). The Occupational Safety and Health Act, 2007. Published by the National Council for Law Reporting.
Other additional information:	Websites, Video link, Lecture Notes

Course Name	Reactor Engineering II
Course Code	CPE426
Course Convener Name **Room No.** **Email**	Samuel Sarmat Technology Building (TBD) samuelsarmat@gmail.com
Year	4
Semester	2

Rationale for the inclusion of the Course in the programme	Reactor Engineering II is one of the core thematic areas in chemical engineering that is widely exploited in chemical, food, pharmaceutical, solid fuel & ore roasting and biological processes among others. The knowledge and skills acquired in the areas of heterogeneous reaction systems & their kinetics, RTD analysis and models of non-ideal reactors are of vital application in real industrial reactors as used in the real world.

Total Student Learning Time (SLT)

Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
28	14		80	122

Credit Value	3
Pre-requisite (if any)	CPE 416- Reactor Engineering I
Course Objective	The objectives of this course are to enable learning about; 1. Multiple reactors and cascade reactors 2. Models of ideal and non-ideal reactors 3. Catalyzed processes in chemical reactors 4. Kinetics of catalytic reactors
Synopsis	Reactor Engineering II applies the concepts of multiple reaction systems to optimize reactor performance in terms of the choice of reactor configuration and reaction conditions. Heterogeneous chemical reaction kinetics gives the knowledge of the rate-controlling step in a series of competing processes using the concept of linearization. Models of non-ideal reactors and RTD analysis becomes handy in the design of real reactors as opposed to ideal reactors studied in reactor engineering I. Shrinking core mathematical models are used in the application of the roasting of solid fuels, dissolving of pills in the stomach of a patient and roasting of mineral ores.
Course Learning Outcomes	By the end of the course, the learner should be able to; 1. Describe terms and principles in chemical reactor kinetics 2. Calculate yield, selectivity, residence time in reactors 3. Apply reaction kinetics to design reactors. 4. Size reactors using residence time distribution
Mode of Delivery	1. Lectures 2. Tutorials 3. Group discussions

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15		X	X	
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK3, WK4, WK5
CO2	PO2	
CO3	PO2	
CO4	PO3	

Content Outline of the Course

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT

and the SLT per Topic	1	Multiple reactors and cascade reactors	4	2		10	
	2	Isothermal operations. Yield and selectivity on series and mixed reactors	2	1		5	
		CAT 1				**1**	**1**
	3	Models of ideal and nonideal reactors. Residence time distribution in reactors.	6	3		15	
	4						
	5	Elementary and complex catalysis. Metal and metal oxide catalysis. Kinetic treatment in catalysis.	4	2		10	
	6	**CAT 2**				**1**	**1**
	7	Catalyzed processes in chemical reactors: heterogeneous catalysis, external transport effects, reaction within porous catalysts.	8	4		20	
	8	Kinetics of catalytic reactors. Fixed bed reactors. Fluidized-bed reactors.	4	2		10	
	9	**Group work**				**1**	**1**
	Final Exam					2	2
			28	**14**		**75**	**5**

Course Texts	**Core Reading Materials** 1. Froment, G.F., DeWilde, J. and Bischoff, K.B. (2011). Chemical reactor analysis and design, (2nd ed)., USA, Wiley and Sons. 2. Scott Fogler, H.S. (2005), Elements of chemical reaction engineering, (4th ed.), Prentice Hall.
Supplementary Texts	1. Davis, M.E. and Davis, R.J. (2003). Fundamentals of chemical reaction engineering, (1st Ed.), USA, McGraw Hill Inc. 2. Levenspiel, O. (1999). Chemical reaction engineering, (3rd ed.), USA, John Wiley & Sons

Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Chemical Engineering Design II				
Course Code	CPE428				
Course Convener Name **Room No.** **Email**	TBD				
Year	4				
Semester	2				
Rationale for the inclusion of the Course in the programme	Chemical and process engineers are involved in the design of process steps and equipments required to convert raw materials into products and by products. In addition, the chemical and process engineer is required to select and size equipments as well as costing of the entire plant. This course enables the learner to perform these functions.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial/ Consultation**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	14	14	42	54	124
Credit Value	3				
Pre-requisite (if any)	CPE418				
Course Objective	The objectives of this course are to enable learning about; piping and instrumentation diagrams, process equipment selection and sizing, HAZOP/HAZAN analysis and project cost analysis.				
Synopsis	This course covers chemical plant diagrams such as block flow diagrams (BFDs), process flow diagrams (PFDs) and piping and instrumentation diagrams (P&IDs), process equipment selection and sizing, materials selection, costing, plant layout and utilities required. In addition, the use of flowsheet simulation (e.g., Aspen Plus, ChemCAD, ProSim, etc) is also covered in this course.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Draw process and instrumentation diagrams (PID) 2. Calculate the size and cost of major equipment used in chemical process 3. Apply economic principles to determine the cost of setting up and running a plant 4. Perform risk assessment, HAZOP/HAZAN analysis				
Mode of Delivery	1. Blended learning 2. Project based learning 3. Case studies 4. Consultations 5. Technical seminar				
Assessment method-CO Mapping	(see table below)				

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in (individual)	10	X	X		
Task 1: Group Assignment/Project	40	X	X	X	X
CAT 2: Sit in (Individual)	10			X	X

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<tr><td></td><td>

Final Examination	40	X	X	X	X

</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>

Course Learning Outcome	**Programme Learning Outcome**	**Knowledge Profile**
CO1	PO1, PO2	WK3, WK4, WK5, WK6
CO2	PO2, PO3	
CO3	PO5, PO8	
CO4	PO9, P010	

</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td>

No.	**Topic**	**Lecture**	**Tutorial /Consultation**	**Lab/ PBL**	**Self-Learning**	**FE/Q/ MT**
1	Chemical Plant Diagrams using CAD: Block Flow Diagrams (BFDs), Process Flow Diagrams (PFDs), Piping and Instrumentation Diagrams (P&IDs)	14	14	42	42	
2	Plot Plans, Elevation Diagrams, Piping Isometrics, Vessel Sketches, Logic Ladder Diagrams, Wiring Diagrams, Site Plans, Structural Support Diagrams, 3–D Plant Modeling.					
3	Process equipment selection and sizing, materials selection, plant layout, utilities required, plant operability					
4	HAZOP/HAZAN, project cost analysis					
5	Use of a flowsheet simulation (e.g., Aspen Plus, ChemCAD, ProSim, etc) in a selected chemical engineering process					
	Final Exam/CATTs				6	6
		14	**14**	**42**	**48**	**6**

</td></tr>
<tr><td>Course Texts</td><td>1. Ghasem, N. & Henda, R. (2014). Principles of Chemical Engineering Processes: Material and Energy Balances. USA: CRC Press.</td></tr>
</table>

	2. Sinnott, R.K. (2005). Coulson & Richardson, Chemical engineering, Vol. 6, (4th edn.). London: Elsevier Butterworth-Heinemann Linacre House.
Supplementary Texts	1. Don, W. G. & Perry, R.H. (1999). Perry's Chemical Engineers' Handbook. (8th edn.). New York: McGraw Hill. 2. Richardson, J.F., Harker, J.H. & Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2, (5th edn.). London: Butterworth-Heinemann Linacre House.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Process Dynamics and Control				
Course Code	CPE 429				
Course Convener Name **Room No.** **Email**	Mr Daudi Masinde TBD maasdaudi@yahoo.com				
Year	4				
Semester	2				
Rationale for the inclusion of the Course in the programme	In an industrial setting there is a need to maintain a process at the desired operating conditions, safely and efficiently, whilst satisfying environmental and product quality requirements. This is achieved via control systems, which can handle changes in a process. Therefore, it is important to understand the process dynamics when a control system is designed.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120
Credit Value	3				
Pre-requisite (if any)	CPE419				
Course Objective	To familiarize the students with the basics of dynamic system theory and practices and to equip them with the tools necessary for control system design and analysis.				
Synopsis	Discuss fundamental concepts in process dynamics and system loop characteristics and apply this to the control of various process system variables e.g. level, flow, temperature etc.				
Course Learning Outcomes	At the conclusion of this course the student should be able to: 1. Describe the basic features and behaviour of a dynamic process 2. Define the fundamentals of open loop systems 3. Identify and design a feedback control system for a particular process 4. Define the fundamentals of a closed loop system and determine the performance of a process control system				
Mode of Delivery	1. Lectures 2. Tutorials 3. Group Discussions 4. Demonstrations (Software-MATLAB)				

Assessment method-CO Mapping	see table below

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: (Sit-In Test 1)	15	X			
Task 1: Case Study 1 (Individual)	10	X	X		
CAT 2 (Sit-In Test 2)	15		X	X	
Task 2: Case Study 2 (Group)	10		X	X	
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO2	WK3, WK5
CO2	PO2	
CO3	PO3, PO5	
CO4	PO2, PO3, PO5,	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction**: Types of variables, Types of control, Process control block diagrams and instrumentation.	2	1		5	
2	**Theoretical Models of Chemical Processes:** Types of models (Theoretical, empirical, semi-empirical), their advantages, disadvantages and applications, Conservation Laws, Dynamic models of representative processes	2	1		5	
3	**Transfer Function Models:** Laplace transforms (Representative functions, properties, partial fraction expansion), Transfer function properties, Linearization of non-linear models.	4	2		10	
	In-Class Test 1				1	1
4	**Dynamic Behaviour of 1st and 2nd Order Processes (Open-loop):** Standard process inputs, Response of 1st order, 2nd order (underdamped,	6	3		15	

	overdamped and critically damped) and integrating processes, Poles and zeros.						
	Task 1: Case Study 1 (Individual)				1	1	
5	**Feedback Controllers Part 1:** Basic control system, Basic control modes (Proportional, Integral, Derivative, PI, PI, PID).	8	4		20		
	In-Class Test 2				1	1	
6	**Feedback Controllers Part 2:** Features of PID controller (Derivative kick, reverse/direct action), Typical responses of feedback control.	2	1		5		
	Task 2: Case Study 2 (Group)				1	1	
7	**Dynamic Behaviour and Stability of Closed-loop Control System:** Block diagram representation, Closed-loop transfer function, responses and stability (Routh stability criterion, Root locus diagrams).	4	2		10		
	Final Exam				2	2	
		28	**14**		**76**	**6**	

Course Texts	1. Seborg, D. E., Edgar, T. F., Mellichamp, D. A., & Doyle III, F. J. (2016). Process dynamics and control. John Wiley & Sons. 2. Donald R. Coughnowr, (1991) Process System Analysis and Control, 2nd ed. McGraw-Hill Inc.
Supplementary Texts	1. George Stephanopoulos, (1993) Chemical Process Control: An Introduction to Theory & Practice, Prentice - Hall of India Private Limited, New Delhi. 2. Carlos A. Smith and Armando B. Corripio, (1985) Principles and Practice of Automatic Process Control, John Wiley & Sons, New York.

Course Name	Operation Research
Course Code	BBM351
Course Convener Name	TBD

<table>
<tr><td>Room No.
Email</td><td></td></tr>
<tr><td>Year</td><td>4</td></tr>
<tr><td>Semester</td><td>2</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td>Operations research provides a powerful approach to decision making than ordinary software and data analytics tools. Employing operations research professionals can help companies achieve more complete datasets, consider all available options, predict all possible outcomes and estimate risk.</td></tr>
<tr><td>Total Student Learning Time (SLT)</td><td>
<table>
<tr><th>Lectures</th><th>Tutorial</th><th>PBL/Design /Lab</th><th>Self-Learning Including Prep Time</th><th>Total Learning Time</th></tr>
<tr><td>28</td><td>14</td><td></td><td>76</td><td>124</td></tr>
</table>
</td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Pre-requisite (if any)</td><td>None</td></tr>
<tr><td>Course Objective</td><td>The purpose of this course is to build the learners capacity to analyse a real industrial problem and make a rational decision based on the application of Operations Research techniques.</td></tr>
<tr><td>Synopsis</td><td>Operations research (OR) is an analytical method of problem-solving and decision-making that is useful in the management of organizations.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Interpret operations research concepts, techniques and models.
2. Solve mathematical models for a real industrial problem.
3. Apply operations research techniques for aiding in decision making.
4. Apply computer simulation models for project planning problems.</td></tr>
<tr><td>Mode of Delivery</td><td>1. Lectures (hybrid)
2. Tutorials
3. Group activity/presentation/discussions</td></tr>
<tr><td>Assessment method-CO Mapping</td><td>
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>10</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>10</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Assignment (Group)</td><td>20</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
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<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
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<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO5</td><td rowspan="4">WK3, WK4</td></tr>
<tr><td>CO2</td><td>PO5</td></tr>
<tr><td>CO3</td><td>PO10</td></tr>
<tr><td>CO4</td><td>PO10</td></tr>
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</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
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<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/MT</th></tr>
</table>
</td></tr>
</table>

		1	**Operations research**: Introduction, scope and applications; Operations research models; Phases of operation research study.	6	3		15		
			Task 1: Assignment				1	1	
		2	**Linear programming**: formulation of linear programming problem, solution using graphical and algebraic solutions, simplex method, dual solution and interpretations, sensitivity analysis, use of computer packages.	4	2		10		
			In-Class Test 1				1	1	
		3	**Transportation Problem**: Formulation of transportation model; Finding initial basic feasible solution; Optimality test and iteration. Assignment models. **Network Analysis**: Preparation of a network, locating of the critical path time and resource scheduling, PERT, use of computer packages.	6	3		15		
			In-Class Test 2				1	1	
		4	**Queuing theory**: Basic structure of queuing models; Birth-death process; Queuing models. **Decision theory**: maximin, maximax and minimax criteria, decision trees, expected value and utility.	4	2		10		
		5	**Game Theory**: Two-person zero-sum game criteria; Games with mixed strategies; solution of game problems using graphical and linear	4	2		10		

	programming procedures.						
6	**Simulation**: simulation model, simulation techniques, introduction to computer simulation.	4	2		10		
	Task 2: Group activity/presentation				1	1	
	Final Exam				2	2	
		28	**14**		**76**	**6**	

Course Texts	1. Taha, Hamdy A. 2007. Operations research: an introduction, 8th ed. p. cm. ISBN 0-13-188923-0. 2. Frederick S. Hillier, Gerald J. Lieberman. 2015. Introduction to Operations Research, McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121.
Supplementary Texts	1. Bernard W. Taylor III 2013. Introduction to management science. Pearson Education, Inc ISBN-13: 978-0-13-275191-9. 2. S. Christian Albright and Wayne Winston, Practical Management Science, South Western. ISBN: 978-1-111-53131-5. 3. Hillier F. and Lieberman G. Introduction to operations Research, McGraw-Hill. ISBN: 007-2-321-695.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Chemical Engineering Practicals IV
Course Code	CPE420
Course Convener **Name** **Room No.** **Email**	TBD
Year	4
Semester	2
Rationale for the inclusion of the Course in the programme	Laboratory experiments are important in chemical and process engineering. Laboratory experiments enable learners to develop critical thinking and practical skills. In addition, they enhance mastery of courses that have executable experiments. The experimental component of various courses offered in fourth year; second semester is done under chemical engineering practicals IV

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	1	13	24	43	81

Credit Value	2
Pre-requisite (if any)	Introduction to Biochemical Engineering, Mass Transfer III, Reactor Engineering II

Course Objective	The objectives of this course are to enable learning about; 1. Principles of liquid-liquid extraction, residence time distribution, solid-liquid extraction, microbial growth and flash points. 2. Collection of experimental data 3. Analysis of experimental data in unit operations. 4. Experimental report writing.
Synopsis	The learners are expected to perform at least two executable experiments in Introduction to Biochemical Engineering, Mass Transfer III, Reactor Engineering II, write a report and make a presentation of his/her findings to the departmental academic and technical staff panel.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Describe the scientific principles of liquid-liquid extraction, residence time distribution, solid-liquid extraction, microbial growth and flash points. 2. Collect and analyze experimental data. 3. Discuss experimental results to evaluate process performance. 4. Write a technical report on the experiments done for oral presentation
Mode of Delivery	1. Group Discussions 2. Lab sessions 3. Oral presentations 4. Demonstrations
Assessment method-CO Mapping	

Distribution	(%)	CO1	CO2	CO3	CO4
Oral Presentation	50	X	X	X	X
Final Report	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO2	WK4, WK8, WK9
CO2	PO2, PO4	
CO3	PO2, PO4	
CO4	P08	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	CPE 422: Sterile techniques for microbiology; Preparation of microbial nutrients (agar plates and solutions); Culturing of microbes in agar plates and flasks; Observation of microbial morphology and their growth progress under microscope; Classification of microbes through morphological features;	1	13	24	42	

		Fermentation of microbes in pilot bioreactors; Determination of microbial growth in pilot bioreactors; Determination of maximum growth rate and Monod constants for a given culture; Determination of enzyme reaction kinetics; Extraction of DNA; PCR for DNA						
	2	CPE 424: Liquid-liquid studies; Solid-liquid studies; Using laboratory data to draw ternary diagram; Determination of the liquid retained with the solids at equilibrium L and its concentrations X_n; Concentration of products through rotary dryer						
	3	CPE 426: Analysis of Residence Time Distribution (RTD) Function						
		Task 1: Oral Presentation				1		
		Final Report						
			1	13	24	43		

Course Texts	1. Dara, S.S. (2011) A textbook on Experiments and Calculations in Engineering Chemistry, S. Chand and Co. New Delhi. 2. Coulson, J.M., Richardson, J.F., Backhurst, J.R. and Harker, J.H. (2002). Coulson and Richardson, Chemical engineering, Fluid Flow, Heat Transfer and Mass Transfer, Vol. 1. (5th edn.). London: Butterworth-Heinemann Linacre House. 3. Yunus S. C. (1998). Heat Transfer- A Practical Approach. New York: Mc Graw-Hill.
Supplementary Texts	1. Warren, M. (2005). Unit operations of chemical engineering. (7th edn.). New York: McGraw Hill Chemical Engineering Series. 2. Richardson, J.F., Harker, J.H. and Backhurst, J.R. (2002). Coulson and Richardson, Chemical engineering, Particle Technology and Separation Processes, Vol. 2. (5th edn.). Oxford: Butterworth-Heinemann Linacre House.
Other additional information:	Websites, Video link, Lecture Notes etc.

<table>
<tr><td></td><td colspan="5"></td></tr>
<tr><td>Course Name</td><td colspan="5">Industrial Attachment II</td></tr>
<tr><td>Course Code</td><td colspan="5">CPE430</td></tr>
<tr><td>Course Convener Name
Room No.
Email</td><td colspan="5">TBD</td></tr>
<tr><td>Year</td><td colspan="5">4</td></tr>
<tr><td>Semester</td><td colspan="5">3</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">Industrial attachment II is an essential component of the learner's academic programme. It challenges the learner to examine the values of the organization involved in the experience and the mastering industrial operations and professional practice at higher level. Learners apply theoretical knowledge to the real world. The experience not only helps the learner to develop skills needed to work in industry and working on real projects, but also equips them with interpersonal skills and confidence needed to work effectively with others. Attachees are highly encourages to identify a problem and propose a workable solution. This could form the basis of the capstone project in final year of study.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td colspan="5">12 weeks</td></tr>
<tr><td>Credit Value</td><td colspan="5">6</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">CPE330 and All Fourth Year Courses</td></tr>
<tr><td>Course Objective</td><td colspan="5">This course are to enable learners to: Integrate the knowledge they acquired in classroom and apply it in real work setting; appreciate work ethics and professionalism in real work environment; appreciate team work, group / organizational behaviour in a work environment, and develop an understanding of the operation of industry, based on which students can further plan their career.</td></tr>
<tr><td>Synopsis</td><td colspan="5">The course provides further exposure of the student to practical industrial engineering operations and professional practices.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Critically accomplish tasks at the workplace.
2. Describe the setting of the industry and the operation of the host company
3. Display commitment, ethics and professionalism in the industry.
4. Apply and integrate the knowledge acquired in the classroom at workplace
5. Identify problems encountered in the industry and propose a workable solution from a vast list of possible options.
6. Display effective verbal and written communication and other soft skills that are required at workplace</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. On the job training
2. Demonstrations
3. Lab sessions and plant operations
4. Special assignments by the industrial supervisor/mentor
5. Industrial supervisor/mentor consultations</td></tr>
</table>

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4	CO5	CO6
Task 1: University Supervisor Assessment	20	X	X	X	X	X	X
Task 2: Industrial Supervisor Assessment	20	X	X	X	X	X	X
Task 3: Logbook Assessment	10	X	X	X	X	X	X
Task 4: Final Written Report	40	X	X	X	X	X	X
Task 5: Oral Presentation	10	X	X	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1		
CO2		
CO3	PO1-P010	
CO4		WK6
CO5		
CO6		

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Pre-attachment training activities: Safety course, behaviour at work, communication and interpersonal skills etc.- 1-week prior to attachment commencement					
2	Hands on training at the company attached under the guidance of the industrial mentor/supervisor e.g. operations, projects, troubleshooting, complex problems solving etc.	12 weeks				
3	Keeping an updated training log book					
4	Learner to contribute to the organization by joining activities and carrying out responsibilities given to them professionally.					
5	University supervisor visits to discuss and					

		review the industrial attachment with learners and mentors					
	6	Other professional training offered.					
	7	Writing a report summarising the learning during the industrial attachment (1 week after completion of attachment)					
	8	Giving a poster presentation on IA training (20 min) – 2nd week after semester commencement					
			12 weeks				
Course Texts	All the relevant printed material on industrial operations including machine operation manuals, quality control excerpts, any relevant core and recommended textbook, industrial project reports among other documentations						
Supplementary Texts	Daniel Alao. Everything Industrial Training						
Other additional information:	Websites, Video link, Lecture Notes etc.						

Fifth Year – First Semester

Course Name	Energy Management				
Course Code	CPE513				
Course Convener Name Room No. Email	TBD				
Year	5				
Semester	1				
Rationale for the inclusion of the Course in the programme	Energy is one of the enablers economic growth through promotion of industrial development. Through this course, knowledge and skills are gained on planning and management of energy. It helps learners to appreciate the policy and regulatory framework that enable proper management of energy in the country.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		82	124
Credit Value	3				

Pre-requisite (if any)	CPE 423- Non fossil fuels Technologies.
Course Objective	The objectives of this course are to enable learning about the policy and legal framework governing energy management in the country. The builds competence in application of principles of energy management, energy pricing, energy audits and energy planning techniques.
Synopsis	This course applies the concepts of sustainable development in planning and management of energy systems. It gives good practices, policies and legal frameworks that guide energy management including energy audits.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Identify various frameworks, practices and policies on energy management. 2. Analyse the factors that affect energy pricing 3. Develop energy action plan 4. Relate energy, environment and sustainable development.
Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.

Assessment method-CO Mapping

Distribution	**(%)**	**CO1**	**CO2**	**CO3**	**CO4**
CAT 1: Sit in	15	X	X	X	X
Task 1: Assignment (Individual)	10		X	X	
CAT 2: Sit in	15	X	X	X	X
Task 2: Assignment (Group)	10			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	**Programme Learning Outcome**	**Knowledge Profile**
CO1	PO1, PO2	WK4 & WK6
CO2	PO2,	
CO3	PO1, PO2, PO3	
CO4	PO2, PO3	

Content Outline of the Course and the SLT per Topic

No.	**Topic**	**Lecture**	**Tutorial**	**Lab**	**Self-Learning**	**FE/Q/MT**
1	**Legal and Regulatory Framework**: Need for energy management- expanding use of energy, resource depletion, environmental degradation. Basic principles of energy management. National and global energy policies.	6	3		15	
	CAT 1 – Sit in				1	1
2	**Energy planning techniques.** Energy Pricing- factors affecting (Coal,	6	3		15	

		Petroleum, Natural Gas, Renewables)					
		Individual assignment				1	1
	3	Energy audits and models. Auditors tool box, Preparations for audit visit, Conducting audit visit (introductory meetings, interviews, walk through, detailed data, measurements), post audit analysis, audit report format, energy action plan, specialized audit tools, industrial audits, commercial audits, residential audits,	8	4		20	
		CAT 2- Sit in				1	1
	4	Energy and environmental management. Fundamentals of Energy Management system ISO 50001. Nexus between ISO 50001 and Environmental management system ISO 14001	8	4		20	
		Group assignment				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**

Course Texts	1. Doty, S., & Turner, W. C. (2004). Energy management handbook. Crc Press. 2. Energy Management Principles, 2nd Ed. (2016)- Craig B. Smith & Kelly E. Parmeter, Elsevier Inc.
Supplementary Texts	Ministry of Energy. (2018). National Energy Policy, Nairobi, Government of Kenya
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Industrial and Labour Laws
Course Code	FLB210
Course Convener	School of Law

Name **Room No.** **Email**	TBD
Year	5
Semester	1
Rationale for the inclusion of the Course in the programme	The course is designed to equip learner with knowledge and practice of laws related to the engineering industry

Total Student Learning Time (SLT)

Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
28	14		78	120

Credit Value	3
Pre-requisite (if any)	None
Course Objective	This course is designed to introduce learners to legal procedures and intellectual property applicable to the engineering industry, relevant legal frameworks to industrial and labour relations and dispute resolution in resolving conflicts in project contracts.
Synopsis	The course covers Legal procedure including law of contract and patent laws. Legal framework such as the Engineers Act 211, Company Act are well explained. Industrial relations in Kenya covering labour laws, trade unions, Trade Dispute Act (Cap. 234), Factories Act (Cap, 514), Occupation Safety and Health Act, Work Injury Benefit Act and other relevant Acts are also included. The course will expose learners to dispute resolution provisions relating to engineering project.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Explain the legal procedures and intellectual property applicable to the engineering industry; 2. Demonstrate an understanding of the labour relations laws in engineering practice 3. Recognize the legal framework governing engineering practice 4. Apply dispute resolution provisions in resolving conflicts in project contracts.
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Group activity/presentation/discussions

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X			
CAT 2 (Sit-In Test 2)	15		X	X	
Task 2: Assignment (Group)	10			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO6	WK7, WK9
CO2	PO6	
CO3	PO7	

Knowledge Profile	CO4	PO7					
Content Outline of the Course and the SLT per Topic	**No.**	**Topic**	**Lecture**	**Tutorial**	**Lab**	**Self-Learning**	**FE/Q/MT**
	1	**Legal procedure:** Law of contract, the law of property, legal principles relating to: sale of goods, agency, negotiable instruments guarantees and indemnities, laws of succession, patent laws.	4	2		10	
	2	**Legal framework:** Engineers Act 2011- the role of an engineer in society, engineering professional development model, Engineers Registration, Engineer as consultant, Engineer as contractor, engineering professional societies;	4	2		10	
		Task 1: Assignment				1	1
	3	**The Company Act:** sole trader, partnership, Limited Liability Company, corporation, parastatal and cooperatives;	2	1		5	
		In-Class Test 1				1	1
	4	**Industrial relations in Kenya:** ***Labour laws-*** employer employee relationships; ***Trade Unions:*** registration, rights and liabilities, Collective Bargaining Agreements (CBA); ***Trade Dispute Act (Cap. 234)*** - with particular reference to the jurisdiction of the industrial court and the protection of essential	10	5		25	

		services, life and property; ***The Factories Act (Cap, 514):*** main provisions as to health, safety and welfare; offences, penalties and legal proceedings; ***Occupation Safety and Health Act:*** main provisions as to health, safety and welfare, offences, penalties and legal proceedings; ***Work Injury Benefit Act.***					
		Other relevant Acts: National Construction Authority Act, Public Procurement and Disposal Act, among others: main provisions; offences, penalties and legal proceedings.	4	2		10	
		In-Class Test 2				1	1
		Dispute Resolution Provisions in project: contractual disputes, dispute resolution mechanisms and laws, traditional litigation, Arbitration, Alternative Dispute Resolution (ADR), role of engineering professional societies. selected case studies	4	2		10	
		Task 2: Group activity/presentation				1	1
		Final Exam				2	2
			28	**14**		**76**	**6**

Course Texts	1. The Engineers Act, 2011 2. Public Procurement and Disposal Act, 2005 3. Factories Act (Cap, 514) 4. EBK, 2016. Code of Ethics and Conduct for Engineers, Engineers Board of Kenya, Nairobi. 5. Charles B. Fleddermann., 2012, Engineering Ethics, Prentice Hall, New York: USA
Supplementary Texts	1. EMCA Act, 1999 2. National Construction Authority Act, 2011 3. Other relevant Acts to Engineering in Kenya

Other additional information:	Johnson, D.G., 1991, Ethical issues in engineering, Prentice Hall, New Jersey: USA

<table>
<tr><td>Course Name</td><td colspan="5">Total Quality Management</td></tr>
<tr><td>Course Code</td><td colspan="5">CPE518</td></tr>
<tr><td>Course Convener Name
Room No.
Email</td><td colspan="5">TBD</td></tr>
<tr><td>Year</td><td colspan="5">5</td></tr>
<tr><td>Semester</td><td colspan="5"></td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">Total quality management involves continuous improvement, leveraging data and metrics to make informed decisions. This course is designed to train learners to acquire knowledge, skills and attitudes on total quality management.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>78</td><td>120</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">CPE 311- Analytical Chemistry</td></tr>
<tr><td>Course Objective</td><td colspan="5">The aim of this course is to enable learning about; The fundamentals of quality management, Different quality control approaches, How quality control standards are applied for continuous quality improvement, and Application of statistical methods to control chemical process.</td></tr>
<tr><td>Synopsis</td><td colspan="5">This course on total quality management illuminates on the process of continual process of detecting and reducing or eliminating errors in manufacturing.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">At the end of this course the learner should be able to:
1. Explain quality control concepts and techniques
2. Compare different quality control approaches
3. Apply statistical tools to determine process performance
4. Design process failure mode and reliability prediction process</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">Blended learning that incorporates both physical and online sessions shall be employed.</td></tr>
<tr><td>Assessment method-CO Mapping</td><td colspan="5">
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>5</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1: Sit in</td><td>10</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Task 2: Assignment (Individual)</td><td>5</td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>CAT 2: Sit in</td><td>10</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>Task 3: Assignment (Group)</td><td>20</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
</table>

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile	Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
	CO1	PO1	WK2, WK5, WK7 & WK8
	CO2	PO2, PO5	
	CO3	PO5, PO10	
	CO4	PO2, , PO9, PO11	

Content Outline of the Course and the SLT per Topic	No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q /MT
	1	**Quality control concepts & techniques,** Quality, Dimensions of quality, Quality control,	4	2		8	
	2	**Quality standards, Specifications** Fundamentals of quality control; Functions, Levels of responsibility for quality, process variation.	4	2		8	
		Individual Assignment				1	1
	3	**Quality costs**; appraisal costs	2			8	
		CAT 1 – Sit in				1	1
	4	**Statistical quality control,** Quality assurance, Quality reliability, Quality testing, Quality inspection, Quality survey, Quality audits, Product audits.	4	2		10	
		Individual Assignment				1	1
	5	**Quality assurance phases,** Methods of quality assurance,	2			8	
	6	**Design for quality,** Tools for concept development-quality function deployment and concept engineering,	2	2		6	
		CAT 2 – Sit in				1	1
	7	**Tools for design** Development-design failure mode and effect analysis and reliability prediction, Tools for Design verification-Reliability testing, measurement system evaluations capability evaluation. Quality	4	2		6	

	improvement, Tools for process improvement.					
8	**Quality Management Systems (QMS),** Principles and Elements of (QMS), ISO 9001 series. Approaches of quality control; Six Sigma, DMAIC, LEAN Manufacturing. Principles of Lean Manufacturing. Good Manufacturing Practices (GMP), Principles and Elements of GMP. Total Quality Management, Principles of TQM. Building a quality culture.	6	4		10	
	Group assignment				1	1
	Final Exam				2	2
		28	**14**		**71**	**7**

Course Texts	1. Juran, J. M & Godfrey, A. B. (1999). Quality by Design: The new steps for planning qualityinto goods and services. Seventh Edition 2. Heizer, J & Rende, B. (2006). Operations Management. PrenHall publishers
Supplementary Texts	
Other additional information:	Websites, Video link, Lecture Notes, Quality Management manuals, etc

Course Name	Industrial Chemical Processes
Course Code	CPE519
Course Convener Name Room No. Email	Ms. Florence Ajiambo TBD famumbwe@gmail.com
Year	5
Semester	1
Rationale for the inclusion of the Course in the programme	Every industrial process is designed to produce a desired product from a variety of starting raw materials using energy through a succession of treatment steps integrated in a rational fashion. The treatments steps are either physical or chemical in nature. An in-depth understanding of the basic processes involved to achieve quality products while efficiently managing energy and waste is desirable.

Total Student Learning Time (SLT)	Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
	28	14		78	120
Credit Value	3				
Pre-requisite (if any)	CPE 418 – Chemical Engineering Design I and CPE 428 – Chemical Engineering Design II				
Course Objective	This course is designed to train learners to acquire knowledge, skills and attitudes on industrial chemical processes. It involves the study of chemistry of raw materials, basic operation processes, quality control and energy and waste management of various industrial processes.				
Synopsis	This course applies the concepts of the basic unit operations involved in production of various chemical products to achieve desirable quality while efficiently managing energy and waste.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Describe production sequence with aid of a flowsheet. 2. Identify relevant unit operations and processes in chemical process industries 3. Apply technical skills to examine quality control parameters of a given chemical process 4. Illustrate with flow diagrams, selected chemical manufacturing processes				
Mode of Delivery	1. Lectures(Hybrid) 2. Tutorials 3. Case studies 4. Group Discussions 5. Presentations 6. Demonstrations				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual Report and presentation)	20	X			
CAT 1 (Sit-In Test 1)	10	X	X		
Task 2: Assignment (Group Report and Presentation)	20			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK3, WK4, WK6
CO2	PO2	
CO3	PO2, PO8	
CO4	PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Study of the chemistry of raw materials Select at least three manufacturing processes	6	3		15	

	2	Basic operation processes Of the selected processes	8	4		20	
	3	Quality Control Of the selected processes	6	3		15	
	4	Energy and Waste Management Of the selected processes	8	4		20	
	Final Exam					6	6
			28	**14**		**76**	**6**
Course Texts	Shreve, R.N. & Austin, G.T. (1984), Shreve's Chemical Process Industries, 5th Ed, Mc Graw Hills						
Supplementary Texts	1. Skogestad, S. (2008). Chemical and Energy Process Engineering. United States: Taylor & Francis. 2. Henda, R., Ghasem, N. (2014). Principles of Chemical Engineering Processes: Material and Energy Balances, Second Edition. United Kingdom: Taylor & Francis. 3. Encyclopedia of Chemical Technology: A to alkaloids. (1991). United Kingdom: Wiley.						
Other additional information:	Websites, Video link, Lecture Notes etc						

Course Name	Chemical Engineering Project I				
Course Code	CPE510				
Course Convener Name Room No. Email	TBD				
Year	5				
Semester	1				
Rationale for the inclusion of the Course in the programme	Developing practical skills which entails laboratory work or workshop activities is crucial in chemical engineering. The data to produce models for processes are gotten through carrying out experiments. Process and product development is achieved through practical data produced in laboratory tests. Many innovations begin by carrying out tests in laboratory or workshop set-ups. Therefore, proficiency in chemical engineering research skills is demonstrated by learners in this course, which involves the problem identification, analysis and through literature, proposing a methodology to solve the problem.				
Total Student Learning Time (SLT)	**Lectures**	**Consultation**	**Project**	**Self-Learning Including Prep Time**	**Student Learning Time**
	1	13	71	42	127
Credit Value	3				

Pre-requisite (if any)	CPE 410-Chemical Engineering Practical 111, CPE 420-Chemical Engineering Practical IV
Course Objective	Chemical Engineering Project I enables learners to demonstrate their hands on competence in solving practical skills. Learners develop skills to identify practical problems, how to analyse possible solutions and theoretically develop a process to solve the problem. Learners develop skills that promote group discussions, research, critical and innovative thinking to be able to solve an engineering challenge. It also seeks to expand the use of computer-aided process design tools to address engineering problems.
Synopsis	The course content covers laboratory problem identification, objectives, literature review, selection of process for solution, justification for the choice and methodology.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Identify a practical problem 2. Analyse literature data to choose a process for solving the problem. 3. Write a laboratory proposal on solving a practical problem 4. Work in team to plan, execute presentations, and manage the project work, ethically, professionally and in safe manner.
Mode of Delivery	1. Consultation 2. Project Based, Group Project 3. Group discussions/ Presentations 4. Academic supervision

Assessment method-CO Mapping

Distribution	**(%)**	**CO1**	**CO2**	**CO3**	**CO4**
Report	50	X	X	X	X
Oral Progress Presentation (Group)	15	X	X		
Consultations	10	X	X	X	X
Oral Presentation/Viva	25	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	**Programme Learning Outcome**	**Knowledge Profile**
CO1	PO2, PO4	WK8
CO2	PO3	
CO3	PO5	
CO4	PO8, PO9	

Content Outline of the Course and the SLT per Topic

No.	**Topic**	**Lecture/consultations**	**Project/Lab/Group discussions**	**Self-Learning**
1	Introduction: Chemical Engineering problem, objectives, justification.	14	70	39
2	Literature Review: well-structured and critical literature review on the subject matter.			
3	Conceptual methodology development:			

		Methodology Description			
	4	Project budget plan and project time plan			
		Viva/Group Oral Presentation		1	1
		Technical Report			
			14	**71**	**42**

Course Texts	4. Michael, P. M., (2011). Research Methods for Science. London: Cambridge University Press.
Supplementary Texts	4. Blessing, L. T. M., & Chakrabarti, A. (2009). DRM, a Design Research Methodology. Germany: Springer. 5. Stuart, M. & Wayne, G. (1996). Research Methodology: An Introduction for Science & Engineering Students. Pretoria: Juta & Co Ltd.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Plant Design Project I				
Course Code	CPE580				
Course Convener Name Room No. Email	TBD				
Year	5				
Semester	1				
Rationale for the inclusion of the Course in the programme	Developing a process design is a crucial skill in chemical engineering, usually carried out by a team of learners who create a flowsheet that manipulates matter and energy, with the incorporation of other aspects. These processes encompass various fundamental activities like mixing, heating, cooling, reacting, crushing, and separating (e.g. crystallization or distillation). Therefore, proficiency in chemical engineering design is demonstrated by learners in this course, which involves the integration of technical and other skills, problem definition, constraint identification, and the use of creativity and innovation.				
Total Student Learning Time (SLT)	**Lectures**	**Consultation**	**Project**	**Self-Learning Including Prep Time**	**Student Learning Time**
	1	13	70	40	124
Credit Value	3				
Pre-requisite (if any)	CPE411- Process Economics, CPE428-Chemical Engineering Design II, CPE411-Process Economics, CPE429-Process Dynamics and Control, 419-CPE-Process Modelling and Simulation				

Course Objective	Plant Design Project I enables learners to apply chemical engineering knowledge to design a sustainable, economic and environmentally safe process flow plant. Learners develop skills that promote group discussions, research, critical and innovative thinking to be able to solve an engineering challenge. It also seeks to expand the use of computer-aided process design tools to address engineering problems.
Synopsis	The course content covers design problem formulation, objectives, literature review, process description, mass and energy balance.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Formulate a design problem and objectives for an identified chemical processing plant based on literature reports. 2. Develop appropriate process block and flow diagram for the plant using process design tools for a given purpose. 3. Perform the mass and energy balance over the entire process plant (using simulation software) 4. Work in team to plan, execute presentations, and manage a chemical plant an ethically, professional and safe manner, and write technical report.
Mode of Delivery	1. Consultation 2. Project Based, Group Project 3. Group discussions/ Presentations 4. Academic supervision

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Report	50	X	X	X	X
Oral Progress Presentation (Group)	15	X	X		
Consultations	10	X	X	X	X
Oral Presentation/Viva	25	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO3	WK2, WK5, WK7
CO2	PO3	
CO3	PO5	
CO4	PO8, PO9, PO10	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture/consultations	Project/Lab/Group discussions	Self-Learning
1	Introduction: Design problem, objectives, justification.	14	70	39
2	Literature Review: well-structured and critical literature review on the subject matter.			
3	Conceptual Process development: Process Description			

	4	Block diagram and process flowsheet diagram (PFD)			
	5	Mass Balance			
	6	Energy Balance			
		Viva/Group Oral Presentation			1
		Technical Report			
			14	**70**	**40**
Course Texts	1. Seider W D, Seader J D, Lewin D R and Widagdo S. 2019. Product and Process Design Principles – Synthesis, Analysis and Evaluation 4th Ed. John Wiley & Sons, NY. 2. Seader J D & Henley E J. 2019. Separation Process Principles 4th ed, John Wiley & Sons, NY. 3. Max S. Peters, Klaus D. Timmerhaus & Ronald E. West. Plant Design and Economics for Chemical Engineers. 5th Edition. McGrawHill, 2005. 4. Smith, R., Chemical Process Design and Integration, 2nd, John Wiley and Sons, Inc., 2016. 5. Towler, G.P. and Sinnott, R.K., Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, 2nd Edition, Elesivier, 2013.				
Supplementary Texts	1. Coulson, J.M, Sinnott. R.K. and Richardson, J.F. Coulson & Richardson's Chemical Engineering: Chemical Engineering Design, Volume 6. Elsevier, 2005 2. Turton, R.; Bailie, R. C.; Whiting, W. B.; Shaelwitz, J. A. Analysis, Synthesis and Design of Chemical Processes, 5th Edition, Prentice Hall: Upper Saddle River, 2019. 3. Mannan S (2012) Lees' Loss Prevention in the Process Industries, 4th Edition, Butterworth-Heinemann 0-7506-1547-8.				
Other additional information:	Websites, Video link, Lecture Notes etc.				

Fifth Year – Second Semester

Course Name	Industrial Management
Course Code	CPE521
Course Convener Name Room No. Email	TBD
Year	5
Semester	2
Rationale for the inclusion of the Course in the programme	Industrial management is a branch of engineering which facilitates creation of management system and integrates the diverse engineering processes. It incorporates the principles of manufacturing system, logistics, supply chain management, materials management, entrepreneurship, among other things. The course trains managers on how to efficiently and economically use resources in a business including labor, materials, machines, time, capital, energy, and information.

Total Student Learning Time (SLT)	Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
	28	14		82	124

Credit Value	3
Pre-requisite (if any)	CSE426- Operations research
Course Objective	This course aims to equip the learner with the fundamental knowledge onaspects of management accounting in industry, human resource management process, production planning and control, marketing concepts and strategies.
Synopsis	This course incorporates the principles of manufacturing system, logistics, supply chain management, materials management, entrepreneurship, among other things to trains managers on how to efficiently and economically use resources in a business including labor, materials, machines, time, capital, energy, and information.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Discuss different aspects of management for industrial production. 2. Outline the human resource management process. 3. Make production plans and control measures for a production process 4. Develop marketing plans and research techniques.
Mode of Delivery	1. Lectures 2. Tutorials

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15	X	X		
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK4
CO2	PO2	
CO3	PO2, PO5	
CO4	PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction to management accounting:** Financial measures in business decisions and manufacturing costs.	6	3		15	
	Task 1: Assignment				1	1
2	**Human resources management:** motivation, leadership, and group processes	4	2		10	

	3	**Interaction with other departments:** job scheduling, work routes, process charts	4	2		10	
		In-Class Test 1				1	1
	4	**Production planning:** Types and functions of production planning	4	2		10	
	5	**Production control:** Types and functions of production control	4	2		10	
		In-Class Test 2				1	1
	6	**Introduction to marketing:** Market planning, marketing decision, market research, marketing strategy, international marketing	6	3		15	
		Task 2: Group activity/presentation				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**
Course Texts	1. Chhabra, T.N. (2019). Principles & Practices of Management, ISBN: 9788177002157 2. Leung, A. (Ed.). (2015). Engineering Management and Industrial Engineering. USA: CRC Press.						
Supplementary Texts	1. McCauley-Bush, P. & Crumpton, L.L. (2016). Essentials of Engineering Leadership and Innovation. USA: CRC Press. 2. Sengupta, R.N. & Dutta, J. (Eds.). (2016). Decision Sciences: Theory and Practice. USA: CRC Press.						
Other additional information:	Websites, Video link, Lecture Notes etc						

Course Name	Safety in Chemical Industries
Course Code	CPE525
Course Convener Name Room No. Email	TBD
Year	5
Semester	2
Rationale for the inclusion of the Course in the programme	Safety is key in chemical process industries. Safe industrial production activities result in increased productivity and enables the company acquire a certain edge in the competitive world. The main challenge in the chemical process industry is how to produce and use products in a manner that is safe for the personnel involved in the actual production, the consumers, near by communities and the environment. This course inculcates safety issues to the learner.

<table>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>82</td><td>124</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5"></td></tr>
<tr><td>Course Objective</td><td colspan="5">The objectives of this course are to enable learning about;
1. Hazards in chemical industries
2. Control strategies for the hazards
3. Government policies on safety in chemical industries
4. Documented accidents in chemical industries</td></tr>
<tr><td>Synopsis</td><td colspan="5">The course introduces the concept of hazards, risks, hazard identification and control methods. Safety issues during transportation and marketing of products are also covered. Emphasis is made on case studies of major accidents that have been reported globally.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Identify hazards in chemical industries.
2. Review control strategies for the hazards.
3. Interpret government policies on safety in chemical industries.
4. Draw safety plans for chemical industries using documented accidents</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. Lectures (hybrid)
2. Case studies
3. Presentations</td></tr>
<tr><td>Assessment method-CO Mapping</td><td colspan="5">
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>10</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>10</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Presentation (Group)</td><td>20</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td colspan="5">
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1</td><td rowspan="4">WK4, WK7, WK9</td></tr>
<tr><td>CO2</td><td>PO2</td></tr>
<tr><td>CO3</td><td>PO6</td></tr>
<tr><td>CO4</td><td>PO7, PO8</td></tr>
</table>
</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td colspan="5">
<table>
<tr><th>No.</th><th>Topic</th><th>Lectur e</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/ MT</th></tr>
</table>
</td></tr>
</table>

	1	Hazards in chemical industries: fire and explosions, chemicals, biologicals, electricity, radiation, noise and vibrations, precautions and safety measures. Human error, release of liquids and gases, evaporation of liquids, dispersion of gases.	4	2		10	
	2	Storage and handling of chemicals: material safety and data sheets, transportation and marketing of hazardous/toxic/flammable products/chemicals.	4	2		10	
		Task 1: Assignment				1	1
	3	Occupational health and safety: policy design and implementation, government policy on occupational health and safety, occupational health and safety policy within the enterprise, OSHA ACT, WIBA ACT, EMCA ACT.	4	2		10	
		In-Class Test 1				1	1
	4	Work control procedures, emergency response plans.	4	2		10	
	5	Hazard operability and analysis. Special designs to mitigate hazards in chemical plants.	4	2		10	
		In-Class Test 2				1	1
	6	Case study of major accidents in chemical industry such as Chernobyl, Bhopal, Toulouse, Fukushima nuclear disaster.	8	4		20	
		Presentation (Group)				1	1
		Final Exam				2	2
			28	**14**		**76**	**6**
Course Texts	1. Klein, J.A. & Vaughen, B.K. (2016). Process Safety Practical Applications for Safe and Reliable Operations. USA: CRC Press. 2. Liptak, B.G. & Venczel, K. (Eds.). (2016). Measurement and Safety. USA: CRC Press.						

	3. Clifton, A. E. (2005). Hazard Analysis Techniques for System Safety. (1st edn.). New York: Wiley.
Supplementary Texts	1. Dekker, S. (2014). Safety Differently: Human Factors for a New Era. (2nd edn.). USA CRC Press. 2. Bahr, J.N. (2014). System Safety Engineering and Risk Assessment: A Practical Approach. (2nd edn.). USA: CRC Press. 3. Ann, M. F. & Louis, T. (2001). Health, Safety, and Accident Management in the Chemical Process Industries. (2nd edn.). USA: CRC Press. 4. Nicholas, J. B. (1997). System Safety Engineering and Risk Assessment: A Practical Approach (Chemical Engineering). (1st edn.). USA: CRC Press. 5. Della-Giustina, D. E. (2014). Fire Safety Management Handbook. (3rd edn.). USA: CRC Press. 6. Laws of Kenya. (2007). Work Injury Benefits Act Chapter 236. Revised Edition 2012. Published by the National Council for Law Reporting. 7. Laws of Kenya. (1999). Environmental Management and Co-Ordination Act Chapter 387. Revised Edition 2012. Published by the National Council for Law Reporting. 8. Laws of Kenya. (2007). The Occupational Safety and Health Act, 2007. Published by the National Council for Law Reporting.
Other additional information:	Websites, Video link, Lecture Notes, etc

Course Name	Environmental and Social Impact Assessment				
Course Code	CSE521				
Course Convener Name Room No. Email	Prof. Eng. Emmanuel Chessum Kipkorir				
Year	5				
Semester	2				
Rationale for the inclusion of the Course in the programme	Carrying out Environmental Impact Assessment (EIA) studies of engineering projects ensures that the safety of the environment can be properly managed at all stages of a project: planning, design, construction, operation, monitoring and evaluation as well as decommissioning. The purpose of this course is to acquaint students with the principles and guidelines of environmental impact assessment and audit. The course further exposes the students to the potential environmental risks and impacts resulting from infrastructure projects and their appropriate mitigation measures.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120
Credit Value	3				
Pre-requisite (if any)					
Course Objective	The aim of this course is to enable learning about; Legal and institutional framework of an Environmental Impact Assessment; Environmental Impact Assessment study; Mitigation				

	measures to potential negative impacts and develop an Environmental Management Plan; Strategic Environmental Assessment; and Undertaking EIA reporting.
Synopsis	This course illuminates on the process of evaluating the likely environmental impacts of a proposed project or development, considering inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.
Course Learning Outcomes	At the end of this course the learner should be able to: 1. Demonstrate an understanding of legal and institutional framework of an environmental impact assessment; 2. Design and conduct an Environmental Impact Assessment study; 3. Identify potential social and environmental risks that can occur before, during and after implementation of infrastructure projects and the potential impacts; 4. Perform Strategic Environmental Assessment 5. Develop Environmental Impact Assessment report.
Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4	C05
Task 1: Assignment (Individual)	5		X			
CAT 1: Sit in	10	X	X			
Task 2: Assignment (Individual)	5			X		
CAT 2: Sit in	10			X	X	
Task 3: Assignment (Group)	20					X
Final Examination	50	X	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO2, PO3	WK1, WK5, WK7 & WK9
CO2	PO2, PO4	
CO3	PO4, PO5, PO6	
CO4	PO2, PO3, PO4, PO8	
CO5	PO7, PO8, PO11	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Environmental Impact Assessment (EIA):** Background of Environmental impact assessment (EIA), definitions and concepts, rationale and historical development of EIA, governing statutes, EIA in relevant Engineering fields.	4			8	
2	**EIA components:** Initial environmental examination, environmental impact	6	2		8	

	statement, environmental appraisal, environmental impact factors and areas of consideration.					
	Individual Assignment				1	1
3	**Law, Policy and Institutional arrangements:** Principles of a functional EIA system.	4	2		8	
	CAT 1 – Sit in				1	1
4	**EIA methodology:** Measurement of environmental impacts, organization, scope and methodologies of EIA, status of EIA in Kenya; Steps, descriptive checklists, simple interaction matrix, stepped matrix, uniqueness ratio, habitat evaluation system; Public involvement techniques, comprehensive environmental impact study, mitigation measures, case studies of various project types, proposing agency	4	2		10	
	Individual Assignment				1	1
5	**Environmental management plan:** evaluation of mitigation measures, responsibility of mitigation, cost of mitigation, project viability and sustainability, Environmental Audits.	2			8	
6	**EAI reporting**: Typical elements, shortcomings in preparation of EIA reports, guidelines for an effective EIA report preparation and production; procedure for evaluating EIA reports; Licensing.	2	2		10	
	CAT 2 – Sit in				1	1
7	**Strategic Environmental Assessment (SEA):** Description of policies,	4	2		6	

		plans, or programs, different types or institutional models of SEA systems. Identification of alternative Policies, Plans, and Programs. Concepts and examples of Trade-Offs. Main elements and differences between SEA process on Policy and SEA for Programs and Plans.					
	8	**Selected Case studies in relevant Engineering field**: irrigation, roads, water treatment, waste water treatment, buildings, airports, ports, hydraulic structures, telecommunication masks, power stations, among others.	2	4		6	
		Group assignment				1	1
	Final Exam					2	2
			28	**14**		**71**	**7**

Course Texts	1. L. W. Canter. 1997. 2nd Ed., Environmental Impact Assessment, McGraw-Hill; 2. G. Burke, B. R. Singh and L. Theodore. 2000. 2nd Ed Handbook of Environmental Management and Technology, John Wiley & Sons; 3. C. H. Eccleston. 2000. Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley & Sons; 4. Laws of Kenya, 2012. Environmental Management and Co-ordination Act, Revised Edition 2012 [1999] Published by the National Council for Law Reporting.
Supplementary Texts	1. Petts J. 1999. (Ed) Handbook of Environmental Impact Assessment Volume 2: Environmental Impact Assessment in Practice: Impact and Limitations. Blackwell Science Ltd., Oxford, UK; 2. Scott Wilson. 1996. Environmental Impact Assessment: Issues, Trends and Practice. Environment and Economics Unit, UNEP, Nairobi; 3. Canter L. 1996. Environmental Impact Assessment (2nd Edition). McGraw Hill Publishing Company, New York; 4. Davis S and Rukuba-Ngaiza N. 1998. Meaningful Consultation in Environmental Assessments. Social Development Note No.39, World Bank, Washington D.C; 5. P. Judith and G. Eduljee. 1994. Environmental Impact Assessment for Waste Treatment and Disposal Facilities, John Wiley & Sons; 6. R. Therivel, John Glasson, Andrew Chadwick. 2005. Introduction to Environmental Impact Assessment (Natural and Built Environment), Routledge. 7. Prager, G. (2018). *Practical Pharmaceutical Engineering*, (1st edn), USA, Wiley
Other additional information:	Websites, Video link, Lecture Notes, EIA Legislative guidelines, etc

Course Name	Process Optimization
Course Code	CPE529
Course Convener Name Room No. Email	TBD
Year	5
Semester	2
Rationale for the inclusion of the Course in the programme	Process Optimization is one of the thematic areas in chemical engineering that is widely exploited in all process industries. The knowledge and skills gained help learners to undertake flow sheet process optimization.

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	7	10	75	120

Credit Value	3
Pre-requisite (if any)	CPE 419: Process Modelling and Simulation, CPE 428: Chemical Engineering Design II
Course Objective	The aim of the course is to: 1. Direct the students to identify various optimization problems in chemical engineering 2. Cause them to develop an optimization model for a process 3. Make them solve optimization problems using numerical techniques 4. Inoculate teamwork skills by using flow sheet optimization software to solve process problems.
Synopsis	This course applies the concepts of process optimization techniques in addition of using a process flow sheet optimization application. Moreover, mathematical models are applied in the design and operation of unit operations and unit processes.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Differentiate optimisation problems encountered in chemical engineering. 2. Develop mathematical models for processes encountered in chemical engineering. 3. Apply various numerical methods in solving process optimization problems. 4. Optimize engineering models using appropriate methods and softwares.
Mode of Delivery	1. Lectures 2. Tutorials 3. Laboratory

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Continuous Assessment Tests and Tasks (CATTs)	40	X	X	X	X
Final Examination	60	X	X	X	X

<table>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1, PO2</td><td rowspan="4">WK2, WK4</td></tr>
<tr><td>CO2</td><td>PO1, PO2</td></tr>
<tr><td>CO3</td><td>PO2, PO3, PO5</td></tr>
<tr><td>CO4</td><td>PO2, PO3, PO5</td></tr>
</table>
</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
<table>
<tr><th>No.</th><th>Topic</th><th>Lecture</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/MT</th></tr>
<tr><td>1</td><td>Basic Concepts of process optimization: Explanation of concepts used in process optimization</td><td>2</td><td>1</td><td></td><td>5</td><td></td></tr>
<tr><td>2</td><td>Problem formulation: Developing mathematical models process optimization</td><td>6</td><td>3</td><td></td><td>15</td><td></td></tr>
<tr><td>3</td><td>Optimization of unconstrained optimization: Direct and indirect search methods</td><td>6</td><td>3</td><td></td><td>15</td><td></td></tr>
<tr><td>4</td><td>Optimization of constrained optimization: Linear and nonlinear programming</td><td>6</td><td>0</td><td>3</td><td>15</td><td></td></tr>
<tr><td>5</td><td>Optimization of stage and discrete processes: Mixed integer nonlinear programming and heuristic search methods</td><td>6</td><td>0</td><td>3</td><td>15</td><td></td></tr>
<tr><td>6</td><td>Case study of processes optimization: Use flow sheet optimization software</td><td>2</td><td>0</td><td>6</td><td>10</td><td></td></tr>
<tr><td colspan="5">Final Exam</td><td>0</td><td>6</td></tr>
<tr><td></td><td></td><td>28</td><td>7</td><td>10</td><td>75</td><td>6</td></tr>
</table>
</td></tr>
<tr><td>Course Texts</td><td>1. Edgar, T.F., Himmelblau, D.M. & Lasdon, L.S. (2001) Optimization of Chemical Processes. (2nd edn.). New Delhi: McGraw-Hill Book Co
2. Turton, R., Shaeiwit, J., Bhattachar, D. and Whiting, W. (2018) Analysis, Synthesis, and Design of Chemical Processes (5th Ed.), Prentice Hall</td></tr>
<tr><td>Supplementary Texts</td><td>1. Venkataraman, P. (2001). Applied Optimization with MATLAB Programming. New York: Wiley.
2. Winston, W.L. (2004). Operations Research - Applications and Algorithms. New York: Brooks Cole.
3. Ronald, L. R. (1998). Optimization in Operations Research. New Delhi: Prentice Hall.</td></tr>
</table>

	4. Steven, C. Chapra, Raymond P. Canale, (1998) Numerical Methods for Engineers 3rd Ed., McGraw-Hill, Boston. 5. Aspentech, (2001) Aspen Physical property methods and models 6. Aspen Plus (v8.4) simulation software 7. Hanyak, M.E, Chemical Process Simulation and the Aspen HYSYS v8.3 Software
Other additional information:	Process Simulator, Websites, Video link, Lecture Notes etc

<table>
<tr><td colspan="6"></td></tr>
<tr><td>Course Name</td><td colspan="5">Chemical Engineering Project II</td></tr>
<tr><td>Course Code</td><td colspan="5">CPE520</td></tr>
<tr><td>Course Convener Name
Room No.
Email</td><td colspan="5">TBD</td></tr>
<tr><td>Year</td><td colspan="5">5</td></tr>
<tr><td>Semester</td><td colspan="5">2</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">This course is an advancement of chemical engineering project I and prepares learners to acquire skills for necessary engineering professional practice. Learners will therefore, be proficient in undertaking research work and producing primary data from laboratory for process and product development. They will acquire skills to work practically in safe and ethical manner.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Consultatio n</td><td>Project</td><td>Self-Learning Including Prep Time</td><td>Student Learning Time</td></tr>
<tr><td>1</td><td>13</td><td>70</td><td>43</td><td>127</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">CPE510-Chemical Engineering Project I</td></tr>
<tr><td>Course Objective</td><td colspan="5">Chemical engineering project II enables learners to get practical skills for working in laboratory/workshop and undertaking research. They device laboratory procedures for undertaking primary data collection and analyse the collected data. Through discussion, based on published data, they draw deductions from their experiments. Learners develop skills that promote group discussions, research, critical and innovative thinking to be able to solve an engineering challenge. It also seeks to expand the technical writing skills of the students by preparing reports and presentation of the same.</td></tr>
<tr><td>Synopsis</td><td colspan="5">The course comprises of a sequence of learning opportunities designed to actualize the proposal developed in chemical engineering project I. covers chemical engineering experimental set-up, primary data collection, data analysis, discussion and conclusion. The final report is compiled and summary presented.</td></tr>
</table>

Course Learning Outcomes

Upon completion of this course, learners will be able to:

1. Design and an experiment set-up for primary chemical engineering data collection.
2. Analyse the collected data and draw logical conclusions from the same.
3. Write a technical report on the project.
4. Present the summary of the project to experts.
5. Work in team to plan, execute and manage the project work, ethically, professionally and in safe manner.

Mode of Delivery

1. Consultation
2. Project Based, Group Project
3. Group discussions/ Presentations
4. Academic supervision

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4	CO5
Technical Report	40	X	X	X	X	X
Oral Progress Presentation (Progress)	10	X	X			
Consultations	20	X	X	X	X	X
Innovation	10	X				
Oral Presentation Final	20	X	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO3	WK8
CO2	PO4	
CO3	PO4	
CO4	PO4	
CO5	PO8, PO9, PO10	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture/consultations	Project/Lab/ Group discussions	Self-Learning
1	Experimental set-up and primary data collection.	14	70	41
2	Data analysis			
3	Discussion, conclusion and recommendations			
	Viva/Group Oral Presentation			2
	Technical Report			
		14	**70**	**43**

Course Texts

1. Michael, P. M., (2011). Research Methods for Science. London: Cambridge University Press.

Supplementary Texts	1. Blessing, L. T. M., & Chakrabarti, A. (2009). DRM, a Design Research Methodology. Germany: Springer. 2. Stuart, M. & Wayne, G. (1996). Research Methodology: An Introduction for Science & Engineering Students. Pretoria: Juta & Co Ltd.
Other additional information:	Websites, Video link, Lecture Notes etc.

Course Name	Plant Design Project II				
Course Code	CPE520				
Course Convener **Name** **Room No.** **Email**	TBD				
Year	5				
Semester	2				
Rationale for the inclusion of the Course in the programme	This course is an advancement of design project I and prepares learners to acquire further plant design skills for necessary engineering professional practice. Learners will therefore, be proficient in designing plants that operate safely, economically, and in a sustainable manner. Skills such as creativity and innovation are integrated with technical know-how and constraint identification.				
Total Student Learning Time (SLT)	**Lectures**	**Consultations**	**Project**	**Self-Learning Including Prep Time**	**Student Learning Time**
	2	13	84	43	142
Credit Value	4				
Pre-requisite (if any)	CPE580-Plant design I				
Course Objective	Plant Design Project II leads learners through systematic engineering design and synthesis process and prepares them for professional practice as engineers. Learners develop skills that promote group discussions, research, critical and innovative thinking to be able to solve an engineering challenge. It also seeks to expand the use of computer-aided process design tools to address engineering problems.				
Synopsis	The course comprises a sequence of learning opportunities designed to integrate and consolidate most of fundamental science and engineering expertise acquired in design I. covers design problem formulation, objectives, literature review, process description, mass and energy balance.				
Course Learning Outcomes	Upon completion of this course, learners will be able to: 1. Design logically, a specific equipment individually while considering specifications, chemical and mechanical aspects. 2. Create an appropriate control system for individual process units, a combination of units and overall process for safe operation of the plant using computer aided design. 3. Perform economic analysis to determine the overall plant feasibility. 4. Propose the suitable plant location while considering safety and environmental impact assessment. 5. Work effectively in design team to plan, and manage a chemical plant in an				

<table>
<tr><td></td><td>ethically, professional and safe manner, write technical report and execute presentations.</td></tr>
<tr><td>Mode of Delivery</td><td>1. Consultation
2. Project Based, Group Project
3. Group discussions/ Presentations
4. Academic supervision</td></tr>
<tr><td>Assessment method-CO Mapping</td><td>
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th><th>CO5</th></tr>
<tr><td>Technical Report</td><td>40</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Oral Progress Presentation (Group)</td><td>10</td><td>X</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Equipment Design (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Consultations</td><td>10</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>PID</td><td>10</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Oral Presentation/Viva</td><td>20</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO3</td><td rowspan="5">WK4, WK5, WK7, WK9</td></tr>
<tr><td>CO2</td><td>PO5</td></tr>
<tr><td>CO3</td><td>PO6</td></tr>
<tr><td>CO4</td><td>PO6, PO7</td></tr>
<tr><td>CO5</td><td>PO8, PO9, PO10</td></tr>
</table>
</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
<table>
<tr><th>No.</th><th>Topic</th><th>Lecture/consultations</th><th>Project/Lab/ Group discussions</th><th>Self-Learning</th></tr>
<tr><td>1</td><td>Major equipment design: process equipment specifications, design procedures, chemical and mechanical design aspects, equipment design and optimisation, material of construction, equipment data sheets etc.</td><td rowspan="3">15</td><td rowspan="3">84</td><td rowspan="3">39</td></tr>
<tr><td>2</td><td>Process Control: Process instrumentation (PID)</td></tr>
<tr><td>3</td><td>Plant economic and sustainability analysis – capital and operating costs estimation, criteria for comparative profitability,</td></tr>
</table>
</td></tr>
</table>

	4	Plant layout and location, safety (HAZOP), and environmental impact assessment (EIA)			
		Viva/Group Oral Presentation			2
		Technical Report			
			15	**86**	**43**

Course Texts	1. Seider W D, Seader J D, Lewin D R and Widagdo S. 2019. Product and Process Design Principles – Synthesis, Analysis and Evaluation 4^{th} Ed. John Wiley & Sons, NY. 2. Seader J D & Henley E J. 2019. Separation Process Principles 4^{th} ed, John Wiley & Sons, NY. 3. Max S. Peters, Klaus D. Timmerhaus & Ronald E. West. Plant Design and Economics for Chemical Engineers. 5^{th} Edition. McGrawHill, 2005. 4. Smith, R., Chemical Process Design and Integration, 2^{nd}, John Wiley and Sons, Inc., 2016. 5. Towler, G.P. and Sinnott, R.K., Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, 2^{nd} Edition, Elesivier, 2013.
Supplementary Texts	1. Coulson, J.M, Sinnott. R.K. and Richardson, J.F. Coulson & Richardson's Chemical Engineering: Chemical Engineering Design, Volume 6. Elsevier, 2005 2. Turton, R.; Bailie, R. C.; Whiting, W. B.; Shaelwitz, J. A. Analysis, Synthesis and Design of Chemical Processes, 5^{th} Edition, Prentice Hall: Upper Saddle River, 2019. 3. Mannan S (2012) Lees' Loss Prevention in the Process Industries, 4th Edition, Butterworth-Heinemann 0-7506-1547-8.
Other additional information:	Websites, Video link, Lecture Notes etc.

Elective Courses

Course Name	Technology of fats & oils
Course Code	CPE500
Course Convener **Name** **Room No.** **Email**	 Samuel Sarmat Technology Building (TBD) samuelsarmat@gmail.com
Year	5
Semester	1
Rationale for the inclusion of the Course in the programme	Fats & oils is one of the many elective courses offered in & process engineering that is of vital importance in the food, paper and cosmetic industries among others. The knowledge and skills gained on candle- making, soap-making, margarine-making, lubricant-making and also use of fats and oils in the paper and cosmetic industries equips the learner with the desired competence required for the achievement of the overall program objective.

Total Student Learning Time (SLT)	Lectures	Tutorial	PBL/Design /Lab	Self-Learning Including Prep Time	Total Learning Time
	28	14		80	122
Credit Value	3				
Pre-requisite (if any)	SCH221- Carbonyl Chemistry				
Course Objective	This course aims to equip the learner with the knowledge of the types, sources, production & refining techniques and use of fats &oils in daily life. This is in order to advise on the types of heart-friendly fats & oils and also appropriate production & refining technologies for use in achieving cholesterol-free fats and oils in human diet.				
Synopsis	This course applies the knowledge of both organic chemistry and process flow charts to conceptualize the process of the production & refining of fats and oils in the industry. The production techniques for different types of fats & oils by use of different reactions between fatty acids and glycerol are explored. Knowledge on candle- making, soap-making, margarine-making, lubricant-making and also use of fats and oils in the paper and cosmetic industries equips the student with the desired competence required for the achievement of the overall program objective.				
Course Learning Outcomes	By the end of the course, the learner should be able to; 1. Identify the nature and sources of different fats and oils 2. Classify different types of fats and oils 3. Apply engineering principles to evaluate the processing technologies of different types of fats and oils. 4. Draw a flowchart for processing of fats and oils				
Mode of Delivery	1. Lectures 2. Tutorials 3. Flipped learning				
Assessment method-CO Mapping	(see table below)				
Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile	(see table below)				
Content Outline of the Course and the SLT per Topic	(see table below)				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Continuous Assessment Tests and Tasks (CATTs)	40	X	X	X	X
Final Examination	60	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK4
CO2	PO2	
CO3	PO2, PO5	
CO4	PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Nature and Sources of Fats and Oils: Chemical and physical characteristics, Animal and vegetable sources, fish oils.	4	2		10	
2	Edible and inedible fats, Drying and non-	4	2		10	

		drying oils. Deterioration of fats and oils, pretreatment and purification of feedstocks.					
	3	**Task 1**				1	1
	4	. Properties of Fats and Oils: Chemical composition, Triglycerides and fatty acids, Saturated and unsaturated fatty acids, Measures of unsaturation, Other useful tests.	6	3		15	
	5	Production of oil: mechanical and solvent extraction, Refining, Decolorizing or bleaching, Deodorizing, Winterizing.	4	2		10	
	6	**Task 2**				1	1
	7	Commercial production of animal fats, Hog fats or lard, Greases, Cattle and sheep fats or tallow, Production of garbage grease and similar products, fractionation, catalytic hydrogenation and interesterification, esterification, glycerol production and esterification, solvolysis of fats in order to make fatty acids, polymerization, ethoxylation and hydrogenation of fatty acids, synthesis of fatty alcohols, fatty amines, branched and dibasic acids and emulsifiers.	8	4		20	
	8	Use: Production of stearin, Hydrogenation of fats and oils, Soap making, Candle making, Lubricants, Margarine, Lard	2	1		5	

	compounds, use in textile, paper and cosmetics industries.					
9	Group work				1	1
Final Exam					2	2
		28	14		75	5

Course Texts	Shahidi, F. (2020). Edible Oil and Fat Products: Chemistry, Properties, and Health Effects, Bailey's Industrial Oil and Fat Products, (7th Edn.), John Wiley & Sons, Inc., Wiley Interscience Publication (2020).
Supplementary Texts	Frank, D. G. (2009). The Chemistry of Oils and Fats: Sources, Composition, Properties and Uses, Blackwell Publishing Ltd, UK.
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Pulp and Paper Technology				
Course Code	CPE501				
Course Convener Name **Room No.** **Email**	TBD				
Year	5				
Semester	2				
Rationale for the inclusion of the Course in the programme	Chemical and process engineers play a critical role in pulp and paper manufacture. The conversion of various raw materials into pulp and paper involves several process steps including debarking, chipping, screening, digestion, pulping, refining, drying etc. This course introduces the learner to the main operations involved in pulp and paper manufacture. The course will enable the learner to work effectively in the pulp and paper industry				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		76	118
Credit Value	3				
Pre-requisite (if any)	CHE 212- Organic Chemistry				
Course Objective	The objectives of this course are to enable learning about; 1. Raw materials for pulp and paper industry 2. Principles of digestion and types of digesters 3. Pulping processes 4. Paper formation processes and machines				
Synopsis	This course applies the concepts of organic chemistry, reactor engineering, particle technology and mass transfer in the manufacture of pulp and paper.				

Course Learning Outcomes	On completion of this course, learners will be able to: 1. Explain the process of paper manufacture from the logs to the final product. 2. Distinguish between different pulping technologies. 3. Apply design principles to illustrate the process for paper making. 4. Cost the paper making process
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Presentations

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15		X	X	
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK4, WK5, WK9
CO2	PO1, PO3	
CO3	PO1, PO8	
CO4	PO1, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Raw materials for pulp and paper industry Logging. Material preparation: debarking, chipping, screening, storage,	4	2		10	
2	Digestion. Principles of digestion, types of digesters.	4	2		10	
	Task 1: Assignment				1	1
3	Pulping processes: mechanical, thermochemical, thermo-mechanical, chemo-thermo-mechanical, chemical, Kraft, Soda, Nitrate, sulphate. Washing of pulp; systems and factors.	6	3		15	
	In-Class Test 1				1	1
4	Refining and refiners. Paper making machines: table	6	3		15	

	machines, cylinder machines.						
5	Stock preparation: sizing, filling, dyeing. Paper formation: casting, dewatering, pressing and presses.	4	2		10		
	In-Class Test 2				1	1	
6	Drying: dryers, mechanisms and factors. Rolling, calendaring, cutting, packaging and storage. Biological pulping.	4	2		10		
	Task 2: Group activity/ presentation)				 1	1	
Final Exam					2	2	
		28	**14**		**76**	**6**	

Course Texts	Clark, J.J. (2018). The Manufacture of Pulp and Paper, Vol. 1: A Textbook of Modern Pulp and Paper Mill Practice.
Supplementary Texts	Smook, G. (2016). Handbook For Pulp and Paper Technologists (The SMOOK Book), (4th Edn.).
Other additional information:	Websites, Video link, Lecture Notes

Course Name	Biochemical Engineering				
Course Code	CPE502				
Course Convener Name **Room No.** **Email**	Mr Daudi Masinde SR3 maasdaudi@yahoo.com				
Year	5				
Semester	1				
Rationale for the inclusion of the Course in the programme	Biochemical Engineering is a sub-field of Chemical Engineering that utilizes biological organisms and organic molecules with various applications in the fields of food production, pharmaceuticals, biofuels, water treatment and biotechnology. Bioprocesses have recently experienced massive growth as they require mild reaction conditions, are more specific and efficient, and produce renewable by-products (biomass) in comparison to more traditional chemical processes				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**

	28	14		82	124

Credit Value	3
Pre-requisite (if any)	CPE 415, CPE 422, CPE 425
Course Objective	To acquaint the students with the fundamentals of Biochemical Engineering. The objective of this course is to introduce the basic concepts of biomolecular and cellular function and how they are applied to bioreactor design and analysis.
Synopsis	The course covers the fundamentals of enzymes and microbes (kinetics, factors, applications etc), bioreactors and sterilization.
Course Learning Outcomes	At the conclusion of this course, the student should be able to; 5. Describe the role of microorganisms and enzymes in Biochemical Engineering 6. Apply biochemical principles to design bioreactors 7. Develop models of microbial growth, product production, substrate utilization through application of the principles of microbial growth kinetics 8. Identify the different types of sterilization and their corresponding applications
Mode of Delivery	1. Lectures 2. Tutorials 3. Group Discussions 4. Case Studies

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: (Sit-In Test 1)	15	X	X		
Task 1: Case Study 1 (Individual)	10	X	X		
CAT 2 (Sit-In Test 2)	15		X	X	
Task 2: Case Study 2 (Individual)	10		X	X	
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2, PO3	WK1, WK2, WK3, WK4, WK5, WK8
CO2	PO1, PO2, PO3	
CO3	PO1, PO2, PO3	
CO4	PO1, P02, PO3, PO6, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction:** Classification and structure of microorganisms (Archaea, bacteria, fungi). Industrial importance of microorganism.	2	1		5	
2	**Enzymes:** Properties of enzymes, Enzymes vs inorganic catalysts, Enzyme	2	1		5	

		Kinetics (Michaelis-Menten model).					
	3	**Bioreactors Part 1:** Bioreactor design, Parts of a bioreactor and their functions, Modes of operation (Batch, fed-batch, continuous), Aerobic and anaerobic fermentation.	4	2		10	
		In-Class Test 1				1	1
	4	**Bioreactors Part 2:** Cell and enzyme immobilization techniques, Types of bioreactors (CSTR, airlift, bubble, fluidized bed, packed bed, photoreactor).	6	3		15	
		Task 1: Case Study 1 (Individual)				1	1
	5	**Microbial Growth Kinetics Part 1:** Monod growth kinetics, Batch culture kinetics, Yield coefficients.	4	2		10	
		In-Class Test 2				1	1
	6	**Microbial Growth Kinetics Part 2:** Continuous culture kinetics (Ideal chemostat, turbidostat, PFR).	6	3		15	
		Task 2: Case Study 2 (Individual)				1	1
	7	**Sterilization:** Applications, Methods of sterilization, Thermal sterilization, Sterilization kinetics, Medium sterilization.	4	2		10	
		Final Exam				2	2
			28	**14**		**76**	**6**
Course Texts	Michael L Schuler, Fikret Kargi (2001), *Bioprocess Engineering Basic Concepts*, 2nd Edition, ISBN 0-13-081908-5						

Supplementary Texts	1. Franco, R. (2022). *Fermentation and Biochemical Engineering*, USA, Kaufman Press Exclusive 2. Katoh, S., Horiuchi, J. and Yoshida, F. (2015). *Biochemical Engineering: A Textbook for Engineers, Chemists and Biologists*, USA, Wiley-VCH
Other additional information:	Websites, Video link, Lecture Notes etc.

<table>
<tr><td>Course Name</td><td colspan="5">Petroleum Technology</td></tr>
<tr><td>Course Code</td><td colspan="5">CPE503</td></tr>
<tr><td>Course Convener Name
Room No.
Email</td><td colspan="5">Mr Wiseman Tumbo Ngigi

TBD

wisemanngigi@mu.ac.ke</td></tr>
<tr><td>Year</td><td colspan="5">5</td></tr>
<tr><td>Semester</td><td colspan="5">2</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">Chemical and process engineers play a critical role in crude oil refining. The conversion of crude oil into finished products involves a number of operations such as distillation, cracking, polymerization, reactors, filtration etc. This course introduces the learner to the main operations involved in crude oil refining.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>76</td><td>118</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">CHE 212- Organic Chemistry.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objectives of this course are to enable learning about;
1. Occurrence of petroleum: exploration and production methods
2. Classification of refinery products and their uses
3. Refining operations
4. Petroleum wastes</td></tr>
<tr><td>Synopsis</td><td colspan="5">This course applies the concepts of organic chemistry, thermodynamics, fluid mechanics, mass transfer, engineering design and reactor engineering in petroleum refining</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Explain the process of manufacture of petroleum products from raw material to the finished product.
2. Identify the unit operations involved in the manufacture of petroleum products from crude petroleum.
3. Model the process of upgrading the petroleum products to add value
4. Design petroleum waste handling systems</td></tr>
<tr><td>Mode of Delivery</td><td colspan="5">1. Lectures (hybrid)
2. Tutorials
3. Presentations</td></tr>
</table>

Assessment method-CO Mapping	(see table below)

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15		X	X	
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK4, WK5, WK9
CO2	PO1, PO3	
CO3	PO1, PO8	
CO4	PO1, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introduction:** occurrence of petroleum. Exploration and production methods. Classification of refinery products and their uses.	4	2		10	
2	Physical and Chemical properties. Chemical constituents.	4	2		10	
	Task 1: Assignment				1	1
3	**Processing or refining operations. Separation process:** fractional distillation, absorption. Conversion process: catalysis and thermal cracking. Catalysis and thermoreforming. Polymerization, alkylation, hydrogenation, isomerization, hydrocracking.	6	3		15	
	In-Class Test 1				1	1
4	Chemical treatment: removal of colour, odour, and gum resins. Asphaltic material.	6	3		15	
5	Fuel Additives: improvement of stability and susceptibility.	4	2		10	
	In-Class Test 2				1	1
6	Petroleum wastes	4	2		10	

	Task 2: Group activity/ presentation)				1	1
Final Exam					2	2
		28	**14**		**76**	**6**

Course Texts	1. Kaiser, M.J., Arno de Klerk, Gary, J.H., & Glenn, E. (2020). Handwerk. Petroleum Refining: Technology, Economics, and Markets, (6th edn), CRC Press, Taylor & Francis Group. 2. Meyers, A.R. (2016). Handbook of Petroleum Refining Processes, (4th edn.), New York, McGraw Hill Publishers.
Supplementary Texts	Rathi, R. (2007). Petroleum Refining Processes. New Delhi, SBS Publishers & Distributors PVT. LTD.
Other additional information:	Websites, Video link, Lecture Notes

-Course Name	Food Processing Industries				
Course Code	CPE504				
Course Convener Name **Room No.** **Email**	TBD				
Year	5				
Semester	1 or 2				
Rationale for the inclusion of the Course in the programme	To provide participants with a thorough understanding of the key concepts and methods in food processing. To enhance knowledge of food safety standards and quality control measures in food processing.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	120
Credit Value	3				
Pre-requisite (if any)	CPE 311 – Analytical Chemistry, CPE 313 – Heat Transfer, CPE 315 – Particle Technology II, CPE 414 – Mass Transfer II, CPE 424 – Mass Transfer III				
Course Objective	This course is designed to train learners to acquire knowledge, skills and attitudes on food processing industries. It enables learning about; Basic Concepts and Principles of food processing and preservation, Unit operations in food processing, Principles of preservation by salting, smoking, microwave, radiation, chemical techniques and common food industries and their technologies: sugar, dairy, cereals, tea, coffee				
Synopsis	This course analyses various aspects of food processing, including raw material handling, preservation techniques, food safety, quality control, and the latest technological advancements in the industry. It applies the concepts of the basic technology and unit operations involved in production of various food products to achieve desirable quality.				

Course Learning Outcomes	By the end of the course, the learner should be able to; 1. Outline the basic concepts and principles of food processing and preservation 2. Analyse the various unit operations in food processing industries 3. Apply the principles of preservation by drying salting, smoking, radiation to solve problems food processing. 4. Evaluate Common food industries and their technologies
Mode of Delivery	4. Lectures(Hybrid) 5. Tutorials 6. Case studies 7. Group Discussions 8. Presentations 9. Demonstrations
Assessment method-CO Mapping	(see table below)

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual Report and presentation)	20	X	X		
CAT 1 (Sit-In Test 1)	10		X		
Task 2: Assignment (Group, Report and presentation)	20			X	X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK3, WK4, WK5, WK6
CO2	PO2	
CO3	PO2, PO8	
CO4	PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Basic Concepts Principles of food processing and preservation**: Unit operations in food processing; Principles of preservation by drying, salting, smoking, radiation and chemical techniques	8	4		20	
	Task 1: Assignment (Individual Report and presentation)				1	1
2	**Sugar Industry:** production of cane sugar, refining, decolorization, char filtration, quality control	6	3		15	

3	**Dairy Technology**: processing of milk and milk products.	4	2		10	
	CAT 1 (Sit-In Test 1)				1	1
4	**Cereals Technology**: technological aspects of the processing of cereals.	4	2		10	
5	**Tea and Coffee Technology**: processing of tea and coffee, classification, blending and packaging.	6	3		15	
	Task 2: Assignment (Group, Report and presentation)				1	1
	CAT 2 (Sit-In Test 2)				1	1
Final Exam					2	2
		28	**14**		**76**	**6**

Course Texts	1. Sharma, H.K. and Kumar, N. (2022). Agro-Processing and Food Engineering: Operational and Application Aspects. 2. Boye, Joyce; Arcand, Yves eds. (2012) Green Technologies in Food Production and Processing, Springer Inc.
Supplementary Texts	1. Clark, S., Jung, S. and Lamsal, B. (2014). Food Processing: Principles and Applications, (2nd Edn), ISBN: 978-0-470-67114-6. 2. Howard, Q. Zhang eds. et al, (2011) Nonthermal Processing Technologies for Food, Wiley-Blackwel
Other additional information:	Websites, Video link, Lecture Notes etc

Course Name	Computer Aided Process Simulation
Course Code	CPE505
Course Convener Name **Room No.** **Email**	TBD
Year	5
Semester	1 or 2
Rationale for the inclusion of the Course in the programme	Computer Aided Process Simulation is one of the supplementary thematic areas in chemical engineering that is widely exploited in all process industries. The knowledge and skills gained help learners to undertake flow sheet process simulation.

Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	18	9	22	71	120
Credit Value	3				

Pre-requisite (if any)	CPE419: Process Modelling & Simulation, CPE 428: Chemical Engineering Design II, CPE429: Process Dynamics & Control
Course Objective	The aim of the course is to: 1. Cause the students to appreciate the importance of computer programs in flow sheeting and mass and energy balance 2. Make them to use computer software in process design 3. Make them apply computer software in process simulation 4. Inoculate teamwork skills by using flow sheet simulation software to simulate a chemical process.
Synopsis	This course applies the process simulation techniques using a process flow sheet simulation application. Moreover, simulation models are applied in the design and operation of unit operations and unit processes.
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Explain the systematic approach to process simulation as applied in design, control and optimization. 2. Develop a process flow sheet in a simulation application 3. Employ a simulation software to design a process 4. Use computer-aided analyses of large-scale chemical processes
Mode of Delivery	1. Lectures 2. Tutorials 3. Laboratory

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Continuous Assessment Tests and Tasks (CATTs)	60	X	X	X	X
Final Examination	40	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK2, WK4
CO2	PO1, PO2	
CO3	PO2, PO3, PO5	
CO4	PO2, PO3, PO5	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Review to Simulation in Chemical Processes:** Computer aided process engineering; Approaches to simulation problems; Architecture of flow sheeting software; Selection of simulation software; Application of computer simulation	6	3	0	15	
2	**Fundamentals of steady flow sheeting:** Fundamental issues in flow sheeting; Unit operations;	4	2	0	10	

	Thermodynamic issues; Simulation procedures					
3	**Basic computer aided process modelling and simulation:** Reactors simulation; Separators simulation; Process synthesis by Hierarchical Approach; Reactor-separation synthesis; Reactor-separator-recycle; Mass transfer equipment; Solid processing.	4	2	11	21	
4	**Computer aided Project evaluation:** Chemical process modelling and simulation of a whole plant; Economic analysis, sensitivity and optimization of a chemical plant; Heat exchangers network	4	2	11	21	
Final Exam					4	6
		18	**9**	**22**	**71**	**6**

Course Texts	1. Turton, R., Shaeiwit, J., Bhattachar, D., Whiting, W. (2018) Analysis, Synthesis, and Design of Chemical Processes (5th Ed.), Prentice Hall 2. Amiya, J.K. (2011) Chemical Process Modelling and Computer Simulation, (2nd Ed.) Prentice-Hall of India Private Ltd, New Delhi. 3. Amiya, J.K. (2009) Process Simulation and Control using Aspen. Prentice-Hall of India Private Ltd, New Delhi.
Supplementary Texts	1. Gaikwad, R.W. and Dhirendra, (2003) *Process Modelling& Simulation*, Central Techno Publications, Nagpur. 2. Michael, B. Cutlip, M. S. (2000) *Problem Solving in Chemical Engineering with Numerical Methods*, Prentice Hall PTR, London. 3. Steven, C. Chapra, Raymond P. Canale, (1998) *Numerical Methods for Engineers* 3rd Ed., McGraw-Hill, Boston. 4. Aspentech, (2001) *Aspen Physical property methods and models* 5. Aspen Plus (v8.4) simulation software 6. Hanyak, M.E, *Chemical Process Simulation and the Aspen HYSYS v8.3 Software*
Other additional information:	Process Simulator, Websites, Video link, Lecture Notes etc

Course Name	Electrochemical and Corrosion Technology
Course Code	CPE506
Course Convener Name **Room No.**	TBD

<table>
<tr><td>Email</td><td></td></tr>
<tr><td>Year</td><td>5</td></tr>
<tr><td>Semester</td><td>2</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td>Chemical and process engineers use equipments to transform raw materials into finished products and by products. Over time, these equipments deteriorate/wear out mainly due to corrosion. This course introduces the concepts of electrochemical and corrosion technology to the learner.</td></tr>
<tr><td>Total Student Learning Time (SLT)</td><td>
<table>
<tr><th>Lectures</th><th>Tutorial</th><th>PBL/Design /Lab</th><th>Self-Learning Including Prep Time</th><th>Total Learning Time</th></tr>
<tr><td>28</td><td>14</td><td></td><td>76</td><td>118</td></tr>
</table>
</td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Pre-requisite (if any)</td><td>CPE 221- Physical Chemistry</td></tr>
<tr><td>Course Objective</td><td>The objectives of this course are to enable learning about;
5. Fundamental concepts for electrolysis process
6. Electrolytic methods
7. Application of electrolysis
8. Corrosion and corrosion control</td></tr>
<tr><td>Synopsis</td><td>This course applies the concepts of physical chemistry in corrosion and electrolysis processes.</td></tr>
<tr><td>Course Learning Outcomes</td><td>On completion of this course, learners will be able to:
1. Define the fundamental concepts for electrolysis process
2. Distinguish the various Electrolytic methods
3. Apply principles of electrolysis to solve engineering problems
4. Develop processes for corrosion control</td></tr>
<tr><td>Mode of Delivery</td><td>1. Lectures (hybrid)
2. Tutorials
3. Presentations</td></tr>
<tr><td>Assessment method-CO Mapping</td><td>
<table>
<tr><th>Distribution</th><th>(%)</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Task 1: Assignment (Individual)</td><td>10</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>CAT 1 (Sit-In Test 1)</td><td>15</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>CAT 2 (Sit-In Test 2)</td><td>15</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Task 2: Assignment (Group)</td><td>10</td><td></td><td></td><td></td><td>X</td></tr>
<tr><td>Final Examination</td><td>50</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
<tr><td>Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile</td><td>
<table>
<tr><th>Course Learning Outcome</th><th>Programme Learning Outcome</th><th>Knowledge Profile</th></tr>
<tr><td>CO1</td><td>PO1</td><td rowspan="4">WK4, WK5, WK9</td></tr>
<tr><td>CO2</td><td>PO1, PO3</td></tr>
<tr><td>CO3</td><td>PO1, PO8</td></tr>
<tr><td>CO4</td><td>PO1, PO8</td></tr>
</table>
</td></tr>
<tr><td>Content Outline of the Course and the SLT per Topic</td><td>
<table>
<tr><th>No.</th><th>Topic</th><th>Lectur e</th><th>Tutorial</th><th>Lab</th><th>Self-Learning</th><th>FE/Q/ MT</th></tr>
</table>
</td></tr>
</table>

	1	Introduction: electrolysis, fundamental concepts for electrolytic processes	4	2		10	
	2	Aluminium manufacture: alternative processes, manufacture of other metals using electrolytic methods such as magnesium, copper, sodium and silicon. Silicothermic and ferrosilicon processes.	4	2		10	
		Task 1: Assignment				1	1
	3	Primary and secondary cells, electromotive force of a cell (emf), voltage and current efficiency, hydrogen oxygen cell, commercial fuel cells.	6	3		15	
		In-Class Test 1				1	1
	4	Electro organic chemical processes: adiponitrile from acrylonitrile and tetra ethyl lead (TEL).	6	3		15	
	5	Corrosion and corrosion control: corrosion cells, standard hydrogen cell, measurement of electrode potential, Nernst equation, corrosion current, rate of corrosion	4	2		10	
		In-Class Test 2				1	1
	6	Mechanisms of passivation, pH measurements, construction of Pourbaix diagrams and their use, cathodic protection, ionic protection.	4	2		10	
		Task 2: Group activity/ presentation)				1	1
		Final Exam				2	2
			28	**14**		**76**	**6**

Course Texts	Nestor, P. (2016). Electrochemistry and Corrosion Science. (2nd edn.) Springer Cham. ISBN978-3-319-24845-5. DOI: https://doi.org/10.1007/978-3-319-24847-9.
Supplementary Texts	Elena, P. G. and Andrew, V. N. (2010). Electrochemical Oxidation and Corrosion of Metals (Chemistry Research and Applications), Nova Science Pub Inc.
Other additional information:	Websites, Video link, Lecture Notes

Course Name	Advanced Industrial Pollution Control				
Course Code	CPE507				
Course Convener Name Room No. Email	TBD				
Year	5				
Semester	1				
Rationale for the inclusion of the Course in the programme	Chemical and process engineers are involved in the conversion of raw materials into products and by products during their day-to-day operations. These operations produce wastes which are harmful to the environment. This course enables the learner to acquire skills on how to manage various types of wastes generated during industrial operations. Emerging environmental issues such as global warming; ozone layer, nuclear wastes and agricultural methods of heavy metals removal are also covered in this course.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		76	118
Credit Value	3				
Pre-requisite (if any)	CPE415: Introduction to Environmental Engineering, CPE425: Industrial Pollution Control II				
Course Objective	The objectives of this course are to enable learning about; 1. Waste treatment systems design and operation 2. Conversion of waste into valuable products 3. Emerging environmental issues and solid waste management 4. Design of waste mitigation techniques				
Synopsis	This course applies the concepts of environmental engineering in industrial pollution control.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Describe various processes and equipment for waste treatment 2. Calculate conversion and yields in the treatment of waste 3. Interpret the nature of emergence of new environmental problems 4. Design waste management techniques to mitigate environmental problems caused by pollution				
Mode of Delivery	1. Lectures (hybrid) 2. Tutorials 3. Presentations				

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
Task 1: Assignment (Individual)	10	X			
CAT 1 (Sit-In Test 1)	15		X	X	
CAT 2 (Sit-In Test 2)	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK4, WK5, WK9
CO2	PO1, PO3	
CO3	PO1, PO8	
CO4	PO1, PO8	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	Design and optimal operation of waste treatment systems; biological and chemical processes, photo protein, cell coagulation, microbial cell removal, application of fixed and fluidized bed reactors	4	2		10	
2	Conversion of waste into valuable products	4	2		10	
	Task 1: Assignment				1	1
3	Emerging environmental issues such as global warming; ozone layer	6	3		15	
	In-Class Test 1				1	1
4	Agricultural methods of heavy metals removal	6	3		15	
5	Nuclear wastes; leakages and hazards	4	2		10	
	In-Class Test 2				1	1
6	Solids waste management.	4	2		10	
	Task 2: Group activity/ presentation)				1	1
Final Exam					2	2
		28	**14**		**76**	**6**

Course Texts

1. Lawrence K. Wang, Norman C. Pereira, Yung Tse Hung eds, (2005) Advanced Air and Noise Pollution Control, Humana Press Inc. New Jersey.
2. Parker, G. (2016). Environmental Engineering: Fundamentals and Applications. USA: CRC Press.
3. Spellman, F.R. (2015). Handbook of Environmental Engineering. USA: CRC Press.

Supplementary Texts	1. Martin, B. & Hocking, M.B. (2005) Handbook of Chemical Technology and Pollution Control. (3rd edn.). London: Elsevier Inc. 2. Laws of Kenya. (1999). Environmental Management and Co-Ordination Act Chapter 387. Revised Edition 2012. Published by the National Council for Law Reporting.
Other additional information:	Websites, Video link, Lecture Notes

Course Name	Polymer Science and Engineering				
Course Code	CPE508				
Course Convener Name **Room No.** **Email**	TBD				
Year	5				
Semester	1				
Rationale for the inclusion of the Course in the programme	Polymer science and engineering is an integral element of chemical engineering profession. It gives learners a rich understanding of the chemistry, properties, processing characterisation and application of polymers. Knowledge acquired in this course will play a major role in advancement of polymer products and end-user applications.				
Total Student Learning Time (SLT)	**Lectures**	**Tutorial**	**PBL/Design /Lab**	**Self-Learning Including Prep Time**	**Total Learning Time**
	28	14		78	124
Credit Value	3				
Pre-requisite (if any)	SCH212 Carbonyl Chemistry, CPE321 Materials Science				
Course Objective	The objectives of this course are to enable learning about; 1. Chemistry and kinetics of polymerization 2. Characteristics and rheological behaviour of polymers 3. Polymer manufacturing technologies 4. Polymer compound design				
Synopsis	This course covers concepts in science and engineering of macromolecules, such as synthesis and chemistry, characterization of molecular weight, morphology, rheology, and mechanical behaviour, structure and property relationship and polymer processing technologies.				
Course Learning Outcomes	On completion of this course, learners will be able to: 1. Describe fundamental concepts and applications of polymer science and engineering 2. Analyse the kinetics and mechanisms of polymerization 3. Develop skills in synthesis and characterisation of polymers. 4. Relate engineering principles to polymer manufacturing process 5. Select a specific polymer for specific applications				
Mode of Delivery	3. Lectures (hybrid) 4. Tutorials 5. Group discussions				

	6. Flipped learning
Assessment method-CO Mapping	(see table below)

Distribution	(%)	CO1	CO2	CO3	CO4	CO5
Task 1: Assignment (Individual)	10	X				
CAT 1 (Sit-In Test 1)	15		X			
CAT 2 (Sit-In Test 2)	15			X		
Task 2: Assignment (Group)	10				X	X
Final Examination	50	X	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1	WK1, WK3, WK4, WK6
CO2	PO1	
CO3	PO3	
CO4	PO2, PO3	
CO5	PO8, PO9	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Introductory concepts and definitions:** Review of the chemistry and kinetics of polymerization: applications, structure of polymers, review of organic molecules, polymer classifications (thermoplastic, thermosets, elastomers), tacticity, copolymers.	4	2		10	
	Task 1: Assignment/Quiz				1	1
2	Polymer characterization, molecular weight- averages and distribution; thermodynamics of polymer solutions, measurement of number-average molecular weight. Polymer crystallinity, glass transition temp, liquid crystalline polymers.	4	2		10	
	In-Class Test 1				1	1
3	Thermodynamics of polymers: solutions and	4	2		10	

		phase separation, enthalpy and entropy of mixing, Flory-Huggins interaction parameter, polymer-solvent interaction parameters, energy of mixing, cohesive energy density, polymer blends.					
		Kinetics of Polymerization: condensations, additions, kinetics of stepwise polymerisations, number average degree of polymerisation, kinetics of addition polymerisations, chain transfer agents, inhibitors, kinetics of polymerisation of co-polymers,	6	3		15	
		In-Class Test 2				1	1
	4	Technology of manufacture: continuous processing: die forming and extrusion, calendaring, fiber spinning Cyclic processing: injection molding, compression molding, blow molding, thermoforming, reaction injection molding. Polymer degradation	4	2		10	
	5	Polymer compounds design, bulk, solution, suspension and emulsion.	2	1		5	
		Group Assignment				1	1
	6	Characteristics of polymers, strength/strain behaviour in tension, compression, shear and flexure, elements of rheological behaviour of polymers, thermal characteristics.	4	2		10	

	Final Exam					2	2
			28	14		76	6

Course Texts	1. Fakirov, S. (2017). *Fundamentals of Polymer Science for Engineers.* Wiley. ISBN:9783527341313, 3527341315 2. Alfred Rudin and Phillip Choi. (2013). Polymer Science and Engineering, 3rd Edition. Academic Press: USA.
Supplementary Texts	Painter, P.C. and Coleman, M.M. (2009). *Essentials of Polymer Science and Engineering.* DEStech Publications, Incorporated. ISBN:9781932078756, 1932078754
Other additional information:	Websites, Video link, Lecture Notes etc.

<table>
<tr><td>Course Name</td><td colspan="5">Pharmaceutical Technology</td></tr>
<tr><td>Course Code</td><td colspan="5">CPE509</td></tr>
<tr><td>Course Convener
Name
Room No.
Email</td><td colspan="5">Prof. Eng. Milton M M'Arimi</td></tr>
<tr><td>Year</td><td colspan="5">5</td></tr>
<tr><td>Semester</td><td colspan="5">1</td></tr>
<tr><td>Rationale for the inclusion of the Course in the programme</td><td colspan="5">Manufacture of pharmaceutical drugs is among the application of chemical engineers. Through this course, knowledge, professional competences and skills in production of human drugs are gained. It helps learners to relate all aspects of drug manufactures such as technical, regulatory, ethical and professional requirements.</td></tr>
<tr><td rowspan="2">Total Student Learning Time (SLT)</td><td>Lectures</td><td>Tutorial</td><td>PBL/Design /Lab</td><td>Self-Learning Including Prep Time</td><td>Total Learning Time</td></tr>
<tr><td>28</td><td>14</td><td></td><td>76</td><td>118</td></tr>
<tr><td>Credit Value</td><td colspan="5">3</td></tr>
<tr><td>Pre-requisite (if any)</td><td colspan="5">CHE 212-Organic Chemistry, CPE 325- Particle Technology II</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objectives of this course are to enable learning about good manufacturing process, quality management systems, process validation in pharmaceutical manufacture, wet and dry processes of tablet manufacture, stages for drug development and approval and drug delivery models. It enables understanding of interrelated disciplines; quality, environment, professional, technical and regulatory requirements that apply in pharmaceutical manufacture process.</td></tr>
<tr><td>Synopsis</td><td colspan="5">This course illuminates on the requirements of drug manufacturing process. The technical processes, management systems and physical structures that are necessary for producing pharmaceutical products are given.</td></tr>
<tr><td>Course Learning Outcomes</td><td colspan="5">On completion of this course, learners will be able to:
1. Outline good manufacturing practices for pharmaceutical products
2. Compare management systems applicable to a pharmaceutical industry
3. Apply engineering principles to determine the special utility requirements for pharmaceutical industry.
4. Model the drug dissipation in a human system</td></tr>
</table>

Mode of Delivery	Blended learning that incorporates both physical and online sessions shall be employed.

Assessment method-CO Mapping

Distribution	(%)	CO1	CO2	CO3	CO4
CAT 1: Sit in	15	X	X		
Task 1: Assignment (Individual)	10		X		
CAT 2: Sit in	15			X	X
Task 2: Assignment (Group)	10				X
Final Examination	50	X	X	X	X

Mapping of the Course to the Programme Learning Outcomes and Knowledge Profile

Course Learning Outcome	Programme Learning Outcome	Knowledge Profile
CO1	PO1, PO2	WK4 & WK6
CO2	PO2, PO4	
CO3	PO1, PO2, PO3	
CO4	PO2, PO3	

Content Outline of the Course and the SLT per Topic

No.	Topic	Lecture	Tutorial	Lab	Self-Learning	FE/Q/MT
1	**Process Validation**: Equipment qualification, Design qualification, Installation qualification, Operation qualification, Performance qualifications, Process validation, Retrospective validation, Cleaning Validation, Analytical method validation, Calibrations, Facility qualification (factory and storage facility),	8	4		20	
	CAT 1- Sit in				1	1
2	**Management systems:** ISO 9001, ISO 14001, HACCP and ISO 45001.	8	4		20	
	Individual Assignment				1	1
3	**Drug manufacturing process:** Contents of drugs, stages of drug manufacture, process layout for general process, wet and dry processes of drug manufacture. PAT (process analytical technology). Process capability and in process control	4	2		10	

		CAT 2 – Sit in				1	1
	4	**Drug development process:** Stages of human drug development, requirements for drug approval.	4	2		10	
	5	**Drug release model:** Models for release of drug into human digestive system	4	2		10	
		Group assignment				1	1
	Final Exam					2	2
			28	**14**		**76**	**6**
Course Texts	1. Sambamurthy, K. (2019). *Pharmaceutical Engineering*. (2nd edn.) India, New Age International Publishers 2. Hickey, A. J. and Ganderton, D. (2016). *Pharmaceutical Process Engineering*, USA, CRC Press.						
Supplementary Texts	1. Paradkar, A. (2016). *Pharmaceutical Engineering*. India, Nirali Prakashan Educational Publishers 2. Prager, G. (2018). *Practical Pharmaceutical Engineering*, (1st edn), USA, Wiley						
Other additional information:	Websites, Video link, Lecture Notes etc						