MOI UNIVERSITY

(ISO 9001: 2015 CERTIFIED INSTITUTION)

SCHOOL OF ENGINEERING

COURSE HANDBOOK

For the

DOCTOR OF PHILOSOPHY (PhD) IN ENERGY STUDIES CURRICULUM

DEPARTMENT OF MECHANICAL, PRODUCTION AND ENERGY ENGINEERING

2020

Contacts: hodmechanical@mu.ac.ke

1. INTRODUCTION

Energy studies is about energy and its sources and how to best utilize resources to provide energy to consumers and to do so as cheaply as possible while still protecting the environment and our health. The PhD programme in Energy studies is geared towards developing energy professionals with essential abilities applicable in both the renewables industry and the traditional energy industry. The study areas of the programme include energy technologies, energy systems management, energy efficiency, energy policy, energy safety and health as well as projects management.

1.1 Programme Philosophy

The philosophy of the PhD programme in Energy Studies is constructivist which is in line with the Moi University philosophy. The course is inter-disciplinary in focus with emphasis on the integration of knowledge and skills required to achieve competence in practice of energy profession. Learning is project based and application oriented, blended with relevant theoretical knowledge. The programme adopts a pragmatic approach in preparing graduates to be technically competent, socially engaged and politically aware in their professional and social role.

1.2 Programme Goal

The goal of this PhD programme is to create the highest level of scholarship, research and development capability in specialized areas of energy to provide sustainable solutions to challenges in the energy sector for betterment of society

1.3 Program Objectives

The overall objective of the programme is to train engineers and scientists in the area of energy by providing them with core knowledge, skills and competencies needed in solving the practical challenges facing the energy industry and the community in general with regard to energy development, provision and utilization. Specifically, the programme seeks to facilitate learning of:

i. Advanced and innovative research methods relevant to the energy sector.
ii. Energy policy, regulations and ethical issues in the energy industry.
iii. Energy resources, technologies and systems.
iv. Sustainable energy resource planning and management.

1.4 Programme Learning Outcomes

The programme provides opportunities for students to develop and demonstrate knowledge, skills and attributes in the areas of specialization. The graduates of this programme should be able to:

i. Develop independent and innovative research towards providing knowledge-based solutions for the challenges in the energy sector.
ii. Formulate appropriate policies, regulations and strategies to support the energy sector.
iii. Plan, implement and manage energy projects.
iv. Design, install and optimize clean energy systems, or adapt existing ones, to support energy accessibility

1.5 Mode of delivery of the Programme

This programme will be implemented using the following modes of delivery:

i. Full time (Face-to-face)
ii. Blended Learning (Lecture and E-learning)
iii. Project based learning
iv. Field practical & excursions

1.6 Academic Regulations

1.6.1 Admission Requirements

(a) To be eligible for admission into the degree programme, an applicant should hold any of the following:
   i. A master's degree of Moi University in Energy Studies, Engineering or any energy related discipline.
   ii. A relevant Master's degree as outlined in (i) from any other recognized University.

(b) In addition to Master's degree, an applicant shall normally have a Bachelor's degree.

1.6.2 Other Admission Requirements

Relevant working experience in the energy industry will be an added advantage.

1.6.3 Duration of the Programme

The duration of the programme shall be normally three (3) years.

1.6.4 Procedure of application for admission to the University

Advertisement for the programme is done annually between the months of May and June in print media and via Moi University website. Prospective students apply and attach copies of their certificates and credentials for consideration. Successful candidates are notified through email for start of classes in September. Admission letters and other relevant admission forms are downloaded from the University website.

1.6.5 Course Requirements

a) The programme consists of course work, examination and thesis. The minimum course work is 15 units of level 9 (PhD. level) courses. All course work is done in the first year of study.

b) The course work and research are distributed as follows:

Year	**Semester**	**Course**	**Units**
1	I	Course work	9
		Research	6
	II	Course Work	9
		Research	6
2	III & IV	Research	15
3	V & VI	Research	15
Total			60

c) A student shall not be allowed to sit for a university examination in a course, if he/she has missed 20% or more of the required course attendance.

d) Lecturers have the responsibility to prepare the course outline based on the curriculum upon which the course will be taught and to conduct content delivery. Copies of the course outline must be distributed to the students and head of department.

1.6.6 Student Assessment and Examination Regulations

The Common Regulations for the examination of PhD programmes of Moi University for both course work and thesis shall apply.

1. Except for the courses indicated in (2) below, each course shall be examined by a three-hour examination paper at the end of the semester, which shall normally contribute 60%

of the total mark. In addition there shall be course work assessment (Progressive/Continuous Assessment Tests and Laboratory Assignments) that will normally contribute to 40% of the total mark.

2. Courses to be examined through continuous assessment and reports only: ENS 901, ENS 902, and ENS 999. The PhD thesis shall be assessed through oral defence and grading of the written scientific document as follows: Oral defence 20% and Scientific document (proposal and thesis) 80%.
3. Candidates shall be required to pass in all the courses for which they are registered. The pass mark shall be 50%.
4. A candidate who fails more than one prescribed course in a given semester shall be discontinued.
5. A candidate who fails one semester course shall be eligible to take a Supplementary Examination provided that the mark obtained in the failed course is not below 40%.
6. Continuous assessment marks shall not count towards Supplementary Examinations.
7. A candidate who fails in any Supplementary Examination shall be discontinued.
8. A candidate who fails to sit an examination for medical reasons or bereavement shall be allowed to sit a Special Examination. Medical cases must be supported by documents from the University Chief Medical Officer.

1.6.7 Grading System for PhD coursework.

Percentage	Grade	
75 – 100	A	Distinction
65 – 74	B	Credit
50 – 64	C	Pass
Below 50	D	Fail

1.6.8 Credit Transfer and Exemption

The Moi University Credit Accumulation, Transfers and Exemptions Policy shall be used in determining the Credit Transfer applicable. The following general guidelines shall be applied:

i. The applicant must have met the minimum admission requirements for the PhD in Energy Studies.

ii. Applicants must have completed less than 49% coursework for the Doctoral degree courses at the previous (sending) institution programme.
iii. Applicants must provide evidence of certified copies of transcripts, course outlines and clearance from Prior Learning Institutions.
iv. Credit transfers shall only be accepted from CUE accredited institutions and other approved relevant professional and regulatory bodies where applicable.
v. Credit transfer will be applicable ONLY to courses with grades that are at least 10% above the Moi University pass mark for course work of a similar programme.
vi. The courses affected must be 75% similar in content to those being offered at the Moi University PhD Energy Studies programme.
vii. Credit transfer shall not be applicable to research proposals and Thesis.
viii. Applicants from Foreign Institutions must have their degree certificates and transcripts equated and certified by CUE.

1.6.9 Reference Materials

A wide range of reference materials covering applied sciences, and engineering are available. Some of the platforms for e-resources accessible in the Library include:

i. Taylor & Francis
ii. IEEE
iii. IMechE
iv. Emerald
v. Wiley Online Library
vi. Springer
vii. Institute of Physics (IOP)

Additional required core references and journals are reflected in curriculum under each subject taught

1.7 Programme Structure

1.7.1 Course Loading

Year	Semester	Code	Title	Units	Hrs
1	1	ENS 901	Research Seminar I	6	90
		ENS 903	Advanced Research Methods & Scientific Writing	3	45
		ENS 904	Energy Planning & Management	3	45
		ENS 905	Energy Projects Management	3	45
1	2	ENS 902	Research Seminar II	6	90
		ENS 906	Energy Systems Modelling & Optimization	3	45
			Elective I	3	45
			Elective II	3	45
2	3,4	ENS 999	Research	15	225
3	5,6	ENS 999	Research/Thesis	15	225
			Total	**60**	**855**

Elective I and II are chosen from the following list or other equivalently weighted courses approved by university Senate.

Code	Title	Units	Hrs
ENS 911E	Computational Fluid Dynamics	3	45
ENS 912E	Advanced Instrumentation for Energy Systems	3	45
ENS 913E	Power Plant Pollution Control	3	45
ENS 914E	Advanced Computational Techniques	3	45

Below is a detailed description of each course

1. ENS 901 RESEARCH SEMINAR I

<table>
<tr><td colspan="7">Course Title: RESEARCH SEMINAR I</td></tr>
<tr><td colspan="2">Course code:
ENS 901</td><td colspan="2">Student workload
180 hours</td><td>Credit Units
6</td><td>Semester
Sem. 1</td><td>Frequency
Year 1</td><td>Duration
1 Semester</td></tr>
<tr><td>1</td><td colspan="2">Types of courses
a) Seminar</td><td>Contact hours
90 hours</td><td colspan="2">Independent study
90 hours</td><td colspan="2">Class size
5 - 15 students</td></tr>
<tr><td>5</td><td colspan="7">Prerequisites for participation (if applicable)
N/A</td></tr>
<tr><td>2</td><td colspan="7">Learning outcomes:
On successful completion of this course, the student should be able to:
i. Review literature survey in area of interest.
ii. Develop a research plan with a clearly formulated problem definition.
iii. Present literature review in a clear manner, with the help of ICT skills.
iv. Prepare a review journal paper on a selected topic.</td></tr>
<tr><td>3</td><td colspan="7">Course Objectives
This course is designed to enable students:
i. Understand methods of literature survey.
ii. Select of relevant topic in their areas of interest.
iii. Develop of research plan.
iv. Write review paper in a Journal.</td></tr>
<tr><td>4</td><td colspan="7">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="7">Assessment method
Individual presentation assed by the course lecturer, 100%</td></tr>
<tr><td>8</td><td colspan="7">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="7">Responsibility for module/course
Prof. Henry Kirimi.</td></tr>
<tr><td>11</td><td colspan="7">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1 Uri Alon. 2009. How to choose a good scientific problem. Molecular Cell Forum.
2 Scott A. Socolofsky. 2004. How to write a research journal article in engineering and science.
3 https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
</table>

2. ENS 902 RESEARCH SEMINAR II

<table>
<tr><td colspan="7">Module/Course Title: ENS 902 RESEARCH SEMINAR II</td></tr>
<tr><td colspan="2">Course code:
ENS 902</td><td>Student workload
180 hours</td><td>Credit Units
6</td><td>Semester
Sem. 2</td><td>Frequency
Year 1</td><td>Duration
1 Semester</td></tr>
<tr><td>1</td><td>Types of courses
a) Seminar</td><td>Contact hours
90 hours</td><td colspan="2">Independent study
90 hours</td><td colspan="2">Class size
5 - 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable)
ENS 901 Research Seminar I</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Identify a researchable topic and formulate a research proposal
ii. Review the current status of research in area of interest
iii. Define and identify scientific gap and methodology for solving them.
iv. Present a research proposal in a seminar.</td></tr>
<tr><td>3</td><td colspan="6">Course Objectives
This course is designed to enable students:
i. Formulate research proposal
ii. Develop literature review from current resources
iii. Identify research problem.
iv. Presentation techniques for seminars</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
Individual presentation assed by the course lecturer, 100%</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Prof. Henry Kirimi</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1 C.R. Kothari, 2004. Research Methodology: Methods & Techniques, 2nd Ed. N.I. Publishers, New Delhi
2 Moi University GSREC Committee: Guidelines for writing thesis.
3 Scott A. Socolofsky. 2004. How to write a research journal article in engineering and science.
4 https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
</table>

3. ENS 903 ADVANCED RESEARCH METHODS & SCIENTIFIC WRITING

<table>
<tr><td colspan="7">Module/Course Title: ADVANCED RESEARCH METHODS & SCIENTIFIC WRITING</td></tr>
<tr><td colspan="2">Course code:
ENS 903</td><td>Student workload
90 hours</td><td>Credit Units
3</td><td>Semester
2. Sem.</td><td>Frequency
Semester 1</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td colspan="2">Types of courses
a) Taught</td><td>Contact hours
45 hours</td><td>Independent study
45 hours</td><td colspan="2">Class size
5 – 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable)
ENS 902 Research Seminar II</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Describe the principles of research and scientific writing.
ii. Identify appropriate methods and techniques applicable to each step of a research.
iii. Design and execute a research.
iv. Communicate research findings.</td></tr>
<tr><td>3</td><td colspan="6">Course Objectives
This course is designed to enable students:
i. Understand the principles of research and scientific writing.
ii. Evaluate various research methods and techniques.
iii. Appraise various research designs.
iv. Generate scientific reports from research findings.</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
End of Semester Examination, 60%; Continuous Assessment Tests (CATs), 40%; Total, 100%.</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Prof. Augustine Makokha/ Dr. NyoTonglo Arowo.</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1. Yogesh Kumar. 2006. Fundamentals of research methodology and statistics, N. I. Publishers, New Delhi.
2. C.R. Kothari, 2004. Research Methodology: Methods & Techniques, 2nd Ed. N.I. Publishers, New Delhi.
3. Creswell, John. 2008. Research design: Qualitative, quantitative, and mixed methods approaches. 2nd ed.: Sage Publications.
4. Montgomery, D. C. 2013. Design and Analysis of Experiments, 8th ed. Wiley
5. Alvin Rencher. 2002., Methods of Multivariate Analysis, John Wiley & Sons, USA.
6. https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
</table>

4. ENS 904 ENERGY PLANNING AND MANAGEMENT

<table>
<tr><td colspan="6">Module/Course Title: ENERGY PLANNING AND MANAGEMENT</td></tr>
<tr><td colspan="2">Course code:
ENS 904</td><td>Student workload
90 hours</td><td>Credit Units
3</td><td>Semester
1. Sem.</td><td>Frequency
Semester 1</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td colspan="2">Types of courses
a) Taught</td><td>Contact hours
45 hours</td><td>Independent study
45 hours</td><td>Class size
5 – 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable)
N/A</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Demonstrate techniques for energy planning.
ii. Appraise sustainable management strategies.
iii. Integrate various tools of energy management systems.
iv. Design an energy planning pathway.</td></tr>
<tr><td>3</td><td colspan="6">Course Objectives
This course is designed to enable students:
i. Understand techniques of energy planning.
ii. Analyse strategies for sustainable development.
iii. Evaluate tools to manage energy systems.
iv. Optimize pathways for energy planning.</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
End of Semester Examination, 60%; Continuous Assessment Tests (CATs), 40%; Total, 100%.</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Prof. Anil Kumar/ Dr. Stephen Talai.</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1 Vincenzo Bianco, 2017. Analysis of Energy Systems: Management, Planning and Policy, 1st Edition, CRC Press, ISBN 9781138746176
2 Anthony David Owen (Ed.), 2009. Energy Policy, Eolss Publishing Co Ltd., Oxford UK.
3 Int. J. Sustainable Energy Planning and Management, Aalborg University Press.
4 Robbins Stephen P and Coulter Mary, 2012. Management, 11th Ed., Prentice Hall, New Jersey.
5 Int. Journal of Energy Production and Management- WIT Press, Energy- Elsevier
6 https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
</table>

5. ENS 905 ENERGY PROJECTS MAMAGEMENT

<table>
<tr><td colspan="7">Module/Course Title: ENERGY PROJECTS MAMAGEMENT</td></tr>
<tr><td colspan="2">Course code:
ENS 905</td><td>Student workload
90 hours</td><td>Credit Units
3</td><td>Semester
2. Sem.</td><td>Frequency
Semester 1</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td colspan="2">Types of courses
a) Taught</td><td>Contact hours
45 hours</td><td colspan="2">Independent study
45 hours</td><td>Class size
5 – 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable)
N/A</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Develop a project plan and feasibility study.
ii. Conduct project life cycle assessment.
iii. Carry out situational analysis an energy project.
iv. Carry out an economic assessment of an energy project.</td></tr>
<tr><td>3</td><td colspan="6">Course Objectives
This course is designed to enable students:
i. Understand project planning process
ii. Assess project life cycle
iii. Appraise the techniques for situational analysis.
iv. Evaluate the economic viability of an energy project.</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
End of Semester Examination, 60%; Continuous Assessment Tests (CATs), 40%; Total, 100%.</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Prof. Anil Kumar/ Dr. Joseph Kiplagat.</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1 Prasanna, C. (2008). Projects, Planning, Analysis, Selection, Financing, Implementation and Review. Tata McGraw-Hill Publishing
2 Finnerty, J. D. (2013). Project financing: Asset-based financial engineering. John Wiley & Sons.
3 Frigenti, E., & Comninos, D. (2002). The Practice of Project Management: a guide to the business-focused approach. Kogan Page Publishers.
4 Andrew S. and Jennifer G. (2005) Applied Software Project Management, Cambridge, MA, O'Reilly Media.
5 Harold K. (2003) Project Management: A Systems Approach to Planning, Scheduling and Controlling, 8th Ed., Wiley.
6 https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
</table>

6. ENS 906 ENERGY SYSTEMS MODELLING & OPTIMIZATION

<table>
<tr><td colspan="7">Module/Course Title: ENERGY SYSTEMS MODELLING & OPTIMIZATION</td></tr>
<tr><td colspan="2">Course code:
ENS 906</td><td colspan="2">Student workload
90 hours</td><td>Credit Units
3</td><td>Semester
2. Sem.</td><td>Frequency
Semester 1</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td colspan="2">Types of courses
a) Taught</td><td>Contact hours
45 hours</td><td colspan="2">Independent study
45 hours</td><td>Class size
5 – 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable)
N/A</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Outline the uses of energy system models and their taxonomy.
ii. Determine the energy efficiency of industrial energy systems.
iii. Integrate the principles of modelling and optimisation in design of energy systems.
iv. Analyse the performance of an energy system using various optimisation tools.</td></tr>
<tr><td>3</td><td colspan="6">Course Objectives
This course is designed to enable students:
i. Understand the energy systems models
ii. Appraise the concepts of energy efficiency in industrial energy systems
iii. Apply energy models to various systems
iv. Evaluate models and optimization tools in design and performance evaluation of energy systems</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
End of Semester Examination, 60%; Continuous Assessment Tests (CATs), 40%; Total, 100%.</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Prof. Simiyu Sitati/ Dr. Letting Lawrence.</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1 Blanchard, Benjamin S., Fabrycky, Walter J., Systems Engineering and Analysis, 5th ed. Prentice Hall International Series, 2010.
2 Bonnans, J.F., Numerical Optimization, 2nd ed, Springer, 2006.
3 Yang, X.-S., Introduction to Mathematical Optimization-From Linear Programming to Metaheuristics: Cambridge International Science Publishing, 2008
4 https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
</table>

7. ENS 911E COMPUTATIONAL FLUID DYNAMICS

<table>
<tr><td colspan="7">Module/Course Title: COMPUTATIONAL FLUID DYNAMICS</td></tr>
<tr><td colspan="2">module/ course code: ENS 911E</td><td>Student workload
90 hours</td><td>Credit Units
3</td><td>Semester
1. Sem.</td><td>Frequency
Semester 1</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td>Types of courses
a) Taught</td><td>Contact hours
45 hours</td><td colspan="2">Independent study
45 hours</td><td colspan="2">Class size
5 – 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable)
N/A</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Formulate and solve the governing equations for fluid flows computationally.
ii. Perform simulations for various flow regimes applicable to energy.
iii. Develop appropriate CFD transport models.
iv. Undertake a case study to validate developed transport models of energy systems.</td></tr>
<tr><td>3</td><td colspan="6">Course Objectives
This course is designed to enable students:
i. Understand the fluid flow regimes and the appropriate simulation methods.
ii. Formulate the governing equations for a given fluid flow regimes.
iii. Appraise CFD techniques for modelling transport phenomena in energy systems.
iv. Apply CFD techniques for solving industrial problems.</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
End of Semester Examination, 60%; Continuous Assessment Tests (CATs), 40%; Total, 100%.</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Prof. Augustine Makokha/ Dr. Stephen Talai..</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1. Alan S. Morris, Reza Langari., 2016. Measurement and Instrumentation: Theory and Application, 2nd ed. Academic Press, ISBN 9780128008843
2. Robert S. Northrop, Introduction to Instrumentation and Measurements, Third Edition, CRC Press Taylor Francis Group, ISBN 9781482214826
3. Rastogi P.K. (Ed.), Holographic Interferometry: Principles and Methods, ISBN 9783540480785
4. Gregory K. McMillan, 1999. Process/Industrial Instruments and Controls Handbook, 5th ed. McGraw-Hill: New York,: 9780070125827
https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
</table>

8. ENS 912E ADVANCED INSTRUMENTATION FOR ENERGY SYSTEMS

<table>
<tr><td colspan="7">Module/Course Title: ADVANCED INSTRUMENTATION FOR ENERGY SYSTEMS</td></tr>
<tr><td colspan="2">Course code:
ENS 912E</td><td>Student workload
90 hours</td><td>Credit Units
3</td><td>Semester
1. Sem.</td><td>Frequency
Semester 1</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td>Types of courses
a) Taught</td><td>Contact hours
45 hours</td><td colspan="2">Independent study
45 hours</td><td colspan="2">Class size
5 – 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable) N/A</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Characterise the different types of transducers used in energy measuring devices and systems
ii. Apply appropriate instrumentation for measurement of energy process variables.
iii. Develop stand-alone and remote “cloud-based” energy data logging systems
iv. Determine uncertainty and defend the accuracy and integrity of acquired data.</td></tr>
<tr><td>3</td><td colspan="6">Course Objectives
This course is designed to enable students:
i. Understand the construction and transfer characteristics of different transducers and sensors applied in process measurements.
ii. Evaluate data acquisition systems for PC-aided measurement of multiple analogue sensor outputs.
iii. Appraise the current trends in data handling and analysis.
iv. Identify sources of noise and uncertainty in measurements and ways to minimise them.</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
End of Semester Examination, 60%; Continuous Assessment Tests (CATs), 40%; Total, 100%.</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Dr. Isaiah Muchilwa/ Dr. Joseph Kiplagat.</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1. Alan S. Morris, Reza Langari., 2016. Measurement and Instrumentation: Theory and Application, 2nd ed. Academic Press, ISBN 9780128008843
2. Robert S. Northrop, Introduction to Instrumentation and Measurements, Third Edition, CRC Press Taylor Francis Group, ISBN 9781482214826
3. Rastogi P.K. (Ed.), Holographic Interferometry: Principles and Methods, ISBN 9783540480785
4. Gregory K. McMillan, 1999. Process/Industrial Instruments and Controls Handbook, 5th ed. McGraw-Hill: New York,: 9780070125827
https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
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9. ENS 913E POWER PLANT POLLUTION CONTROL

<table>
<tr><td colspan="7">Module/Course Title: POWER PLANT POLLUTION CONTROL</td></tr>
<tr><td colspan="2">Course code:
ENS 913E</td><td colspan="2">Student workload
90 hours</td><td>Credit Units
3</td><td>Semester
2. Sem.</td><td>Frequency
Semester 1</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td colspan="2">Types of courses
a) Taught</td><td>Contact hours
45 hours</td><td colspan="2">Independent study
45 hours</td><td>Class size
5 – 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable)
N/A</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Compare and contrast types of pollution and pollutants in thermal power plants.
ii. Assess the level of pollutant emissions and recommend control strategies.
iii. Apply pollution control measures to power plants emissions.
iv. Design alternative power systems.</td></tr>
<tr><td>3</td><td colspan="6">Course Objectives
This course is designed to enable students:
i. Discuss types of pollution and pollutants in power plants
ii. Evaluate methods for prevention and mitigation of power plant pollution.
iii. Appraise measures applied in management of pollution in power plants
iv. Conceptualise alternative power systems</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
End of Semester Examination, 60%; Continuous Assessment Tests (CATs), 40%; Total, 100%.</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Prof. Zachary Siagi/ Dr. Charles Nzila.</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
1 Arcadio P. Sincero and Gregoria A. Sincero, 1996. Environmental Engineering: A Design Approach, Prentice Hall.
2 D. H. F. Lui, B.G. Lipak. 1997. Environmental Engineers' Handbook, 2nd Ed. Boca Raton: CRC press.
3 Behar, M. Chasin,M. Cheesman, 2000. Noise Control: A Primer. California: Singular Publishing Group.
4 B.J. Smith, R.J. Peters, S. Owen. 2001. Acoustic and Noise Control. 2nd Ed. Essex: Longman Group.
5 https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
</table>

10. ENS 914E ADVANCED COMPUTATIONAL TECHNIQUES

<table>
<tr><td colspan="7">Module/Course Title: ADVANCED INSTRUMENTATION FOR ENERGY SYSTEMS</td></tr>
<tr><td colspan="2">Course code:
ENS 914E</td><td>Student workload
90 hours</td><td>Credit Units
3</td><td>Semester
2. Sem.</td><td>Frequency
Semester 1</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td>Types of courses
a) Taught</td><td>Contact hours
45 hours</td><td colspan="2">Independent study
45 hours</td><td colspan="2">Class size
5 – 15 students</td></tr>
<tr><td>5</td><td colspan="6">Prerequisites for participation (if applicable)
N/A</td></tr>
<tr><td>2</td><td colspan="6">Learning outcomes
On successful completion of this course, the student should be able to:
i. Perform numerical integration.
ii. Solve problems using multivariate regression and time series analysis.
iii. Apply interpolation and carry out Fourier approximations.
iv. Use computer packages to solve complex computations for an energy case study.</td></tr>
<tr><td>3</td><td colspan="6">Subject aims/Content
This course is designed to enable students:
i. Understand numerical integration and optimisation techniques
ii. Formulate multivariate regression and time series analysis.
iii. Construct Least-square regression and Fourier analysis.
iv. Apply computer software’s in solving numerical problems</td></tr>
<tr><td>4</td><td colspan="6">Teaching methods
Lectures, Tutorials, Group Discussions, Presentations, Computer demonstrations</td></tr>
<tr><td>6</td><td colspan="6">Assessment methods
End of Semester Examination, 40%; Continuous Assessment Tests (CATs) and assignments, 60%; Total, 100%.</td></tr>
<tr><td>8</td><td colspan="6">This module/course is used in the following study programme/s as well
N/A</td></tr>
<tr><td>10</td><td colspan="6">Responsibility for module/course
Prof. Augustine Makokha/ Dr. Paul Maina.</td></tr>
<tr><td>11</td><td colspan="6">Other information:
Instructional Tools and Materials
Text books, handouts, Digital projectors, computers, white-boards, black-boards, Internet
Bibliographical references
References
1 Chapra S.C., Canale R.P. 2010. “Numerical Methods for Engineers”, Mc Graw Hill, 6th edition, ISBN 978-0-07-340106-5.
2 Buchanan J.L., Turner P.R. 1992. “Numerical Methods and Analysis”, Mc Graw Hill, Int. editions 1992, ISBN 0-07-112922-7.
3 Mathews J.H. 2003. “Numerical Methods for Mathematics, Science and Engineering, Prentice-Hall of India, 2nd edition, ISBN 81-203-0845-X.
4 Stroud K.A. 2009. “Advanced Engineering Mathematics”, Palgrave Macmillan, 4th edition, ISBN 978-I-403-93302-7.
5 https://ebookcentral.proquest.com/auth/lib/moiuniv-ebooks/</td></tr>
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