AOU Mechanical Engineering — Lecturer Handbook (Part I)

B.Eng. · COREN / Washington Accord · OBE, schemes, course-file & CLO–PO mapping

AKPAKIP ORO UNIVERSITY (AU)

Oro Nation, Akwa Ibom State, Nigeria

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

LECTURER HANDBOOK

PART I

B.Eng. Mechanical Engineering

(with Thermo-Fluids/Energy, Manufacturing, Automotive, and Oil & Gas/Process Plant Specialisation Tracks)

Teaching Schedule, Scheme of Work, Course-File and Outcome-Mapping Requirements

Curriculum Framework: NUC CCMAS + AU Institutional Curriculum, aligned to Washington Accord Graduate Attributes | Quality Framework: Outcome-Based Education (OBE)

Table of Contents

A. Quality Framework, Programme Educational Objectives and Programme Outcomes

A.1 Accreditation and Quality Framework

This handbook is prepared to meet the Nigerian Universities Commission (NUC) Core Curriculum and Minimum Academic Standards (CCMAS) for engineering programmes, and is additionally structured to align with international outcome-based accreditation conventions — including the twelve Washington Accord graduate attributes used by ABET, ECUK/Engineers Ireland, ECSA and comparable international accreditation bodies.

Delivery follows Outcome-Based Education (OBE): every course, weekly topic and assessment you set must be traceable to stated Course Learning Outcomes (CLOs) and, in aggregate, to the Programme Outcomes (POs) listed below. You are responsible for demonstrating this traceability in your course file (Section E).

A.2 Programme Educational Objectives (PEOs)

Within three to five years of graduation, graduates of the Department are expected to:

PEO1: Apply mathematical, scientific and engineering principles to identify, formulate and solve problems in thermo-fluids, manufacturing, machine design and energy systems relevant to the Niger Delta, the Gulf of Guinea and the wider international engineering context.

PEO2: Pursue and attain professional registration and certification (COREN, IMechE, ASME, or equivalent international bodies) and progress into engineering practice, research, or postgraduate study.

PEO3: Practise engineering with integrity, ethical judgement and leadership grounded in the Oro (Oron) Nation's and wider African cultural values of dignity, empathy, inclusion and justice.

PEO4: Design, manufacture and maintain safe, efficient and sustainable mechanical systems and process plant relevant to the region's energy, maritime and industrial base.

PEO5: Engage in continuous, life-long learning, innovation and the responsible application of digital, computational and AI-enabled engineering tools throughout a professional career.

A.3 Programme Outcomes (POs)

Your teaching, assessment design and CLOs must collectively build toward the following twelve outcomes:

No.

Outcome

Description

PO1

Engineering Knowledge

Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.

PO2

Problem Analysis

Identify, formulate, research literature and analyse complex engineering problems, reaching substantiated conclusions.

PO3

Design/Development of Solutions

Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health, safety, and the environment.

PO4

Investigation

Conduct investigations of complex problems using research-based knowledge and methods, including design of experiments, analysis and interpretation of data.

PO5

Modern Tool Usage

Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including digital, AI-enabled and prediction tools, with an understanding of their limitations.

PO6

Engineer and Society

Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PO7

Environment and Sustainability

Understand the impact of professional engineering solutions on societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PO8

Ethics

Apply ethical principles and commit to professional ethics, responsibilities and norms of engineering practice.

PO9

Individual and Team Work

Function effectively as an individual and as a member or leader in diverse and multidisciplinary teams.

PO10

Communication

Communicate effectively on complex engineering activities, including preparing reports, design documentation, and giving and receiving clear instructions.

PO11

Project Management and Finance

Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work and in multidisciplinary environments.

PO12

Life-Long Learning

Recognise the need for and engage in independent and life-long learning in the broadest context of technological change.

A.4 How to Use This Handbook

Use the semester scheme in Part B as the minimum teaching framework for every course you teach, and develop a full course file per Section E.

A.5 Credit Unit and Grading Convention

One (1) credit unit is equivalent to one hour of lecture/tutorial contact per week, or two-to-three hours of laboratory/workshop contact per week, over a fifteen-week semester. Indicative total load is approximately 180-190 credit units; final unit-load balancing is subject to Faculty Board/Senate ratification. SIWES is Pass/Fail, no unit weight. Continuous assessment shall typically constitute 30-40% of the total course grade.

B.Eng. Mechanical Engineering

Delivered by the Department of Mechanical Engineering, with specialisation pathways in Thermo-Fluids & Energy Systems, Manufacturing & Production Engineering, Automotive & Machine Design, and Oil & Gas/Process Plant Engineering.

Programme Emphasis

The programme develops engineers capable of designing, manufacturing, operating and maintaining mechanical systems, machines and process plant, with particular attention to the energy, maritime and industrial base of the Niger Delta and Gulf of Guinea.

Curriculum Structure — Semester-by-Semester Summary

Semester

Level

Academic Theme

Semester 1

100 Level, First Semester

Engineering Foundation I

Semester 2

100 Level, Second Semester

Engineering Foundation II

Semester 3

200 Level, First Semester

Core Engineering Science and Materials

Semester 4

200 Level, Second Semester

Application of Engineering Science

Semester 5

300 Level, First Semester

Design and Thermo-Fluid Systems

Semester 6

300 Level, Second Semester

Machine Design, Manufacturing and Controls

Semester 7

400 Level, First Semester

Specialised Mechanical Engineering Practice

Semester 8

400 Level, Second Semester

Industrial Application and Professional Integration

Semester 9

500 Level, First Semester

Engineering Management and Maintenance

Semester 10

500 Level, Second Semester

Integrated Engineering Design and Professional Readiness

Semester 1 — 100 Level, First Semester

Academic Theme: Engineering Foundation I

Registered Courses

Code

Course Title

Units

Status

Prerequisite

GST 101

Communication in English I

2

C

None

GST 103

Nigerian Peoples and Culture

2

C

None

CHM 101

General Chemistry I

3

C

None

MEE 101

Engineering in Society

1

C

None

MEE 103

Engineering Graphics and Solid Modelling I

2

C

None

MTH 101

Elementary Mathematics I

3

C

None

PHY 101

General Physics I

3

C

None

MEE 105

Introduction to Mechanical Engineering

2

C

None

Total Units This Semester

18

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Weeks 1-2

Orientation; what mechanical engineers do; engineering ethics.

Weeks 3-6

Elementary mathematics and physics for mechanical engineering.

Weeks 7-10

Chemistry and engineering materials.

Weeks 11-13

Engineering graphics and solid modelling.

Weeks 14-15

Introduction to mechanical engineering disciplines; revision.

Coursework Requirements

Mathematics problem sets

Physics laboratory report

Chemistry practical report

Engineering drawing portfolio

Career reflection essay

Semester Project: "My First Mechanism"

Students sketch and build a simple mechanism (e.g. a lever or pulley system) and present a short report.

Semester 2 — 100 Level, Second Semester

Academic Theme: Engineering Foundation II

Registered Courses

Code

Course Title

Units

Status

Prerequisite

GST 102

Communication in English II

2

C

GST 101

GST 104

Use of Library, Study Skills and ICT

1

C

None

MTH 102

Elementary Mathematics II

3

C

MTH 101

PHY 102

General Physics II

3

C

PHY 101

CHM 102

General Chemistry II (Materials Chemistry)

2

C

CHM 101

MEE 104

Engineering Graphics and Solid Modelling II

2

C

MEE 103

MEE 106

Engineering Measurements and Laboratory Practice

1

C

None

MEE 108

Introduction to Manufacturing Processes

2

C

None

MEE 110

Workshop Practice I

2

C

None

Total Units This Semester

18

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Focus

Mathematics and physics continuation; engineering graphics and solid modelling; survey of manufacturing processes (casting, machining, welding, forming); workshop safety and practice.

Coursework Requirements

Mathematics/physics assignments

CAD portfolio

Manufacturing processes report

Workshop logbook

Semester Project: "Semester Output"

Portfolio demonstrating basic mathematics, science, drawing and workshop skills.

Semester 3 — 200 Level, First Semester

Academic Theme: Core Engineering Science and Materials

Registered Courses

Code

Course Title

Units

Status

Prerequisite

GST 201

Entrepreneurship Studies I

2

C

None

MTH 201

Engineering Mathematics III

3

C

MTH 102

EEE 201

Applied Electricity

2

C

PHY 102

MEE 201

Engineering Materials

2

C

CHM 102

MEE 203

Workshop Practice II

1

C

MEE 110

MEE 205

Fluid Mechanics I

3

C

PHY 102, MTH 102

MEE 207

Thermodynamics I

3

C

PHY 102

MEE 209

Mechanics of Machines I (Statics)

3

C

PHY 102, MTH 102

CSC 201

Computing and Software Applications in Engineering

2

C

None

MEE 291

SIWES I

0

C

Pass/Fail, logged

Total Units This Semester

21

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Focus

Applied electricity; engineering materials; workshop practice; fluid mechanics fundamentals; thermodynamics fundamentals; statics of machines; introductory engineering computing.

Coursework Requirements

Materials identification report

Fluid mechanics lab report

Thermodynamics problem sets

Statics assignment

Workshop practical

SIWES

Students begin structured industrial exposure (SIWES) in accordance with the approved SIWES arrangement.

Semester 4 — 200 Level, Second Semester

Academic Theme: Application of Engineering Science

Registered Courses

Code

Course Title

Units

Status

Prerequisite

MTH 202

Engineering Mathematics IV

3

C

MTH 201

MEE 202

Strength of Materials I

3

C

MEE 209

MEE 204

Fluid Mechanics II

3

C

MEE 205

MEE 206

Thermodynamics II

3

C

MEE 207

MEE 208

Mechanics of Machines II (Dynamics)

3

C

MEE 209

MEE 210

Engineering Drawing and CAD for Mechanical Systems

2

C

MEE 104

GST 202

Entrepreneurship Studies II

2

C

GST 201

Total Units This Semester

19

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Focus

Stress/strain and material behaviour; fluid flow and pumps; closed-cycle thermodynamics; kinematics and dynamics of machines; CAD for mechanical components.

Coursework Requirements

Strength of materials calculations

Fluid-flow experiment

Thermodynamics assignment

Dynamics problem sets

CAD drawing set

Semester Project: "Mini Project — Simple Machine Component Design"

Students design, model and analyse a simple machine component (e.g. a shaft or bracket), producing a calculation report and CAD drawing.

Semester 5 — 300 Level, First Semester

Academic Theme: Design and Thermo-Fluid Systems

Registered Courses

Code

Course Title

Units

Status

Prerequisite

MEE 301

Strength of Materials II

3

C

MEE 202

MEE 303

Fluid Mechanics III (Fluid Machinery)

3

C

MEE 204

MEE 305

Thermodynamics III (Applied and Power Cycles)

3

C

MEE 206

MEE 307

Machine Design I

3

C

MEE 202

MEE 309

Manufacturing Technology I

2

C

MEE 108

MTH 301

Engineering Mathematics V (Statistics and Numerical Methods)

3

C

MTH 202

MEE 311

Engineering Communication

1

C

GST 102

MEE 391

SIWES II

0

C

Pass/Fail, logged

Total Units This Semester

18

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Focus

Advanced strength of materials (torsion, buckling, fatigue); pumps, turbines and fluid machinery; power cycles (Rankine, Brayton); machine element design; manufacturing technology; numerical methods.

Coursework Requirements

Strength of materials assignment

Fluid machinery lab report

Power cycle analysis

Machine design project

Manufacturing technology report

Semester 6 — 300 Level, Second Semester

Academic Theme: Machine Design, Manufacturing and Controls

Registered Courses

Code

Course Title

Units

Status

Prerequisite

MEE 302

Machine Design II

3

C

MEE 307

MEE 304

Heat Transfer

3

C

MEE 305

MEE 306

Manufacturing Technology II (CNC/CAM)

3

C

MEE 309

MEE 308

Industrial Engineering and Ergonomics

2

C

None

MEE 310

Instrumentation and Control for Mechanical Systems

2

C

EEE 201

MEE-E1

Specialisation Elective (choose one; see options below)

3

E

Varies

Total Units This Semester

16

Specialisation / Pathway Options

Code

Option Title

MET-A01

Thermo-Fluids and Energy Systems Fundamentals

MET-B01

Manufacturing and Production Engineering Fundamentals

MET-C01

Automotive and Machine Design Fundamentals

MET-D01

Oil and Gas/Process Plant Engineering Fundamentals

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Focus

Machine element design (gears, bearings, springs); conduction/convection/radiation heat transfer; CNC and computer-aided manufacturing; industrial engineering and ergonomics; mechanical system instrumentation.

Coursework Requirements

Machine design project

Heat transfer assignment

CNC programming exercise

Ergonomics case study

Instrumentation lab report

Semester Project: "Design Project — A Mechanical Power Transmission System"

Students design a gear or belt power transmission system, including selection, calculations and drawings.

Semester 7 — 400 Level, First Semester

Academic Theme: Specialised Mechanical Engineering Practice

Students formally declare one specialisation pathway at the start of Semester 7, carried through Semester 8: (A) Thermo-Fluids and Energy Systems, (B) Manufacturing and Production Engineering, (C) Automotive and Machine Design, or (D) Oil and Gas/Process Plant Engineering.

Registered Courses

Code

Course Title

Units

Status

Prerequisite

MEE 401

Advanced Machine Design

3

C

MEE 302

MEE 403

Mechanical Vibrations

3

C

MEE 208

MEE 405

Professional Practice and Engineering Ethics

1

C

None

MEE 407

Research Methods and Project Proposal

2

C

None

MEE 409

Renewable and Sustainable Energy Systems

2

C

MEE 305

MEE 411

AI, Robotics and Convergent Technologies in Mechanical Engineering

2

C

CSC 201

MEE-P1

Pathway Course (choose track A, B, C or D)

3

E

Declared pathway

Total Units This Semester

16

Specialisation / Pathway Options

Code

Option Title

A - MEE 413

Power Plant Engineering and Energy Systems

B - MEE 415

Computer-Integrated Manufacturing

C - MEE 417

Automotive Systems and Vehicle Design

D - MEE 419

Process Plant Design and Piping Engineering

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Fieldwork

At least one supervised engineering field exercise (power plant, manufacturing facility, or process plant) shall be undertaken.

Coursework Requirements

Advanced machine design project

Vibrations analysis assignment

Renewable energy case study

Research proposal

Pathway case study report

Semester 8 — 400 Level, Second Semester

Academic Theme: Industrial Application and Professional Integration

Registered Courses

Code

Course Title

Units

Status

Prerequisite

MEE 402

Mechanical System Design Project

3

C

MEE 401

MEE 404

Refrigeration and Air Conditioning

2

C

MEE 305

MEE 406

Engineering Law

2

C

None

MEE 408

Engineering Project Management

2

C

None

MEE 410

Research Methodology and Project Proposal II

2

C

MEE 407

MEE-P2

Pathway Course (continuation of declared track)

3

E

Declared pathway

Total Units This Semester

14

Specialisation / Pathway Options

Code

Option Title

A - MEE 412

Gas Turbine and Power Plant Operations

B - MEE 414

CNC Programming and Automation

C - MEE 416

Vehicle Dynamics and Automotive Electronics

D - MEE 418

Piping Stress Analysis and Plant Layout

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Output

Each student prepares a preliminary final-year project proposal containing a problem statement, literature review, objectives, methodology, expected results, work programme and preliminary budget.

Coursework Requirements

Mechanical system design report

Refrigeration/AC lab report

Engineering law case study

Project proposal

Semester 9 — 500 Level, First Semester

Academic Theme: Engineering Management and Maintenance

Registered Courses

Code

Course Title

Units

Status

Prerequisite

MEE 501

Engineering Project Management II

2

C

MEE 408

MEE 503

Engineering Law and Professional Practice II

2

C

MEE 406

MEE 505

Maintenance Engineering and Reliability

3

C

None

MEE 507

Final Year Project I (Proposal, Literature Review and Methodology)

3

C

MEE 410

MEE-E2

AU Specialist Elective I

3

E

Declared pathway

MEE-E3

AU Specialist Elective II

3

E

Declared pathway

Total Units This Semester

16

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Project Phase I

Proposal approval; literature review; design methodology; data collection; preliminary analysis.

Coursework Requirements

Maintenance engineering case study

Project proposal

Project management plan

Engineering law case study

Semester 10 — 500 Level, Second Semester

Academic Theme: Integrated Engineering Design and Professional Readiness

Registered Courses

Code

Course Title

Units

Status

Prerequisite

MEE 599

Final Year Project II (Design, Analysis and Defence)

6

C

MEE 507

MEE 502

Seminar in Mechanical Engineering

1

C

None

MEE 504

Professional Practice, Ethics and Engineering Registration

2

C

MEE 503

MEE-E4

AU Specialist Elective III

3

E

Declared pathway

MEE-E5

AU Specialist Elective IV

3

E

Declared pathway

Total Units This Semester

15

Weekly Teaching Scheme of Work

Weeks

Topics / Learning Activities

Requirements

Complete technical investigation; produce engineering design; conduct analysis/simulation where appropriate; produce drawings/prototype; prepare technical report; defend project before a panel; submit corrected final copy.

Graduation Portfolio Requirements

Transcript

Project report

Project drawings/prototype

Laboratory/field reports

SIWES evidence

Professional development record

Selected coursework portfolio

D. Common Teaching and Assessment Schedule

A normal fifteen-week teaching semester shall generally follow:

Week(s)

Activity

Week 1

Orientation / course introduction.

Weeks 2-5

Core theory and guided tutorials.

Week 6

Continuous assessment / test.

Weeks 7-10

Advanced theory plus laboratory/workshop/field activities.

Week 11

Practical/coursework assessment.

Weeks 12-13

Integrated problem-solving/design work.

Week 14

Revision and project presentation.

Week 15

Final revision / course completion.

Examination period

As separately published by the University.

D.1 Coursework Principle

Every technical course should normally contain a balanced combination of individual assignments, group problem-solving, tutorials, laboratory/workshop work, fieldwork where appropriate, quizzes/tests, design exercises, technical reports and presentations. Lecturers shall not rely exclusively on final examinations.

E. Lecturer Course-File Requirement

For every course, you shall compile and maintain a course file containing:

Course specification (aims, CLOs, credit load, contact hours).

Course Learning Outcomes (CLOs), mapped to Programme Outcomes (PO1-PO12).

Weekly scheme of work.

Lecture materials.

Tutorial questions.

Practical/laboratory manual, where applicable.

Assignment questions.

Quiz/test instruments.

Examination paper.

Marking scheme.

Attendance record.

Student feedback.

CLO attainment analysis.

PO mapping evidence.

Course review report.

F. Student Weekly Study Model (For Lecturer Awareness)

Students are expected to plan their week across lectures, tutorials, practical work, independent study, coursework and group work, and to maintain a personal Engineering Learning Portfolio across the ten semesters.

Appendix I: Course Learning Outcome (CLO) to Programme Outcome (PO) Mapping — Template and Worked Example

Every course specification in your course file (Section E) must include a CLO-PO mapping matrix of this form. A worked example is provided below.

Worked Example — MEE 401: Advanced Machine Design

Course Learning Outcome

Mapped Programme Outcome(s)

CLO1: Apply fatigue, fracture and failure theories to the design of machine elements.

PO1, PO2, PO3

CLO2: Select appropriate materials and manufacturing processes for a designed component.

PO1, PO3, PO6

CLO3: Use CAD/CAE tools to model and analyse machine component designs.

PO3, PO5

CLO4: Communicate design decisions in a professional engineering report.

PO10, PO11

Appendix II: Course Specification Template

Use this template as the first page of every course file (Section E):

Course Code and Title:

Credit Units / Status (Core or Elective):

Pre-requisite(s):

Level and Semester:

Course Aim(s):

Course Learning Outcomes (CLO1-CLOn):

CLO-to-PO Mapping Matrix (see Appendix I):

Weekly Topics (15-week scheme):

Teaching Methods (lecture/tutorial/laboratory/fieldwork ratio):

Assessment Breakdown (continuous assessment % / examination %):

Recommended Textbooks and References:

Required Equipment/Software/Laboratory Facilities:

Appendix III: Recommended Textbooks and References

This master reading list supports the 'Recommended Textbooks and References' field of the Course Specification Template (Appendix II).

Appendix III.1 — B.Eng. Mechanical Engineering

Mathematics and Physics

Stroud, K.A. and Booth, D.J. — Engineering Mathematics, Palgrave Macmillan.

Halliday, D., Resnick, R. and Walker, J. — Fundamentals of Physics, Wiley.

Thermodynamics and Heat Transfer

Cengel, Y.A. and Boles, M.A. — Thermodynamics: An Engineering Approach, McGraw-Hill.

Incropera, F.P., DeWitt, D.P., Bergman, T.L. and Lavine, A.S. — Fundamentals of Heat and Mass Transfer, Wiley.

Fluid Mechanics and Fluid Machinery

Douglas, J.F., Gasiorek, J.M., Swaffield, J.A. and Jack, L.B. — Fluid Mechanics, Pearson.

White, F.M. — Fluid Mechanics, McGraw-Hill.

Strength of Materials, Mechanics of Machines and Machine Design

Hibbeler, R.C. — Mechanics of Materials, Pearson.

Budynas, R.G. and Nisbett, J.K. — Shigley's Mechanical Engineering Design, McGraw-Hill.

Norton, R.L. — Design of Machinery, McGraw-Hill.

Manufacturing and Production Engineering

Groover, M.P. — Fundamentals of Modern Manufacturing, Wiley.

Kalpakjian, S. and Schmid, S.R. — Manufacturing Engineering and Technology, Pearson.

Mechanical Vibrations and Dynamics

Rao, S.S. — Mechanical Vibrations, Pearson.

Refrigeration, Air Conditioning and Energy Systems

Stoecker, W.F. and Jones, J.W. — Refrigeration and Air Conditioning, McGraw-Hill.

Masters, G.M. — Renewable and Efficient Electric Power Systems, Wiley.

Maintenance Engineering and Reliability

Mobley, R.K. — An Introduction to Predictive Maintenance, Butterworth-Heinemann.

Automotive Engineering (Specialisation Track)

Heisler, H. — Advanced Vehicle Technology, Butterworth-Heinemann.

Oil and Gas/Process Plant Engineering (Specialisation Track)

Peters, M.S., Timmerhaus, K.D. and West, R.E. — Plant Design and Economics for Chemical Engineers, McGraw-Hill.

Sahdev, M. — Piping and Pipeline Engineering (course reference compilation), as adopted by Faculty Board.

Engineering Project Management and Professional Practice

Kerzner, H. — Project Management: A Systems Approach to Planning, Scheduling and Controlling, Wiley.

COREN — Code of Conduct for Engineering Practitioners in Nigeria (current edition).