Lecturers' Handbook

Mechanical Engineering (Manufacturing and Production; Naval Architecture and Boat Building; Materials and Corrosion options)

Faculty of Engineering, Akpakip Oro University (AOU)

For teaching staff and laboratory supervisors

Draft for departmental approval

1. Purpose and Responsibilities

This handbook supports teaching staff delivering the Mechanical Engineering (Manufacturing and Production; Naval Architecture and Boat Building; Materials and Corrosion options) programme. It sets out the outcome mapping, teaching schemes, lesson-planning expectations, laboratory procedures, assessment design and marking standards. It is a working guide and does not replace the university's regulations.

- Deliver courses against the learning outcomes in the Students' Handbook.
- Publish the week-by-week scheme and assessment plan to students in the first week.
- Design assessments that test the stated outcomes at the appropriate level.
- Mark consistently, moderate with colleagues and give timely, specific feedback.
- Supervise projects, SIWES placements and laboratory work to the standards set here.

2. Programme Outcome Mapping

Each graduate competency is developed across several courses. The mapping below is generated from the course list and must be checked against the CCMAS mapping before accreditation.

Competency	Main contributing courses
Mechanics and design	MEC 201, MEC 209, MEC 301, MEC 309, MEC 406, MEC 403
Thermal and fluid systems	MEC 204, MEC 212, MEC 302, MEC 205, MEC 213, MEC 310
Materials	MEC 206, MEC 214, MEC 305, MEC 313, MEC 506, MEC 414
Manufacturing processes	MEC 208, MEC 215, MEC 304, MEC 401, MEC 314
Production systems	MEC 312, MEC 315, MEC 407, MEC 415, MEC 510
Additive manufacturing	MEC 402, MEC 409, MEC 410, MEC 501, MEC 502
Corrosion and surface engineering	MEC 311, MEC 405, MEC 413, MEC 505, MEC 512
Marine engineering	MEC 404, MEC 411, MEC 412, MEC 503, MEC 504, MEC 511
Measurement and quality	MEC 303, MEC 306, MEC 307
Professional practice	MEC 104, MEC 106, MEC 416, MEC 513, MEC 514

3. Teaching Schemes

For each semester, the table shows the delivery mode and assessment method. Contact hours and rooms are set by the timetable.

Year 1: Engineering Foundations

Semester 1

Code	Course	Units	Delivery	Assessment
MEC 101	Mathematics I	3	Lecture	CA 30 / Exam 70
MEC 102	General Physics I	3	Lecture	CA 30 / Exam 70
MEC 103	General Chemistry I	2	Lecture	CA 30 / Exam 70
MEC 104	Introductory Engineering	2	Lecture	CA 50 / Exam 50
MEC 105	Introduction to Computing	2	Lecture	CA 60 / Exam 40
MEC 106	Communication in English	2	Lecture	CA 60 / Exam 40
MEC 107	Engineering Laboratory Practicals	1	Lecture with lab / practical	Lab reports 100
MEC 108	Introduction to Mechanical Engineering	2	Lecture	CA 40 / Exam 60

Semester 2

Code	Course	Units	Delivery	Assessment
MEC 109	Mathematics II	3	Lecture	CA 30 / Exam 70
MEC 110	General Physics II	3	Lecture	CA 30 / Exam 70
MEC 111	Engineering Drawing and Graphics	2	Lecture with lab / practical	Coursework 60 / Exam 40
MEC 112	Programming and Engineering Computation	2	Lecture	CA 50 / Exam 50
MEC 113	Nigerian Peoples and Cultures	2	Lecture	CA 40 / Exam 60
MEC 114	Physics Practicals	1	Lecture with lab / practical	Lab reports 100
MEC 115	Engineering Workshop and Safety	2	Lecture with lab / practical	Practical 70 / Exam 30
MEC 116	Electrical Principles	3	Lecture	CA 30 / Exam 70

Year 2: Core Engineering

Semester 3

Code	Course	Units	Delivery	Assessment
MEC 201	Engineering Mechanics: Statics	3	Lecture	CA 30 / Exam 70
MEC 202	Strength of Materials I	3	Lecture	CA 30 / Exam 70
MEC 203	Engineering Mathematics	3	Lecture	CA 30 / Exam 70
MEC 204	Thermodynamics I	3	Lecture	CA 30 / Exam 70
MEC 205	Fluid Mechanics I	3	Lecture	CA 30 / Exam 70
MEC 206	Engineering Materials I	2	Lecture	CA 40 / Exam 60
MEC 207	Computer-Aided Design	2	Lecture	Coursework 100
MEC 208	Manufacturing Processes I	3	Lecture	CA 40 / Exam 60

Semester 4

Code	Course	Units	Delivery	Assessment
MEC 209	Engineering Mechanics: Dynamics	3	Lecture	CA 30 / Exam 70
MEC 210	Strength of Materials II	3	Lecture	CA 30 / Exam 70
MEC 211	Numerical Methods for Engineers	3	Lecture	CA 40 / Exam 60
MEC 212	Thermodynamics II	3	Lecture	CA 30 / Exam 70
MEC 213	Fluid Mechanics II	3	Lecture	CA 30 / Exam 70
MEC 214	Engineering Materials II	2	Lecture	CA 40 / Exam 60
MEC 215	Manufacturing Processes II	3	Lecture	CA 40 / Exam 60
MEC 216	Mechanical Engineering Laboratory I	2	Lecture with lab / practical	Lab reports 100

Year 3: Specialist Foundations

Semester 5

Code	Course	Units	Delivery	Assessment
MEC 301	Machine Design I	3	Lecture	CA 30 / Exam 70
MEC 302	Heat Transfer	3	Lecture	CA 30 / Exam 70
MEC 303	Engineering Metrology and Quality Control	3	Lecture	CA 40 / Exam 60

Code	Course	Units	Delivery	Assessment
MEC 304	Machine Tools and Machining	3	Lecture with lab / practical	Lab 40 / Exam 60
MEC 305	Materials Science and Metallurgy	3	Lecture	CA 30 / Exam 70
MEC 306	Engineering Statistics and Research Methods	2	Lecture	CA 40 / Exam 60
MEC 307	Control Systems Fundamentals	2	Lecture	CA 40 / Exam 60
MEC 308	Mechanical Engineering Laboratory II	2	Lecture with lab / practical	Lab reports 100

Semester 6

Code	Course	Units	Delivery	Assessment
MEC 309	Machine Design II	3	Lecture	CA 30 / Exam 70
MEC 310	Fluid Machinery	3	Lecture	CA 30 / Exam 70
MEC 311	Corrosion Fundamentals	3	Lecture	CA 30 / Exam 70
MEC 312	Production Planning and Control	3	Lecture	CA 40 / Exam 60
MEC 313	Polymer and Composite Materials	3	Lecture	CA 30 / Exam 70
MEC 314	Joining and Welding Technology	3	Lecture	CA 40 / Exam 60
MEC 315	Computer-Aided Manufacturing	3	Lecture with lab / practical	Practical 50 / Exam 50
MEC 316	Engineering Economics	2	Lecture	CA 40 / Exam 60

Year 4: Advanced Design and Industrial Practice

Semester 7

Code	Course	Units	Delivery	Assessment
MEC 401	Advanced Manufacturing Processes	3	Lecture	CA 30 / Exam 70
MEC 402	Additive Manufacturing Fundamentals	3	Lecture	CA 30 / Exam 70
MEC 403	Design for Manufacturing and Assembly	3	Lecture	CA 30 / Exam 70
MEC 404	Naval Architecture I: Hydrostatics and Stability	3	Lecture	CA 30 / Exam 70
MEC 405	Electrochemistry and Corrosion Control	3	Lecture	CA 30 / Exam 70
MEC 406	Finite Element Methods	3	Lecture	Coursework 60 / Exam 40
MEC 407	Lean Manufacturing and Operations	2	Lecture	CA 40 / Exam 60
MEC 408	Research Project I	2	Studio / project supervision	Proposal 100

Semester 8

Code	Course	Units	Delivery	Assessment
MEC 409	Additive Manufacturing Processes and Materials	3	Lecture	CA 30 / Exam 70
MEC 410	Additive Manufacturing Design and Post-processing	2	Lecture	Coursework 60 / Exam 40
MEC 411	Ship Resistance and Propulsion	3	Lecture	CA 30 / Exam 70
MEC 412	Marine Structures and Boat Construction	3	Lecture	CA 30 / Exam 70

Code	Course	Units	Delivery	Assessment
MEC 413	Surface Engineering and Protective Coatings	3	Lecture	CA 30 / Exam 70
MEC 414	Failure Analysis and Materials Degradation	3	Lecture	CA 30 / Exam 70
MEC 415	Automation in Manufacturing	2	Lecture	CA 40 / Exam 60
MEC 416	Industrial Training (SIWES)	3	Industrial placement	Logbook 40 / Report 40 / Assessor 20

Year 5: Specialisation, Integration and Professional Readiness

Semester 9

Code	Course	Units	Delivery	Assessment
MEC 501	Advanced Additive Manufacturing	3	Lecture	CA 30 / Exam 70
MEC 502	Additive Manufacturing Quality and Certification	2	Lecture	CA 40 / Exam 60
MEC 503	Ship Design Project	3	Studio / project supervision	Design project 60 / Exam 40
MEC 504	Seakeeping and Ship Motions	3	Lecture	CA 30 / Exam 70
MEC 505	Advanced Corrosion Engineering	3	Lecture	CA 30 / Exam 70
MEC 506	Advanced Materials Selection	2	Lecture	CA 40 / Exam 60
MEC 507	Research Project II	3	Studio / project supervision	Project 100
MEC 508	Technical Elective I	2	Lecture	CA 40 / Exam 60

Semester 10

Code	Course	Units	Delivery	Assessment
MEC 509	Integrated Mechanical Systems Design	3	Lecture	Design project 100
MEC 510	Manufacturing Systems Design	2	Lecture	CA 40 / Exam 60
MEC 511	Marine Vessel Construction and Survey	2	Lecture	CA 40 / Exam 60
MEC 512	Asset Integrity and Corrosion Management	2	Lecture	CA 40 / Exam 60
MEC 513	Engineering Professional Practice and Ethics	2	Lecture	CA 50 / Exam 50
MEC 514	Environmental Impact and Sustainability	2	Lecture	CA 40 / Exam 60
MEC 515	Final-Year Design Project and Defence	4	Studio / project supervision	Project 60 / Defence 40
MEC 516	Technical Elective II	2	Lecture	CA 40 / Exam 60

4. Lesson Planning

Every lecture and practical session should have a written lesson plan, kept with the course file and sampled during moderation.

Lesson plan template

- **Course and week:** code, title, week number.
- **Learning outcome(s):** the outcome(s) this session addresses.
- **Prerequisites, resources and activities:** what students must know, what is needed, and the timed outline.

- **Check for understanding:** at least one formative question or task.
- **Homework or preparation:** the task and its due date.

Worked example: Machining parameters and tool life (2-hour session)

Time	Activity	Check for understanding
0 to 10 min	Starter: recall of cutting speed, feed and depth of cut	Quick oral questions
10 to 40 min	Explanation: tool wear mechanisms and the Taylor tool-life equation	Students state two wear mechanisms
40 to 65 min	Worked example: estimate tool life at two cutting speeds	Pairs solve a similar case
65 to 95 min	Group problem: choose parameters for a stated production target	Each group presents its choice and reason
95 to 110 min	Short quiz on the session content	Marks recorded for formative tracking
110 to 120 min	Summary; homework on the effect of coolant on tool life	Homework due next session

5. Laboratory and Practical Instructions

Standard references are given for orientation. Confirm the current edition and the department's approved procedure before issuing instructions to students.

5.1 Tensile test of metals (Mechanical Engineering Laboratory I)

Aim. Determine the yield strength, tensile strength and elongation of a metal specimen.

Equipment.

- Universal testing machine
- Extensometer
- Standard test specimens
- Vernier callipers

Procedure.

1. Measure the gauge length and cross-sectional dimensions of the specimen.
2. Fit the specimen and extensometer in the grips and zero the readings.
3. Load the specimen at the specified rate until fracture, recording load and extension.
4. Plot the stress-strain curve and determine the properties; measure the final gauge length.

Safety.

- Keep clear of the test frame while it is loaded; stand behind the guard.
- Handle specimens with gloves: fractured edges are sharp.

Report requirements. Include the stress-strain curve, the measured properties, a comparison with the material data sheet, and a description of the fracture.

5.2 Turning parameters and surface roughness (Machine Tools and Machining)

Aim. Measure the effect of cutting speed and feed on surface roughness during turning.

Equipment.

- Lathe
- Cutting tool and tool holder
- Surface roughness tester
- Workpiece bar stock

Procedure.

1. Set the spindle speed and feed for the first trial and record the settings.
2. Turn a short length and measure the surface roughness at three positions.
3. Repeat for the other speed and feed combinations.
4. Tabulate the results and plot roughness against feed.

Safety.

- Keep guards in place; never reach across a rotating workpiece.
- Use the chuck key only when the lathe is stopped.

Report requirements. Include the parameters, roughness readings, plots and a discussion of the dominant factor.

5.3 FDM build and dimensional accuracy (Additive Manufacturing Fundamentals)

Aim. Print a test specimen and measure its dimensional accuracy against the CAD model.

Equipment.

- FDM 3D printer
- PLA or ABS filament
- CAD test model
- Digital callipers

Procedure.

1. Prepare the CAD test model and slice it with the specified layer height and infill.
2. Print the specimen and allow it to cool before removal.
3. Measure the critical dimensions and compare them with the CAD model.
4. Record the deviation and suggest a correction for the next build.

Safety.

- Ventilate the printing area; some filaments release fumes.
- Keep hands clear of the nozzle and bed while printing.

Report requirements. Include the print settings, measured dimensions, deviations and a discussion of the sources of error.

5.4 Corrosion coupon weight-loss test (Corrosion Fundamentals)

Aim. Determine the corrosion rate of a metal coupon from its mass loss in a test solution.

Equipment.

- Metal coupons
- Test solution (as specified)
- Analytical balance
- Cleaning materials and desiccator

Procedure.

1. Clean, dry and weigh each coupon to the nearest 0.1 mg.
2. Immerse the coupons in the solution for the specified exposure time.
3. Remove, clean and dry the coupons according to the standard procedure, then re-weigh them.
4. Calculate the corrosion rate from the mass loss, area, density and time.

Safety.

- Use gloves and eye protection when handling the test solution.
- Dispose of solutions and cleaning waste as the data sheet requires.

Report requirements. Include the mass losses, the corrosion rates, the cleaning procedure used and the sources of uncertainty.

6. Assessment Design

6.1 Assessment blueprint for written examinations

Cognitive level	Typical weight	Typical question form
Remember	10%	Definitions, standard values, short recall
Understand	20%	Explain principles, interpret results
Apply	40%	Calculations, applying standards and methods
Analyse	20%	Multi-step problems and system analysis
Evaluate	10%	Design choices, critique, justification

6.2 Continuous assessment

- Each course should have at least two CA components, spread across the semester.
- At least one CA item should test an outcome the exam does not.
- Publish all CA marking schemes before the task is issued.

7. Rubrics

Each criterion is scored from 1 to 4. The total is converted to the mark scale in the regulations.

7.1 Design project rubric

Criterion	4 Excellent	3 Good	2 Satisfactory	1 Unsatisfactory
Design concept	Clear, justified and suited to the brief	Sound with minor gaps	Partly justified	Unclear or unsuitable
Calculations or analysis	Complete, correct and checked	Minor errors, method correct	Method partly correct	Major errors or missing
Use of standards	Correct standards applied and cited	Mostly applied correctly	Some misapplied	Not used
Drawings, code or specifications	Clear, complete, to convention	Minor omissions	Incomplete	Not usable
Safety and sustainability	Addressed in depth	Addressed adequately	Mentioned only	Not addressed

7.2 Laboratory report rubric

Criterion	4 Excellent	3 Good	2 Satisfactory	1 Unsatisfactory
Method	Complete and reproducible	Mostly complete	Partly complete	Not usable
Data and analysis	Accurate and correctly processed	Minor errors	Several errors	Major errors
Discussion	Insightful, error sources analysed	Adequate	Superficial	Absent
Presentation	Clear and professional	Mostly clear	Hard to follow	Poor

7.3 Oral defence rubric

Criterion	4 Excellent	3 Good	2 Satisfactory	1 Unsatisfactory
Explanation	Clear and complete	Clear with minor gaps	Partial	Unclear

Criterion	4 Excellent	3 Good	2 Satisfactory	1 Unsatisfactory
Response to questions	Confident, accurate, reasoned	Mostly accurate	Some accurate	Mostly inaccurate
Professional judgement	Justifies trade-offs well	Justifies most decisions	Limited	None

8. Marking, Moderation and Feedback

- Mark against the published scheme, and record the reason for any deduction.
- Moderate a sample of at least 10% of scripts or reports across the mark range, with a second marker.
- Return feedback within the period set by the regulations, identifying strengths and next steps.
- Record any change to a published mark, with the reason and the approver.

9. Supervision of Projects and SIWES

- Supervisors meet each student at least every two weeks and keep a meeting log.
- Projects require an approved written proposal before execution.
- Check each SIWES placement before the student starts; review the logbook and report, and complete the assessor's form.

10. Quality Assurance and Accreditation Readiness

- Keep a course file for each course: specification, scheme, assessment items, marking schemes, moderation records and feedback.
- Maintain records of equipment, calibration and maintenance for each laboratory.
- Invite an external examiner to review standards and assessment, and act on their report.
- Update the CCMAS mapping whenever a course changes.

11. Academic Integrity and Professional Ethics

- Explain the university's academic integrity policy at the start of every course.
- Report suspected misconduct through the department to the appropriate committee.
- Model professional ethics, including honest reporting of data and clear acknowledgement of sources.