Lecturers' Handbook

Electrical and Electronics Engineering: Renewable Energy Option

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 Electrical and Electronics Engineering: Renewable Energy Option 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
Circuit and electronics analysis	EEE 201, EEE 202, EEE 210, EEE 302, EEE 309
Power systems	EEE 304, EEE 311, EEE 405, EEE 404, EEE 504
Power electronics	EEE 310, EEE 403, EEE 505
Control and instrumentation	EEE 305, EEE 312, EEE 407, EEE 206
Renewable energy systems	EEE 314, EEE 401, EEE 402, EEE 410, EEE 502
Energy storage and grid integration	EEE 409, EEE 411, EEE 501
Electrical machines and drives	EEE 214, EEE 303, EEE 414
Design, standards and safety	EEE 415, EEE 412, EEE 512, EEE 514
Sustainability and economics	EEE 503, EEE 316, EEE 511, EEE 510
Professional practice	EEE 104, EEE 106, EEE 416, EEE 513

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
EEE 101	Mathematics I	3	Lecture	CA 30 / Exam 70
EEE 102	General Physics I	3	Lecture	CA 30 / Exam 70
EEE 103	General Chemistry I	2	Lecture	CA 30 / Exam 70
EEE 104	Introductory Engineering	2	Lecture	CA 50 / Exam 50
EEE 105	Introduction to Computing	2	Lecture	CA 60 / Exam 40
EEE 106	Communication in English	2	Lecture	CA 60 / Exam 40
EEE 107	Engineering Laboratory Practicals	1	Lecture with lab / practical	Lab reports 100
EEE 108	Introduction to Electrical and Electronics Engineering	2	Lecture	CA 40 / Exam 60

Semester 2

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

Year 2: Core Engineering

Semester 3

Code	Course	Units	Delivery	Assessment
EEE 201	Circuit Theory I	3	Lecture	CA 30 / Exam 70
EEE 202	Electronic Devices I	3	Lecture	CA 30 / Exam 70
EEE 203	Engineering Mathematics	3	Lecture	CA 30 / Exam 70
EEE 204	Electromagnetic Fields I	3	Lecture	CA 30 / Exam 70
EEE 205	Digital Logic Design	3	Lecture	CA 40 / Exam 60
EEE 206	Electrical Measurement and Instrumentation	2	Lecture	CA 40 / Exam 60
EEE 207	Engineering Mechanics: Statics	2	Lecture	CA 30 / Exam 70
EEE 208	Electrical Materials	2	Lecture	CA 40 / Exam 60

Semester 4

Code	Course	Units	Delivery	Assessment
EEE 209	Circuit Theory II	3	Lecture	CA 30 / Exam 70
EEE 210	Electronic Devices II	3	Lecture	CA 30 / Exam 70
EEE 211	Numerical Methods for Engineers	3	Lecture	CA 40 / Exam 60
EEE 212	Signals and Systems I	3	Lecture	CA 30 / Exam 70
EEE 213	Digital Electronics	3	Lecture	CA 40 / Exam 60
EEE 214	Electrical Machines I	3	Lecture	CA 30 / Exam 70
EEE 215	Electrical Engineering Laboratory I	2	Lecture with lab / practical	Lab reports 100
EEE 216	Thermodynamics for Engineers	2	Lecture	CA 40 / Exam 60

Year 3: Specialist Foundations

Semester 5

Code	Course	Units	Delivery	Assessment
EEE 301	Signals and Systems II	3	Lecture	CA 30 / Exam 70
EEE 302	Analogue Electronics I	3	Lecture	CA 30 / Exam 70

Code	Course	Units	Delivery	Assessment
EEE 303	Electrical Machines II	3	Lecture	CA 30 / Exam 70
EEE 304	Power Systems I	3	Lecture	CA 30 / Exam 70
EEE 305	Control Systems I	3	Lecture	CA 30 / Exam 70
EEE 306	Microprocessors and Microcontrollers	3	Lecture	CA 40 / Exam 60
EEE 307	Electrical Installation and Wiring	2	Lecture	CA 40 / Exam 60
EEE 308	Engineering Statistics and Research Methods	2	Lecture	CA 40 / Exam 60

Semester 6

Code	Course	Units	Delivery	Assessment
EEE 309	Analogue Electronics II	3	Lecture	CA 30 / Exam 70
EEE 310	Power Electronics I	3	Lecture	CA 30 / Exam 70
EEE 311	Power Systems II	3	Lecture	CA 30 / Exam 70
EEE 312	Control Systems II	3	Lecture	CA 30 / Exam 70
EEE 313	Communication Systems I	3	Lecture	CA 30 / Exam 70
EEE 314	Renewable Energy Fundamentals	3	Lecture	CA 40 / Exam 60
EEE 315	Electrical Engineering Laboratory II	2	Lecture with lab / practical	Lab reports 100
EEE 316	Engineering Economics	2	Lecture	CA 40 / Exam 60

Year 4: Advanced Design and Industrial Practice

Semester 7

Code	Course	Units	Delivery	Assessment
EEE 401	Solar Photovoltaic Systems	3	Lecture	CA 30 / Exam 70
EEE 402	Wind Energy Systems	3	Lecture	CA 30 / Exam 70
EEE 403	Power Electronics II	3	Lecture	CA 30 / Exam 70
EEE 404	Power System Protection	3	Lecture	CA 30 / Exam 70
EEE 405	Power Systems Analysis	3	Lecture	CA 30 / Exam 70
EEE 406	Digital Signal Processing	3	Lecture	CA 30 / Exam 70
EEE 407	Instrumentation and Control Systems	2	Lecture	CA 40 / Exam 60
EEE 408	Research Project I	2	Studio / project supervision	Proposal 100

Semester 8

Code	Course	Units	Delivery	Assessment
EEE 409	Energy Storage and Battery Systems	3	Lecture	CA 30 / Exam 70
EEE 410	Hydro and Bioenergy Systems	2	Lecture	CA 40 / Exam 60
EEE 411	Grid Integration of Renewable Energy	3	Lecture	CA 30 / Exam 70
EEE 412	High Voltage Engineering	3	Lecture	CA 30 / Exam 70
EEE 413	Power Distribution and Substation Design	3	Lecture	CA 30 / Exam 70
EEE 414	Industrial Electrical Systems	2	Lecture	CA 40 / Exam 60
EEE 415	Electrical Systems Design and Standards	2	Lecture	CA 40 / Exam 60

Code	Course	Units	Delivery	Assessment
EEE 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
EEE 501	Smart Grids and Microgrids	3	Lecture	CA 30 / Exam 70
EEE 502	Solar Energy Systems Design	3	Lecture	Design project 60 / Exam 40
EEE 503	Renewable Energy Policy and Economics	2	Lecture	CA 40 / Exam 60
EEE 504	Power System Stability	3	Lecture	CA 30 / Exam 70
EEE 505	Advanced Power Electronics for Renewables	3	Lecture	CA 30 / Exam 70
EEE 506	Research Project II	3	Studio / project supervision	Project 100
EEE 507	Engineering Project Management	2	Studio / project supervision	CA 40 / Exam 60
EEE 508	Technical Elective I	2	Lecture	CA 40 / Exam 60

Semester 10

Code	Course	Units	Delivery	Assessment
EEE 509	Integrated Renewable Energy System Design	3	Lecture	Design project 100
EEE 510	Energy Efficiency and Auditing	2	Lecture	CA 40 / Exam 60
EEE 511	Environmental Impact and Sustainability	2	Lecture	CA 40 / Exam 60
EEE 512	Electrical Safety and Risk Management	2	Lecture	CA 40 / Exam 60
EEE 513	Engineering Professional Practice and Ethics	2	Lecture	CA 50 / Exam 50
EEE 514	Quality and Standards in Electrical Engineering	2	Lecture	CA 40 / Exam 60
EEE 515	Final-Year Design Project and Defence	4	Studio / project supervision	Project 60 / Defence 40
EEE 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: DC-DC buck converter (2-hour session)

Time	Activity	Check for understanding
0 to 10 min	Starter: recall of inductor and capacitor behaviour	Quick oral questions
10 to 40 min	Explanation: buck converter topology, continuous conduction, duty cycle	Students derive output voltage from duty cycle
40 to 65 min	Worked example: design the inductor for a given ripple current	Pairs solve a similar case
65 to 95 min	Simulation exercise: observe switching waveforms at two duty cycles	Each pair reports one observation
95 to 110 min	Short quiz on the session content	Marks recorded for formative tracking
110 to 120 min	Summary; homework on boost converter operation	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 Circuit analysis and Thevenin equivalent (Electrical Engineering Laboratory I)

Aim. Verify the Thevenin equivalent of a resistive network by measurement.

Equipment.

- DC power supply
- Multimeters
- Resistors and breadboard
- Connecting leads

Procedure.

1. Build the network and measure the open-circuit voltage at the terminals of interest.
2. Measure the short-circuit current at the same terminals.
3. Compute the Thevenin resistance from the two measurements.
4. Attach a load and compare the measured load voltage with the Thevenin prediction.

Safety.

- Switch off the supply before changing connections.
- Keep voltages within the rated limits of the components.

Report requirements. Include the theoretical and measured values, percentage error and a comment on the sources of error.

5.2 PV module I-V characterisation (Renewable Energy option)

Aim. Measure the I-V and P-V curves of a PV module and locate the maximum power point.

Equipment.

- PV module on a stand
- Variable electronic load
- Irradiance meter
- Voltmeter and ammeter

Procedure.

1. Record the irradiance and module temperature before testing.
2. Sweep the load from short-circuit to open-circuit and record voltage and current at each step.
3. Plot the I-V and P-V curves.

4. Identify the maximum power point and compare it with the manufacturer's rating.

Safety.

- Keep cables insulated and secure; avoid short-circuiting the module.
- Work in daylight with supervision only.

Report requirements. Include both curves, the maximum power point, the fill factor, and the effect of irradiance on the results.

5.3 Buck converter operation (Power Electronics I)

Aim. Observe the switching behaviour of a buck converter and verify the output voltage against duty cycle.

Equipment.

- Buck converter board
- Variable DC supply
- MOSFET driver and PWM source
- Oscilloscope and probes

Procedure.

1. Set the input voltage and the PWM frequency.
2. Vary the duty cycle and measure the output voltage at each setting.
3. Capture the switch and output waveforms at two duty cycles.
4. Compare the measured output with the theoretical value.

Safety.

- Limit the input current; never exceed the device ratings.
- Keep hands clear of the board while it is energised.

Report requirements. Include the measured and theoretical output voltages, waveform captures and a comment on losses.

5.4 Transformer open-circuit and short-circuit tests (Electrical Machines I)

Aim. Determine the equivalent circuit parameters of a single-phase transformer.

Equipment.

- Single-phase transformer
- Variac
- Wattmeter, voltmeter and ammeter
- Protective equipment

Procedure.

1. Carry out the open-circuit test on the low-voltage side and record voltage, current and power.
2. Carry out the short-circuit test on the high-voltage side at reduced voltage.
3. Calculate the shunt and series branch parameters.
4. Compute the efficiency at a stated load and power factor.

Safety.

- Never short-circuit the secondary of the open-circuit test.
- Bring the variac to zero before switching on.

Report requirements. Include the test readings, the equivalent circuit, the efficiency calculation and the safety measures used.

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
Response to questions	Confident, accurate, reasoned	Mostly accurate	Some accurate	Mostly inaccurate

Criterion	4 Excellent	3 Good	2 Satisfactory	1 Unsatisfactory
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.