Curriculum

Mechatronics and Robotics Engineering

Faculty of Engineering, Akpakip Oro University (AOU)

Curriculum document, with the Industrial Automation and Robotics Systems options

Course codes, units and status are provisional until reconciled with the NUC CCMAS

1. Preamble

This curriculum sets out the five-year Bachelor of Engineering programme in Mechatronics and Robotics Engineering, offered by the Department of Mechatronics and Robotics Engineering, Faculty of Engineering, Akpakip Oro University (AOU). It is designed to meet the NUC Core Curriculum and Minimum Academic Standards (CCMAS) and the professional requirements for engineering registration in Nigeria.

Course codes, units and compulsory or elective status are provisional and must be reconciled with the official CCMAS before Senate adoption. The CCMAS expansion used here should also be verified against the NUC publication.

2. Aims and Objectives

- Produce mechatronics and robotics engineers who integrate mechanical, electrical, control and software systems.
- Offer two pathways: Industrial Automation, for production and process systems, and Robotics Systems, for robot design and intelligent machines.
- Build strong foundations in mathematics, mechanics, electronics and programming.
- Prepare graduates for COREN registration and for employment or postgraduate study.

3. Graduate Competencies

On graduation, students should demonstrate competence in the areas below.

Competency	Expected graduate capability
Mechanical design	Analyse forces, stresses and mechanisms and design machine elements.
Electrical and electronic systems	Analyse circuits, electronics and electrical machines for mechatronic systems.
Control systems	Model, analyse and tune control systems for machines and robots.
Sensors, actuators and embedded systems	Select and interface sensors and actuators and program embedded controllers.
Industrial automation	Design PLC, SCADA and automation systems for production.
Robotics	Model the kinematics and dynamics of robots and design their control.
Intelligent and autonomous systems	Apply machine vision, planning and autonomy to robots and machines.
Design and integration	Integrate subsystems into complete, tested mechatronic systems.
Professional practice	Demonstrate ethical judgement, teamwork, communication and safety awareness.

4. Programme Structure

The programme comprises 80 courses and 207 units across ten semesters. The Track column shows whether a course is core (taken by all students) or belongs to a named option.

Track: 'Core' is taken by all students. 'IA' marks Industrial Automation option courses; 'RS' marks Robotics Systems option courses.

Year 1: Engineering Foundations

Semester 1 (First semester)

Code	Course	Units	Track
MRE 101	Mathematics I	3	Core
MRE 102	General Physics I	3	Core
MRE 103	General Chemistry I	2	Core
MRE 104	Introductory Engineering	2	Core

Code	Course	Units	Track
MRE 105	Introduction to Computing	2	Core
MRE 106	Communication in English	2	Core
MRE 107	Engineering Laboratory Practicals	1	Core
MRE 108	Introduction to Mechatronics and Robotics	2	Core
	Semester total	**17**	

Semester 2 (Second semester)

Code	Course	Units	Track
MRE 109	Mathematics II	3	Core
MRE 110	General Physics II	3	Core
MRE 111	Engineering Drawing and Graphics	2	Core
MRE 112	Programming and Engineering Computation	2	Core
MRE 113	Nigerian Peoples and Cultures	2	Core
MRE 114	Physics Practicals	1	Core
MRE 115	Engineering Workshop and Safety	2	Core
MRE 116	Electrical Principles	3	Core
	Semester total	**18**	

Year 2: Core Engineering

Semester 3 (First semester)

Code	Course	Units	Track
MRE 201	Engineering Mechanics: Statics	3	Core
MRE 202	Strength of Materials I	3	Core
MRE 203	Engineering Mathematics	3	Core
MRE 204	Electrical Circuits I	3	Core
MRE 205	Digital Logic Design	3	Core
MRE 206	Computer-Aided Design	2	Core
MRE 207	Engineering Materials	2	Core
MRE 208	Electronic Devices I	3	Core
	Semester total	**22**	

Semester 4 (Second semester)

Code	Course	Units	Track
MRE 209	Engineering Mechanics: Dynamics	3	Core
MRE 210	Machine Elements	3	Core
MRE 211	Numerical Methods for Engineers	3	Core
MRE 212	Electrical Machines I	3	Core
MRE 213	Microcontrollers and Embedded Programming	3	Core
MRE 214	Fluid Mechanics I	3	Core
MRE 215	Signals and Systems I	3	Core
MRE 216	Mechatronics Laboratory I	2	Core
	Semester total	**23**	

Year 3: Specialist Foundations

Semester 5 (First semester)

Code	Course	Units	Track
MRE 301	Control Systems I	3	Core
MRE 302	Sensors and Transducers	3	Core
MRE 303	Industrial Automation and PLCs	3	IA
MRE 304	Kinematics of Machines	3	Core
MRE 305	Analogue Electronics	3	Core
MRE 306	Robot Fundamentals and Kinematics	3	RS
MRE 307	Electrical Drives	2	Core
MRE 308	Engineering Statistics and Research Methods	2	Core
	Semester total	**22**	

Semester 6 (Second semester)

Code	Course	Units	Track
MRE 309	Control Systems II	3	Core
MRE 310	Actuators and Power Electronics	3	Core
MRE 311	Mechanism Design	3	Core
MRE 312	Robot Dynamics	3	RS
MRE 313	SCADA and Industrial Networks	3	IA
MRE 314	Embedded Systems Design	3	Core
MRE 315	Mechatronics Laboratory II	2	Core
MRE 316	Engineering Economics	2	Core
	Semester total	**22**	

Year 4: Advanced Design and Industrial Practice

Semester 7 (First semester)

Code	Course	Units	Track
MRE 401	Hydraulics and Pneumatics	3	IA
MRE 402	Industrial Robotics	3	RS
MRE 403	Robot Control	3	RS
MRE 404	Machine Vision	3	Core
MRE 405	Mechatronic System Modelling	3	Core
MRE 406	Instrumentation and Data Acquisition	2	Core
MRE 407	Industrial Automation Systems Design	3	IA
MRE 408	Research Project I	2	Core
	Semester total	**22**	

Semester 8 (Second semester)

Code	Course	Units	Track
MRE 409	Artificial Intelligence for Robotics	3	RS
MRE 410	Mobile Robotics	3	RS
MRE 411	Industrial Internet of Things	3	IA

Code	Course	Units	Track
MRE 412	Robot Programming and Simulation	2	RS
MRE 413	Autonomous Systems	3	Core
MRE 414	Mechatronics Systems Integration	3	Core
MRE 415	Safety Systems and Machine Guarding	2	IA
MRE 416	Industrial Training (SIWES)	3	Core
	Semester total	**22**	

Year 5: Specialisation, Integration and Professional Readiness

Semester 9 (First semester)

Code	Course	Units	Track
MRE 501	Advanced Robotics	3	RS
MRE 502	Human-Robot Interaction	2	RS
MRE 503	Advanced Industrial Automation	3	IA
MRE 504	Industrial IoT Analytics	2	IA
MRE 505	Control of Autonomous Systems	3	Core
MRE 506	Research Project II	3	Core
MRE 507	Engineering Project Management	2	Core
MRE 508	Technical Elective I	2	Core
	Semester total	**20**	

Semester 10 (Second semester)

Code	Course	Units	Track
MRE 509	Integrated Mechatronics System Design	3	Core
MRE 510	Industrial Automation Commissioning	2	IA
MRE 511	Robot Deployment and Integration	2	RS
MRE 512	Environmental Impact and Sustainability	2	Core
MRE 513	Engineering Professional Practice and Ethics	2	Core
MRE 514	Safety and Risk Management	2	Core
MRE 515	Final-Year Design Project and Defence	4	Core
MRE 516	Technical Elective II	2	Core
	Semester total	**19**	

Units by year

Year	Level	Units
Year 1	100	35
Year 2	200	45
Year 3	300	44
Year 4	400	44
Year 5	500	39
Total		207

5. Option Emphasis

Students choose a pathway in Year 3. Industrial Automation (IA) covers PLC and SCADA systems, industrial networks, hydraulics and pneumatics, automation system design, industrial IoT, and commissioning. Robotics Systems (RS) covers robot kinematics and dynamics, industrial robotics, robot control, mobile robotics, AI for robotics, and human-robot interaction. Core courses in mechanics, electronics, control, embedded systems, machine vision and project work are common to both pathways. Option courses are labelled in the Track column of the structure tables.

6. Assessment Framework

The department uses a balanced assessment system. Exact weightings must be approved under the university's academic regulations and applicable programme standards.

Assessment method	Purpose
Written examinations	Test conceptual understanding and engineering analysis.
Assignments and problem sets	Assess calculations, design reasoning and independent learning.
Laboratory reports	Assess experimental method, data analysis and technical reporting.
Design projects	Assess engineering judgement, calculations, drawings and specifications.
Presentations and defences	Assess communication, teamwork and justification of technical decisions.
Industrial training	Assess workplace competence, professional conduct and practical experience.
Final-year project	Assess independent investigation and integrated engineering design.

7. Industrial Training and Projects

- **SIWES (Semester 8, 3 units):** supervised industrial attachment, assessed by logbook, report and assessor.
- **Research Project I and II (Semesters 7 and 9):** proposal, then execution and reporting.
- **Final-Year Design Project and Defence (Semester 10, 4 units):** integrated design with a formal defence.

8. Resource Requirements for Accreditation

The resource-verification file should document actual facilities, staff, maintenance and funding, not only proposed equipment.

- **Robotics laboratory:** industrial and educational manipulators, mobile robots and sensors.
- **Automation laboratory:** PLC and SCADA training stations, pneumatic and hydraulic training rigs.
- **Mechanical workshop:** machine tools, CAD workstations and 3D printing where available.
- **Vision and sensing:** cameras, lighting and data acquisition equipment.
- **Human resources:** qualified academic staff and technical staff with appropriate specialisms.
- **Library:** current textbooks, standards, technical journals and digital reference access.
- **Digital facilities:** software licences and computing infrastructure appropriate to the programme.
- **Industry partnerships:** employers, professional bodies and placement providers for SIWES.

9. Quality Assurance and CCMAS Alignment

- Map each course to the relevant NUC CCMAS course and learning outcomes.
- Verify course numbering, credit units, contact hours and prerequisites.
- Confirm the allocation of core and university-designed courses under the applicable CCMAS framework.
- Check professional requirements with COREN and other relevant accreditation bodies.
- Establish a curriculum review committee and an external academic review process.
- Submit the programme through the university's governance and regulatory approval processes.

10. Companion Documents

This curriculum is accompanied by the Students' Handbook, with full course specifications, and the Lecturers' Handbook, with teaching schemes, lab instructions, rubrics and assessment design.