Students' Handbook

Mechatronics and Robotics Engineering

Faculty of Engineering, Akpakip Oro University (AOU)

Academic year: [to be inserted]

Draft for Faculty approval

1. Welcome

Welcome to the Department of Mechatronics and Robotics Engineering. This handbook explains the Mechatronics and Robotics Engineering programme: what you will study, how you will be assessed, and where to get help. Read it alongside the university's academic regulations, which take precedence where they differ.

2. About the Programme

The programme trains engineers who combine mechanical, electrical, control and software systems to build automated machines and robots. Years 1 and 2 build the foundations in mathematics, mechanics, electronics and programming. Years 3 to 5 add the pathway specialisation, culminating in an integrated design project and defence.

Graduate profile

- Integrate mechanical, electrical, control and software subsystems.
- Design and program automation systems and robots to applicable safety standards.
- Model, simulate and tune control systems.
- Work ethically and communicate effectively in multidisciplinary teams.
- Consider safety, sustainability and the human impact of automation.

Career pathways

Graduates may work in manufacturing and process industries, automation integrators, robotics companies, electronics and machine builders, and research and development organisations. Graduates who register with COREN may practise as professional engineers in Nigeria. Postgraduate study is also an option.

Professional registration

Registration with the Council for the Regulation of Engineering in Nigeria (COREN) requires an accredited qualification and professional experience. Keep your SIWES records and project reports, as they support your later registration.

3. Programme Structure

The tables list every course, its units, the semester in which it is taken, and its track. Codes and units are provisional until confirmed in the approved CCMAS schedule.

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
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

Code	Course	Units	Track
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
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**	

4. Course Specifications

Each entry gives the course description, learning outcomes, topics, assessment and recommended texts. Your lecturer issues the week-by-week scheme for each course.

Year 1: Engineering Foundations

MRE 101 Mathematics I

Units: 3 | Year 1, Semester 1 (First semester)

Description. Algebra, calculus and coordinate geometry for engineering.

Learning outcomes:

- Solve algebraic and trigonometric problems
- Apply differentiation to engineering rates

Course topics:

1. Functions and graphs
2. Differentiation
3. Integration
4. Applications

Assessment: CA 30 / Exam 70

Recommended texts: Stroud and Booth, Engineering Mathematics (latest edition)

MRE 102 General Physics I

Units: 3 | Year 1, Semester 1 (First semester)

Description. Mechanics, waves and thermal physics for engineers.

Learning outcomes:

- Analyse forces, motion and energy
- Apply conservation laws

Course topics:

1. Kinematics and dynamics
2. Work and energy
3. Rotation
4. Oscillations

Assessment: CA 30 / Exam 70

Recommended texts: Halliday, Resnick and Walker (latest edition)

MRE 103 General Chemistry I

Units: 2 | Year 1, Semester 1 (First semester)

Description. Atomic structure, bonding and stoichiometry relevant to materials.

Learning outcomes:

- Explain atomic structure and bonding
- Perform stoichiometric calculations

Course topics:

1. Atomic structure
2. Bonding
3. Stoichiometry
4. Solutions

Assessment: CA 30 / Exam 70

Recommended texts: Chang and Goldsby (latest edition)

MRE 104 Introductory Engineering

Units: 2 | Year 1, Semester 1 (First semester)

Description. Overview of engineering disciplines, problem solving and professional ethics.

Learning outcomes:

- Describe engineering disciplines
- Apply a structured problem-solving method

Course topics:

1. Disciplines and roles
2. Units
3. Problem solving
4. Professional ethics

Assessment: CA 50 / Exam 50

Recommended texts: Dym and Little, Engineering Design (latest edition)

MRE 105 Introduction to Computing

Units: 2 | Year 1, Semester 1 (First semester)

Description. Computer fundamentals and productivity tools.

Learning outcomes:

- Use common computing tools
- Explain computer system components

Course topics:

1. Hardware
2. Operating systems
3. Productivity tools
4. Data management

Assessment: CA 60 / Exam 40

Recommended texts: Shelly and Vermaat (latest edition)

MRE 106 Communication in English

Units: 2 | Year 1, Semester 1 (First semester)

Description. Academic and technical writing and presentation.

Learning outcomes:

- Write clear technical reports
- Deliver structured presentations

Course topics:

1. Academic writing
2. Technical reports
3. Presentations
4. Listening

Assessment: CA 60 / Exam 40

Recommended texts: Swales and Feak (latest edition)

MRE 107 Engineering Laboratory Practicals

Units: 1 | Year 1, Semester 1 (First semester)

Description. Introductory measurement, error analysis and laboratory safety.

Learning outcomes:

- Record and analyse measurement data
- Apply laboratory safety procedures

Course topics:

1. Units and measurement
2. Error analysis
3. Data presentation
4. Laboratory safety

Assessment: Lab reports 100

Recommended texts: Institutional laboratory manual

MRE 108 Introduction to Mechatronics and Robotics

Units: 2 | Year 1, Semester 1 (First semester)

Description. Scope of mechatronics and robotics and its role in automation.

Learning outcomes:

- Describe mechatronic systems
- Discuss automation and robotics careers

Course topics:

1. Mechatronic systems
2. Automation
3. Robotics
4. Careers and ethics

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 109 Mathematics II

Units: 3 | Year 1, Semester 2 (Second semester)

Description. Matrices, series, vectors and differential equations.

Learning outcomes:

- Solve linear systems
- Solve first and second order differential equations

Course topics:

1. Matrices
2. Vectors
3. Series
4. Differential equations

Assessment: CA 30 / Exam 70

Recommended texts: Stroud and Booth (latest edition)

MRE 110 General Physics II

Units: 3 | Year 1, Semester 2 (Second semester)

Description. Electricity, magnetism, optics and modern physics.

Learning outcomes:

- Analyse electric and magnetic fields
- Apply optics and modern physics concepts

Course topics:

1. Electrostatics
2. Magnetism
3. Optics
4. Modern physics

Assessment: CA 30 / Exam 70

Recommended texts: Halliday, Resnick and Walker (latest edition)

MRE 111 Engineering Drawing and Graphics

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Orthographic and assembly drawing for machines and systems.

Learning outcomes:

- Produce orthographic drawings
- Read assembly drawings

Course topics:

1. Orthographic projection
2. Sections
3. Dimensioning
4. Assembly drawings

Assessment: Coursework 60 / Exam 40

Recommended texts: Giesecke et al., Technical Drawing (latest edition)

MRE 112 Programming and Engineering Computation

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Structured programming and numerical methods.

Learning outcomes:

- Write structured programs for engineering problems
- Apply numerical methods

Course topics:

1. Programming basics
2. Control structures
3. Functions
4. Numerical methods

Assessment: CA 50 / Exam 50

Recommended texts: Chapra (latest edition)

MRE 113 Nigerian Peoples and Cultures

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Nigerian history, cultures and national development, or applicable general studies as prescribed.

Learning outcomes:

- Describe Nigerian cultural diversity
- Discuss national development issues

Course topics:

1. Nigerian history
2. Cultural diversity
3. Governance
4. Contemporary issues

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 114 Physics Practicals

Units: 1 | Year 1, Semester 2 (Second semester)

Description. Laboratory experiments reinforcing physics theory.

Learning outcomes:

- Perform standard physics experiments
- Write accurate laboratory reports

Course topics:

1. Experimental methods
2. Measurement
3. Physics experiments
4. Report writing

Assessment: Lab reports 100

Recommended texts: Institutional laboratory manual

MRE 115 Engineering Workshop and Safety

Units: 2 | Year 1, Semester 2 (Second semester)

Description. Workshop practice, machine tools and machine safety.

Learning outcomes:

- Use common machine tools safely
- Apply workshop safety standards

Course topics:

1. Workshop safety
2. Hand tools
3. Machine tools
4. Fabrication practice

Assessment: Practical 70 / Exam 30

Recommended texts: Institutional workshop manual

MRE 116 Electrical Principles

Units: 3 | Year 1, Semester 2 (Second semester)

Description. Basic DC and AC circuit analysis and electrical quantities.

Learning outcomes:

- Analyse resistive DC circuits
- Apply basic AC circuit concepts

Course topics:

1. DC circuits
2. Network theorems
3. AC fundamentals
4. Power and energy

Assessment: CA 30 / Exam 70

Recommended texts: Hughes, Electrical and Electronic Technology (latest edition)

Year 2: Core Engineering

MRE 201 Engineering Mechanics: Statics

Units: 3 | Year 2, Semester 3 (First semester)

Description. Equilibrium of particles and rigid bodies.

Learning outcomes:

- Analyse equilibrium of rigid bodies
- Determine forces in frames

Course topics:

1. Force systems
2. Equilibrium
3. Trusses and frames
4. Friction

Assessment: CA 30 / Exam 70

Recommended texts: Hibbeler, Engineering Mechanics: Statics (latest edition)

MRE 202 Strength of Materials I

Units: 3 | Year 2, Semester 3 (First semester)

Description. Stress, strain and deformation of members and beams.

Learning outcomes:

- Calculate stresses and strains
- Analyse bending and shear

Course topics:

1. Stress and strain
2. Axial loading
3. Torsion
4. Bending and shear

Assessment: CA 30 / Exam 70

Recommended texts: Gere and Goodno, Mechanics of Materials (latest edition)

MRE 203 Engineering Mathematics

Units: 3 | Year 2, Semester 3 (First semester)

Description. Partial derivatives, multiple integrals and Laplace transforms.

Learning outcomes:

- Apply Laplace transforms
- Solve partial differential problems

Course topics:

1. Partial derivatives
2. Multiple integrals
3. Laplace transforms
4. Fourier series

Assessment: CA 30 / Exam 70

Recommended texts: Kreyszig (latest edition)

MRE 204 Electrical Circuits I

Units: 3 | Year 2, Semester 3 (First semester)

Description. Network analysis of linear electrical circuits.

Learning outcomes:

- Apply nodal and mesh analysis
- Use network theorems

Course topics:

1. Nodal analysis
2. Mesh analysis
3. Network theorems
4. Transients

Assessment: CA 30 / Exam 70

Recommended texts: Nilsson and Riedel, Electric Circuits (latest edition)

MRE 205 Digital Logic Design

Units: 3 | Year 2, Semester 3 (First semester)

Description. Boolean algebra and combinational and sequential logic.

Learning outcomes:

- Simplify Boolean functions
- Design combinational and sequential circuits

Course topics:

1. Boolean algebra
2. Combinational logic
3. Flip-flops
4. Counters

Assessment: CA 40 / Exam 60

Recommended texts: Mano and Ciletti (latest edition)

MRE 206 Computer-Aided Design

Units: 2 | Year 2, Semester 3 (First semester)

Description. CAD modelling of mechanical parts and assemblies.

Learning outcomes:

- Model parts and assemblies in CAD
- Produce engineering drawings from models

Course topics:

1. Solid modelling
2. Assemblies
3. Drawings
4. Tolerances

Assessment: Coursework 100

Recommended texts: Institutional CAD manual

MRE 207 Engineering Materials

Units: 2 | Year 2, Semester 3 (First semester)

Description. Properties and selection of metals, polymers and ceramics.

Learning outcomes:

- Select materials for mechanical and electrical use
- Explain material properties

Course topics:

1. Metals
2. Polymers
3. Ceramics
4. Material testing

Assessment: CA 40 / Exam 60

Recommended texts: Callister and Rethwisch (latest edition)

MRE 208 Electronic Devices I

Units: 3 | Year 2, Semester 3 (First semester)

Description. Semiconductor devices and diode circuits.

Learning outcomes:

- Explain semiconductor behaviour
- Analyse diode circuits

Course topics:

1. Semiconductor physics
2. PN junction
3. Diode circuits
4. Rectifiers

Assessment: CA 30 / Exam 70

Recommended texts: Boylestad and Nashelsky (latest edition)

MRE 209 Engineering Mechanics: Dynamics

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Kinematics and kinetics of particles and rigid bodies.

Learning outcomes:

- Analyse motion of rigid bodies
- Apply work-energy and impulse-momentum

Course topics:

1. Kinematics
2. Kinetics
3. Work and energy
4. Impulse and momentum

Assessment: CA 30 / Exam 70

Recommended texts: Meriam and Kraige (latest edition)

MRE 210 Machine Elements

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Design of shafts, bearings, gears and fasteners.

Learning outcomes:

- Design shafts and fasteners
- Select bearings and gears

Course topics:

1. Shaft design
2. Fasteners
3. Bearings
4. Gears

Assessment: CA 30 / Exam 70

Recommended texts: Shigley and Mischke, Mechanical Engineering Design (latest edition)

MRE 211 Numerical Methods for Engineers

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Numerical solution of engineering equations.

Learning outcomes:

- Apply numerical root finding and interpolation
- Solve ODEs numerically

Course topics:

1. Root finding
2. Interpolation
3. Numerical integration
4. ODE solvers

Assessment: CA 40 / Exam 60

Recommended texts: Chapra (latest edition)

MRE 212 Electrical Machines I

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Transformers and DC machines.

Learning outcomes:

- Analyse transformer performance
- Analyse DC motor characteristics

Course topics:

1. Transformers
2. DC generators
3. DC motors
4. Motor selection

Assessment: CA 30 / Exam 70

Recommended texts: Fitzgerald, Kingsley and Umans (latest edition)

MRE 213 Microcontrollers and Embedded Programming

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Architecture and programming of microcontrollers.

Learning outcomes:

- Program microcontrollers in C
- Interface sensors and actuators

Course topics:

1. Architecture
2. C programming
3. GPIO and timers
4. Interfacing

Assessment: CA 40 / Exam 60

Recommended texts: Predko (latest edition)

MRE 214 Fluid Mechanics I

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Fluid properties, hydrostatics and conservation principles.

Learning outcomes:

- Calculate hydrostatic forces
- Apply continuity and Bernoulli principles

Course topics:

1. Fluid properties
2. Hydrostatics
3. Continuity
4. Bernoulli equation

Assessment: CA 30 / Exam 70

Recommended texts: Streeter, Wylie and Bedford (latest edition)

MRE 215 Signals and Systems I

Units: 3 | Year 2, Semester 4 (Second semester)

Description. Continuous-time signals and linear systems.

Learning outcomes:

- Classify signals and systems
- Apply Fourier analysis

Course topics:

1. Signal classification
2. LTI systems
3. Convolution
4. Fourier analysis

Assessment: CA 30 / Exam 70

Recommended texts: Oppenheim and Willsky (latest edition)

MRE 216 Mechatronics Laboratory I

Units: 2 | Year 2, Semester 4 (Second semester)

Description. Practical sensor, microcontroller and mechanism experiments.

Learning outcomes:

- Carry out sensor and microcontroller experiments
- Write technical lab reports

Course topics:

1. Sensor interfacing
2. Microcontroller tasks
3. Mechanism tests
4. Reporting

Assessment: Lab reports 100

Recommended texts: Institutional laboratory manual

Year 3: Specialist Foundations

MRE 301 Control Systems I

Units: 3 | Year 3, Semester 5 (First semester)

Description. Modelling and time-domain analysis of control systems.

Learning outcomes:

- Derive transfer functions
- Analyse time response and stability

Course topics:

1. Transfer functions
2. Block diagrams
3. Time response
4. Stability

Assessment: CA 30 / Exam 70

Recommended texts: Ogata, Modern Control Engineering (latest edition)

MRE 302 Sensors and Transducers

Units: 3 | Year 3, Semester 5 (First semester)

Description. Principles and selection of sensors for mechatronic systems.

Learning outcomes:

- Select sensors for given applications
- Condition sensor signals

Course topics:

1. Position and motion sensors
2. Force sensors
3. Signal conditioning
4. Selection

Assessment: CA 40 / Exam 60

Recommended texts: Bolton, Mechatronics (latest edition)

MRE 303 Industrial Automation and PLCs

Units: 3 | Year 3, Semester 5 (First semester)

Description. PLC architecture, ladder logic and industrial control.

Learning outcomes:

- Write ladder logic programs
- Design PLC-based control

Course topics:

1. PLC architecture
2. Ladder logic
3. Timers and counters
4. Control design

Assessment: Practical 40 / Exam 60

Recommended texts: Petruzella, Programmable Logic Controllers (latest edition)

MRE 304 Kinematics of Machines

Units: 3 | Year 3, Semester 5 (First semester)

Description. Mechanisms, linkages and cams.

Learning outcomes:

- Analyse position, velocity and acceleration
- Design cam and linkage mechanisms

Course topics:

1. Mechanisms
2. Linkages
3. Cams
4. Gear trains

Assessment: CA 30 / Exam 70

Recommended texts: Norton, Design of Machinery (latest edition)

MRE 305 Analogue Electronics

Units: 3 | Year 3, Semester 5 (First semester)

Description. Operational amplifiers and signal conditioning circuits.

Learning outcomes:

- Analyse op-amp circuits
- Design signal conditioning circuits

Course topics:

1. Op-amps
2. Feedback
3. Active filters
4. Signal conditioning

Assessment: CA 30 / Exam 70

Recommended texts: Sedra and Smith (latest edition)

MRE 306 Robot Fundamentals and Kinematics

Units: 3 | Year 3, Semester 5 (First semester)

Description. Robot structure and forward and inverse kinematics.

Learning outcomes:

- Derive forward kinematics
- Solve inverse kinematics for simple arms

Course topics:

1. Robot structure
2. Coordinate frames
3. Forward kinematics
4. Inverse kinematics

Assessment: CA 30 / Exam 70

Recommended texts: Craig, Introduction to Robotics (latest edition)

MRE 307 Electrical Drives

Units: 2 | Year 3, Semester 5 (First semester)

Description. Motor drives for mechatronic systems.

Learning outcomes:

- Select motor drives
- Analyse drive performance

Course topics:

1. Motor drives
2. Speed control
3. Stepper motors
4. Servo motors

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 308 Engineering Statistics and Research Methods

Units: 2 | Year 3, Semester 5 (First semester)

Description. Statistics and research design for engineering.

Learning outcomes:

- Apply descriptive and inferential statistics
- Design simple experiments

Course topics:

1. Descriptive statistics
2. Probability
3. Hypothesis testing
4. Research design

Assessment: CA 40 / Exam 60

Recommended texts: Montgomery and Runger (latest edition)

MRE 309 Control Systems II

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Frequency-domain design and state space.

Learning outcomes:

- Design compensators using frequency response
- Apply state-space methods

Course topics:

1. Frequency response
2. Bode plots
3. Compensator design
4. State space

Assessment: CA 30 / Exam 70

Recommended texts: Ogata (latest edition)

MRE 310 Actuators and Power Electronics

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Electric, hydraulic and pneumatic actuators and their drivers.

Learning outcomes:

- Select actuators
- Analyse actuator drivers

Course topics:

1. Electric actuators
2. Hydraulic actuators
3. Pneumatic actuators
4. Drivers

Assessment: CA 30 / Exam 70

Recommended texts: Mohan, Undeland and Robbins (latest edition)

MRE 311 Mechanism Design

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Synthesis and design of mechanisms for robots and machines.

Learning outcomes:

- Synthesise planar mechanisms
- Evaluate mechanism performance

Course topics:

1. Synthesis
2. Four-bar linkages
3. Performance
4. Design trade-offs

Assessment: CA 30 / Exam 70

Recommended texts: Norton (latest edition)

MRE 312 Robot Dynamics

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Dynamic models of manipulators.

Learning outcomes:

- Derive robot dynamic equations
- Analyse dynamic behaviour

Course topics:

1. Lagrangian method
2. Manipulator dynamics
3. Joint torques
4. Simulation

Assessment: CA 30 / Exam 70

Recommended texts: Craig (latest edition)

MRE 313 SCADA and Industrial Networks

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Supervisory control and industrial communication networks.

Learning outcomes:

- Design SCADA screens and tags
- Configure industrial networks

Course topics:

1. SCADA architecture
2. HMI design
3. Fieldbus networks
4. Alarms

Assessment: Practical 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 314 Embedded Systems Design

Units: 3 | Year 3, Semester 6 (Second semester)

Description. Design of embedded control systems.

Learning outcomes:

- Design embedded control systems
- Use real-time scheduling

Course topics:

1. Embedded architecture
2. Real-time scheduling
3. Firmware
4. Testing

Assessment: CA 40 / Exam 60

Recommended texts: Wolf, Computers as Components (latest edition)

MRE 315 Mechatronics Laboratory II

Units: 2 | Year 3, Semester 6 (Second semester)

Description. Control, robot and automation experiments.

Learning outcomes:

- Carry out control experiments
- Test robotic and automation systems

Course topics:

1. PID control
2. Robot tests
3. Automation tests
4. Data analysis

Assessment: Lab reports 100

Recommended texts: Institutional laboratory manual

MRE 316 Engineering Economics

Units: 2 | Year 3, Semester 6 (Second semester)

Description. Economic evaluation of engineering projects.

Learning outcomes:

- Evaluate project cash flows
- Compare investment options

Course topics:

1. Time value of money
2. Cash flow
3. Depreciation
4. Appraisal

Assessment: CA 40 / Exam 60

Recommended texts: Blank and Tarquin (latest edition)

Year 4: Advanced Design and Industrial Practice

MRE 401 Hydraulics and Pneumatics

Units: 3 | Year 4, Semester 7 (First semester)

Description. Hydraulic and pneumatic power systems for automation.

Learning outcomes:

- Design hydraulic circuits
- Design pneumatic circuits

Course topics:

1. Hydraulic circuits
2. Pneumatic circuits
3. Valves
4. Actuator sizing

Assessment: CA 30 / Exam 70

Recommended texts: Majumdar, Oil Hydraulics (latest edition)

MRE 402 Industrial Robotics

Units: 3 | Year 4, Semester 7 (First semester)

Description. Industrial robot systems, programming and applications.

Learning outcomes:

- Program industrial robots
- Select robots for applications

Course topics:

1. Robot systems
2. Programming
3. End effectors
4. Applications

Assessment: CA 40 / Exam 60

Recommended texts: Groover, Industrial Robotics (latest edition)

MRE 403 Robot Control

Units: 3 | Year 4, Semester 7 (First semester)

Description. Control of robot manipulators and mobile platforms.

Learning outcomes:

- Design joint-space and task-space controllers
- Analyse robot stability

Course topics:

1. Joint control
2. Task-space control
3. Trajectory planning
4. Stability

Assessment: CA 30 / Exam 70

Recommended texts: Siciliano et al., Robotics (latest edition)

MRE 404 Machine Vision

Units: 3 | Year 4, Semester 7 (First semester)

Description. Image acquisition and processing for automation and robotics.

Learning outcomes:

- Acquire and process images
- Apply vision algorithms to inspection

Course topics:

1. Image acquisition
2. Filtering
3. Segmentation
4. Object recognition

Assessment: CA 40 / Exam 60

Recommended texts: Gonzalez and Woods, Digital Image Processing (latest edition)

MRE 405 Mechatronic System Modelling

Units: 3 | Year 4, Semester 7 (First semester)

Description. Modelling and simulation of multi-domain mechatronic systems.

Learning outcomes:

- Build multi-domain models
- Simulate system behaviour

Course topics:

1. Modelling
2. Bond graphs
3. Simulation
4. Validation

Assessment: CA 30 / Exam 70

Recommended texts: Karnopp, Margolis and Rosenberg (latest edition)

MRE 406 Instrumentation and Data Acquisition

Units: 2 | Year 4, Semester 7 (First semester)

Description. Data acquisition systems and instrumentation for test and control.

Learning outcomes:

- Configure data acquisition systems
- Analyse sampled data

Course topics:

1. Sampling
2. Data acquisition
3. Calibration
4. Noise

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 407 Industrial Automation Systems Design

Units: 3 | Year 4, Semester 7 (First semester)

Description. Design of complete automation systems.

Learning outcomes:

- Design automation cells
- Specify and document automation systems

Course topics:

1. Cell layout
2. Control architecture
3. Safety
4. Documentation

Assessment: Design project 60 / Exam 40

Recommended texts: Departmental reading list, to be confirmed

MRE 408 Research Project I

Units: 2 | Year 4, Semester 7 (First semester)

Description. Literature review and proposal for the final-year project.

Learning outcomes:

- Conduct a literature review
- Write a research proposal

Course topics:

1. Literature search
2. Research questions
3. Methodology
4. Proposal writing

Assessment: Proposal 100

Recommended texts: Supervisor guidance and departmental guide

MRE 409 Artificial Intelligence for Robotics

Units: 3 | Year 4, Semester 8 (Second semester)

Description. AI methods for perception, planning and decision making in robots.

Learning outcomes:

- Apply search and planning methods
- Apply learning methods to robot tasks

Course topics:

1. Search
2. Planning
3. Learning
4. Decision making

Assessment: CA 30 / Exam 70

Recommended texts: Russell and Norvig, Artificial Intelligence (latest edition)

MRE 410 Mobile Robotics

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Localisation, mapping and navigation of mobile robots.

Learning outcomes:

- Design localisation filters
- Plan paths for mobile robots

Course topics:

1. Localisation
2. Mapping
3. Path planning
4. Navigation

Assessment: CA 30 / Exam 70

Recommended texts: Siegwart, Nourbakhsh and Scaramuzza (latest edition)

MRE 411 Industrial Internet of Things

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Connected sensors, devices and data platforms in industry.

Learning outcomes:

- Design industrial IoT architectures
- Secure device communication

Course topics:

1. IoT architecture
2. Protocols
3. Edge devices
4. Security

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 412 Robot Programming and Simulation

Units: 2 | Year 4, Semester 8 (Second semester)

Description. Programming and simulation of robot cells.

Learning outcomes:

- Program robots in simulation
- Validate programs before deployment

Course topics:

1. Simulation environments
2. Offline programming
3. Collision checking
4. Validation

Assessment: Practical 60 / Exam 40

Recommended texts: Departmental reading list, to be confirmed

MRE 413 Autonomous Systems

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Architectures and control of autonomous machines.

Learning outcomes:

- Describe autonomous system architectures
- Design simple autonomous behaviours

Course topics:

1. Architectures
2. Sensing
3. Decision making
4. Behaviour design

Assessment: CA 30 / Exam 70

Recommended texts: Departmental reading list, to be confirmed

MRE 414 Mechatronics Systems Integration

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Integration and testing of mechatronic subsystems.

Learning outcomes:

- Integrate subsystems
- Test integrated systems

Course topics:

1. Interfaces
2. Integration
3. Testing
4. Fault analysis

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 415 Safety Systems and Machine Guarding

Units: 2 | Year 4, Semester 8 (Second semester)

Description. Safety-related control and guarding of machines and robots.

Learning outcomes:

- Apply machine safety standards
- Specify guarding and safety functions

Course topics:

1. Machine safety
2. Guarding
3. Safety functions
4. Risk reduction

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 416 Industrial Training (SIWES)

Units: 3 | Year 4, Semester 8 (Second semester)

Description. Supervised industrial attachment in a relevant organisation.

Learning outcomes:

- Apply engineering knowledge in practice
- Keep a professional logbook

Course topics:

1. Workplace induction
2. Practical tasks
3. Reporting
4. Professional conduct

Assessment: Logbook 40 / Report 40 / Assessor 20

Recommended texts: SIWES guidelines issued by the Industrial Training Fund and AOU

Year 5: Specialisation, Integration and Professional Readiness

MRE 501 Advanced Robotics

Units: 3 | Year 5, Semester 9 (First semester)

Description. Advanced manipulation, humanoid and multi-robot systems.

Learning outcomes:

- Analyse advanced manipulation
- Evaluate multi-robot coordination

Course topics:

1. Advanced manipulation
2. Humanoids
3. Multi-robot systems
4. Coordination

Assessment: CA 30 / Exam 70

Recommended texts: Siciliano et al. (latest edition)

MRE 502 Human-Robot Interaction

Units: 2 | Year 5, Semester 9 (First semester)

Description. Safe and effective interaction between people and robots.

Learning outcomes:

- Assess human-robot safety
- Design interaction interfaces

Course topics:

1. Collaborative robots
2. Safety
3. Interfaces
4. Evaluation

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 503 Advanced Industrial Automation

Units: 3 | Year 5, Semester 9 (First semester)

Description. Advanced control architectures and automation strategies.

Learning outcomes:

- Design advanced automation architectures
- Evaluate control strategies

Course topics:

1. Distributed control
2. Motion control
3. Automation strategy
4. Optimisation

Assessment: CA 30 / Exam 70

Recommended texts: Departmental reading list, to be confirmed

MRE 504 Industrial IoT Analytics

Units: 2 | Year 5, Semester 9 (First semester)

Description. Data analytics for industrial equipment and processes.

Learning outcomes:

- Apply analytics to machine data
- Predict maintenance needs

Course topics:

1. Data pipelines
2. Analytics
3. Predictive maintenance
4. Dashboards

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 505 Control of Autonomous Systems

Units: 3 | Year 5, Semester 9 (First semester)

Description. Control and decision-making for autonomous systems.

Learning outcomes:

- Design controllers for autonomous systems
- Evaluate system performance

Course topics:

1. Control design
2. Estimation
3. Decision-making
4. Performance

Assessment: CA 30 / Exam 70

Recommended texts: Departmental reading list, to be confirmed

MRE 506 Research Project II

Units: 3 | Year 5, Semester 9 (First semester)

Description. Execution, analysis and reporting of the final-year project.

Learning outcomes:

- Execute a research project
- Report findings professionally

Course topics:

1. Data collection
2. Analysis
3. Writing
4. Oral presentation

Assessment: Project 100

Recommended texts: Supervisor guidance and departmental guide

MRE 507 Engineering Project Management

Units: 2 | Year 5, Semester 9 (First semester)

Description. Planning, scheduling and control of engineering projects.

Learning outcomes:

- Plan and schedule projects
- Manage cost and risk

Course topics:

1. Planning
2. Scheduling
3. Cost control
4. Risk

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 508 Technical Elective I

Units: 2 | Year 5, Semester 9 (First semester)

Description. Elective from the approved mechatronics and robotics list.

Learning outcomes:

- Apply specialist knowledge in the chosen area
- Evaluate case studies

Course topics:

1. Selected topic
2. Case studies
3. Applications
4. Review

Assessment: CA 40 / Exam 60

Recommended texts: As specified for the chosen elective

MRE 509 Integrated Mechatronics System Design

Units: 3 | Year 5, Semester 10 (Second semester)

Description. Capstone design of an integrated mechatronic or robotic system.

Learning outcomes:

- Integrate mechanical, electrical and software subsystems
- Produce a coordinated design

Course topics:

1. System integration
2. Design documentation
3. Testing
4. Review

Assessment: Design project 100

Recommended texts: Departmental design brief

MRE 510 Industrial Automation Commissioning

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Commissioning, testing and handover of automation systems.

Learning outcomes:

- Commission automation systems
- Prepare handover documentation

Course topics:

1. Commissioning
2. Testing
3. Handover
4. Documentation

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 511 Robot Deployment and Integration

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Installation and integration of robots into production environments.

Learning outcomes:

- Plan robot deployment
- Integrate robots with existing systems

Course topics:

1. Deployment planning
2. Integration
3. Cell safety
4. Maintenance

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 512 Environmental Impact and Sustainability

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Environmental assessment of automation and robotics.

Learning outcomes:

- Assess environmental impacts
- Apply sustainability criteria

Course topics:

1. Impact assessment
2. Energy efficiency
3. Lifecycle
4. Sustainability criteria

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 513 Engineering Professional Practice and Ethics

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Professional conduct, registration and engineering law.

Learning outcomes:

- Apply professional ethics
- Describe registration and legal responsibilities

Course topics:

1. Ethics
2. Professional bodies
3. Registration
4. Engineering law

Assessment: CA 50 / Exam 50

Recommended texts: Departmental reading list, to be confirmed

MRE 514 Safety and Risk Management

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Risk assessment and safety management for automated systems.

Learning outcomes:

- Conduct risk assessments
- Develop safety management plans

Course topics:

1. Hazard identification
2. Risk assessment
3. Safety plans
4. Monitoring

Assessment: CA 40 / Exam 60

Recommended texts: Departmental reading list, to be confirmed

MRE 515 Final-Year Design Project and Defence

Units: 4 | Year 5, Semester 10 (Second semester)

Description. Culminating integrated design project with defence.

Learning outcomes:

- Produce a complete design project
- Defend design decisions orally

Course topics:

1. Design development
2. Documentation
3. Presentation
4. Defence

Assessment: Project 60 / Defence 40

Recommended texts: Departmental project guide

MRE 516 Technical Elective II

Units: 2 | Year 5, Semester 10 (Second semester)

Description. Second elective from the approved mechatronics and robotics list.

Learning outcomes:

- Apply specialist knowledge in the chosen area
- Evaluate case studies

Course topics:

1. Selected topic
2. Case studies
3. Applications
4. Review

Assessment: CA 40 / Exam 60

Recommended texts: As specified for the chosen elective

5. Industrial Training (SIWES)

- SIWES is taken in Year 4, Semester 8, for 3 units.
- Keep a daily or weekly logbook that records tasks, supervision and what you learned.
- Obtain the placement letter and supervisor details before you start.
- Your final report and assessor's evaluation are part of your assessment.
- Follow the Industrial Training Fund and AOU SIWES guidelines throughout.

6. Assessment and Academic Regulations

Assessment follows the university's approved academic regulations, which govern grading, attendance, progression, carry-over and classification. This summary does not replace those regulations.

- Continuous assessment (CA) is set by course. Examinations form the remainder unless a course states otherwise.
- Practical and laboratory courses are assessed on reports, practical work and, where stated, a viva.
- Design projects and the final-year defence are assessed by a panel using published rubrics.
- Report any missed assessment through the department as soon as possible, with supporting evidence.
- Grading and classification are as set out in the regulations: [insert AOU grading table].

7. Student Support and Conduct

- **Academic advising:** each student is assigned an adviser. Meet your adviser at least once a semester.
- **Academic integrity:** plagiarism, falsified data and unauthorised collaboration are serious offences.
- **Respect and inclusion:** treat staff, colleagues and communities with dignity; report harassment through the appropriate channel.
- **Wellbeing:** seek help early from your adviser or the university welfare services.

8. Laboratory, Workshop and Field Safety

- Wear the prescribed personal protective equipment (PPE) in laboratories, workshops and on sites.
- Follow the instructions of the technician and lecturer. Never operate equipment you have not been trained to use.
- Report every accident, near miss and damaged equipment immediately.
- Robots and moving machines are hazardous: keep clear of the working envelope and use guards and emergency stops.
- Test new programs in simulation before running them on hardware, and never bypass safety interlocks.
- Follow lock-out and tag-out procedures before maintaining hydraulic, pneumatic or electrical equipment.

9. Contacts

Role	Name	Contact
Head of Department	[to be inserted]	[to be inserted]
Programme coordinator	[to be inserted]	[to be inserted]
Level advisers	[to be inserted]	[to be inserted]
SIWES coordinator	[to be inserted]	[to be inserted]
Laboratory technical officer	[to be inserted]	[to be inserted]