MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

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| **Module Information**  معلومات المادة الدراسية | | | | | | | |
| **Module Title** | Biomedical Transducers and Sensors | | | | **Module Delivery** | | |
| **Module Type** | Core | | | | **☒ Theory**   * **Lecture**   **☒ Lab**   * **Tutorial** * **Practical** * **Seminar** | | |
| **Module Code** | MIE22106 | | | |
| **ECTS Credits** | 5 | | | |
| **SWL (hr/sem)** | 125 | | | |
| **Module Level** | | UGII | **Semester of Delivery** | | | | 4 |
| **Administering Department** | | MIE | **College** | MUC | | | |
| **Module Leader** | Halah Ismail Khani | | **e-mail** | hala.ismail@muc.edu.iq | | | |
| **Module Leader’s Acad. Title** | | Asst . Lect | **Module Leader’s Qualification** | | | | MSc. |
| **Module Tutor** |  | | **e-mail** |  | | | |
| **Peer Reviewer Name** | Dr.Noor Kadhim Meftin | | **e-mail** | noor.kadhim@muc.edu.iq | | | |
| **Scientific Committee Approval Date** | 01/06/2023 | | **Version Number** | | | 1.0 | |

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| **Relation with other Modules**  العلاقة مع المواد الدراسية الاخرى | | | |
| **Prerequisite module** | Fundamental of Electrical Engineering | **Semester** | UGI-S1 |
| **Co-requisites module** | None | **Semester** |  |

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| **Module Aims, Learning Outcomes and Indicative Contents**  أهداف المادة الدراسية ونتائج التعلم والمحتويات الارشادية | |
|  | 1. Analyze errors and uncertainty of experimental results obtained from biomedical sensors. |
|  | 2. Understand requirements, calibration, characteristics, and parameters of biomedical sensors. |
| **Module Aims** | 3. Design with confidence signal conditioning systems required for processing the sensors responses. |
| أهداف المادة الدراسية | 1. Understand the operating principle, types, parameters, signal conditioning, and applications of resistive, reactance variation and self-generating sensors. 2. Understand the operating principle of different types of optical sensors and their features. 3. Understand the operation, models, and parameters of ultrasound transducers. 4. Understand the design, main building blocks, features, and calibration of intelligent sensors. |
| **Module Learning Outcomes** | 1. Define biomedical sensors, biosensors, and biomedical transducers. 2. Classify the biomedical sensors. Acquire knowledge about sensor data processing and feature extraction. 3. Recognize the requirements of biomedical sensors. 4. Explain the Static and dynamic characteristics of biomedical sensors. 5. Explain the requirements of signal conditioning circuits suitable for biomedical sensors. 6. Identify design principles of conditioning circuits. 7. Identify the different types of resistive, reactance variation and self- 8. generating sensors. 9. Explain the operating principle, parameters, calibration and applications. of resistive, reactance variation and self-generating sensors. 10. Identify the different types of optical sensors. 11. Reveal the advantages of optical sensors. 12. Classify ultrasound transducers. 13. Recognize the main parts of ultrasound transducers. |
| مخرجات التعلم للمادة الدراسية |

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|  | 14. List the main features of intelligent sensors. |
| **Indicative Contents**  المحتويات الارشادية | Indicative Contents including the following:  General concept and terminology, Sensor classification and calibration, static and dynamic characteristics, errors [10 hrs]  Resistive Temperature Detectors (RTD), Thermistors, light-dependent resistors, signal conditioning for resistive sensors [5 hrs]  Capacitive sensors, Inductive sensors, Electromagnetic sensors, signal conditioning for reactance variation sensors [5 hrs]  Thermoelectric sensors, Piezoelectric sensors, Electrochemical sensors, Signal conditioning for self-generating sensors.[7 hrs]  Optical techniques, General principles of optical sensing, Fiber-optic basics, Fiber- optic sensor technologies and applications[7 hrs]  Fundamentals of ultrasonic-based sensors, Ultrasonic-based sensing methods and applications.[8 hrs]  Definition, parameters, features, operating principle , main building blocks and applications.[5 hrs] |

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| **Learning and Teaching Strategies**  استراتيجيات التعلم والتعليم | |
| **Strategies** | Active learning, where students should be active and involved in the learning process inside the classroom, will be emphasized in the delivery of this course.   * Different active learning methods/approaches such as: Engaged Learning, Project-Based Learning, Cooperative Learning, Problem-based Learning, Structured Problem-solving, will be used. * The teaching method that will be used in this course will be composed of a series of mini lectures interrupted with frequent discussions and brainstorming exercises. PowerPoint presentations will be prepared for the course materials. * Use software packages for design and simulation of signal conditioning circuits implemented using these sensors. |

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| **Student Workload (SWL)**  الحمل الدراسي للطالب | | | |
| **Structured SWL (h/sem)**  الحمل الدراسي المنتظم للطالب خلال الفصل | 64 | **Structured SWL (h/w)**  الحمل الدراسي المنتظم للطالب أسبوعيا | 4 |
| **Unstructured SWL (h/sem)**  الحمل الدراسي غير المنتظم للطالب خلال الفصل | 61 | **Unstructured SWL (h/w)**  الحمل الدراسي غير المنتظم للطالب أسبوعيا | 6 |
| **Total SWL (h/sem)**  الحمل الدراسي الكلي للطالب خلال الفصل | 125 | | |

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| **Module Evaluation**  تقييم المادة الدراسية | | | | | |
|  | | **Time/Nu**  **mber** | **Weight (Marks)** | **Week Due** | **Relevant Learning**  **Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 5% (5) | 6, 9 | LO # 1-4, and 5-8 |
| **Assignments** | 2 | 5% (5) | 5, 12 | LO # 1-4, and 5-10 |
| **Projects / Lab.** | 1 | 10% (10) | Continuous | All |
| **Report** | 1 | 10% (10) | 14 | LO # 5-14 |
| **Summative**  **assessment** | **Midterm Exam** | 2 hr | 20% (20) | 12 | LO # 1-9 |
| **Final Exam** | 4hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) |  |  |

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| **Delivery Plan (Weekly Syllabus)**  المنهاج الاسبوعي النظري | |
|  | **Material Covered** |
| **Week 1,2** | **Introduction to Biomedical Sensors**  General concept and terminology, Sensor classification and calibration, static and dynamic characteristics, errors and uncertainty. |
| **Week 3,4** | **Resistive Sensors and their signal conditioning** Potentiometers, Strain gages, Resistive Temperature Detectors (RTD), Thermistors, light- dependent resistors, signal conditioning for resistive  sensors |

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| **Week 5,6** | **Reactance Variation and Electromagnetic Sensors**  Capacitive sensors, Inductive sensors, Electromagnetic sensors, signal conditioning for reactance variation sensors, |
| **Week 7** | **Mid- Exam** |
| **Week 8,9** | **Self-Generating Sensors and Signal Conditioning**  Thermoelectric sensors, Piezoelectric sensors, Electrochemical sensors, Signal conditioning for self-generating sensors. |
| **Week 10,11** | **Optical Sensors**  Optical techniques, General principles of optical sensing, Fiber-optic basics, Fiber-optic sensor technologies and applications. |
| **Week 12,13** | **Ultrasound Transducers**  Fundamentals of ultrasonic-based sensors, Ultrasonic-based sensing methods and applications. |
| **Week 14,15** | **Intelligent Sensors**  Definition, parameters, features, operating principle , main building blocks and applications. |
| **Week 16** | Preparatory week before final exam |



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| **Delivery Plan (Weekly Lab. Syllabus)**  المنهاج الاسبوعي للمختبر | |
|  | **Material Covered** |
| **Week 1,2** | Characteristics of various Biomedical sensors(Pulse sensor, Galvanic skin Response, Glucose  sensor, EMG sensor). |
| **Week 3,4** | Measurement of Resistance, Inductance and Capacitance using bridge circuits. |
| **Week 5** | Measurement of temperature using thermistor and RTD. |
| **Week 6** | Design of preamplifiers to acquire bio-signals along with impedance matching circuit using  suitable ICs. |
| **Week 7,8** | Design of EEG, ECG amplifiers and Measurement of heart rate. |
| **Week 9,10** | Acquire and display electrical and biological biosignals on a computer using the appropriate  hardware and software tools. |
| **Week 11** | e-Health Sensor Platform V2.0 using Arduino and Raspberry Pi. |
| **Week 12** | Measurement of respiration rate. |

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| **Learning and Teaching Resources**  مصادر التعلم والتدريس | | |
|  | **Text** | **Available in the**  **Library?** |
| **Required Texts** | Sensors and Signal Conditioning, Ramon Pallas-Areny and John  G. Webster, John Wiley & Sons, 2001,2nd Edition | No |
| **Recommended Texts** | Biosensors: An Introduction , Eggins, Brian, John Wiley & Sons,  1996,1st Edition | No |
| **Websites** | https://[www.multisim.com/](http://www.multisim.com/) | |

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| **Grading Scheme**  مخطط الدرجات | | | | |
| **Group** | **Grade** | التقدير | **Marks (%)** | **Definition** |
| **Success Group (50 - 100)** | **A -** Excellent | امتياز | 90 - 100 | Outstanding Performance |
| **B -** Very Good | جيد جدا | 80 - 89 | Above average with some errors |
| **C -** Good | جيد | 70 - 79 | Sound work with notable errors |
| **D -** Satisfactory | متوسط | 60 - 69 | Fair but with major shortcomings |
| **E -** Sufficient | مقبول | 50 - 59 | Work meets minimum criteria |
| **Fail Group (0 – 49)** | **FX –** Fail | راسب (قيد المعالجة) | (45-49) | More work required but credit awarded |
| **F –** Fail | راسب | (0-44) | Considerable amount of work required |
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| **Note:** Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the  automatic rounding outlined above. | | | | |