# MODULE DESCRIPTION of ANALYTICAL CHEMISTRY

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Analytical Chemistry** | | | **Module Delivery** | |
| **Module Type** | **S** | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | **CRE1104** | | | | |
| **ECTS Credits** | **5** | | | | |
| **SWL (hr/sem)** | **125** | | | | |
| **Module Level** | 1 | | **Semester of Delivery** | 1 | |
| **Administering Department** | Type Dept. Code | | **College** | Type College Code | |
| **Module Leader** | Hasan Mohammed Luaibi | | **e-mail** | hasan.luaibi@kus.edu.iq | |
| **Module Leader's Acad. Title** | Assistant Professor | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | None | | **e-mail** | E-mail | |
| **Peer Reviewer Name** | None | | **e-mail** | E-mail | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Objectives**<br>أهداف المادة الدراسية | The main objectives of a General Chemistry I module that covers the basics of general Chemistry and how to solve their parameters, which include:<br><br>1. Understanding the Buffer solutions, Volumetric Analysis. ,Types of Titration. ,Gravimetric Analysis. , Analytical Statistics. ,Analytical Separation Methods. And Green Chemistry .<br><br>2. Understanding about Buffer solution Understanding about Buffer solutions and the Buffer capacity , how can solve the problems of Buffer calculate when used strong acid and strong base or weak acid and base.<br>3. Understanding volumetric analysis , This objective would cover the types of classical methods with the titration steps and explain them details and solve their different question.<br>4. Understanding the second type of classical method it's gravimetric analysis and define the types of it , also explain the different between organic an in organic reagents , and the steps of gravimetric analysis in details. and examining the advantage and disadvantages between the types of gravimetric analysis.<br>5. Study the analytical Statistics ,this objective would cover statistical laws with learning how to used them to solve the practical data.<br>7. Explain another type of analytical chemistry is Analytical Separation Methods, and types of column which used to separate the different positive and negative ion . explain also how can separated the analyte from the interferences in the same sample , and which masking agent should used to avoid the interferences.<br>8. Green Chemistry, this objective would cover after all the subjects which the student studied them. how can chose the green material and used it instead of chemistry materials, or at least the students will Know how to choose the material which is safety for health and the environment<br>From that this section would also cover the role that green chemistry may play in meeting future energy needs and reducing greenhouse gas emissions. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | The students will be able to:<br><br>1. How can identify the primary standard materials and solutions .<br>2. How can identify the secondary standard materials and solutions .<br>3. Calculate the pH function for strong and weak acid and base , and how to distinguish between them.<br>4. Calculate concentration of liquid example and the percentage of example .<br>5. How to derive the calibration curve.<br>6. How to determine of Calcium or Magnesium ions which cause hardness in water at PH 10.<br>7. How to determination of halids in presence of the other without problem or side reaction.<br>8. How to calculate the mean, Recovery , Relative standard division and relative error.<br>9. How to separated the different ions from the other |

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|---|---|
| | 10. How can avoid the interferences.<br>11. What is green chemistry . |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br>**Theory:**<br>- Buffer solutions and their calculations. [ 3 hrs].<br>- Volumetric Analysis. ,Types of Titrations., Acid- base titrations [12hrs]<br>- Gravimetric Analysis. [9hrs]<br>- Analytical Statistics. [3hrs]<br>- Analytical Separation Methods. [18hrs]<br>- Green Chemistry [3hrs] |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | **1. Lectures:** used to introduce and explain key concepts related to Buffer solutions. Volumetric Analysis. Types of Titration, Gravimetric Analysis, Analytical Statistics, Analytical Separation Methods, Green Chemistry**.**<br>**2.Interactive discussions:** used to engage students in critical thinking and problem-solving questions related to calculate the pH ,the percentage , the concentration of metal ion , separation the ion through group discussions, debates, case studies, and simulations.<br>**3.Multimedia resources:** used to enhance student engagement and understanding of complex concepts related to the types of chemistry through videos, and animations**.**<br>**4.Assessment and feedback:** used to measure student learning and provide feedback on their progress through quizzes, exams, and projects. |

| **Student Workload (SWL)**<br>الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 79 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 5 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 46 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 3.06 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **125** | | |

## Module Evaluation

تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| Formative assessment | Quizzes | 2 | 10% (10) | 5 and 10 | LO #1, #2 and #3, #6 |
| | Assignments | 2 | 10% (10) | 2 and 12 | LO #3, #4 and #5, #7 |
| | Projects / Lab. | 1 | 10% (10) | Continuous | All |
| | Report | 1 | 10% (10) | 13 | LO #2, #3 and #5 |
| Summative assessment | Midterm Exam | 1hr | 10% (10) | 7 | LO #1 - #5 |
| | Final Exam | 3hr | 50% (50) | 16 | All |
| Total assessment | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

| | Material Covered |
|---|---|
| Week 1 | Buffer solutions , |
| Week 2 | calculate buffer solution. |
| Week 3 | Volumetric Analysis methods , Titrations |
| Week 4 | Neutralization titrations and solve the problem. |
| Week 5 | Acid -base titrations |
| Week 6 | Precipitation titrations |
| Week 7 | Complex-formation titrations |
| Week 8 | Oxidation -reduction titrations |
| Week 9 | Gravimetric analysis methods |
| Week 10 | Calculation |
| Week 11 | Analytical Statistics. |
| Week 12 | Analytical Separation Methods |
| Week 13 | Types of Analytical Separation Methods . |
| Week 14 | Applications of Analytical Separation Methods |
| Week 15 | Green Chemistry |
| Week 16 | **Final Exam** |

## Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

| | Material Covered |
|---|---|
| **Week 1** | Preparation of 0.1 N Hydrochloric Acid (Secondary Standard) and its standardization with Sodium Carbonate (Primary Standard). |
| **Week 2** | Preparation of 0.1 N Sodium Hydroxide and its standardization with standard HCl solution. |
| **Week 3** | Standardization of HCl using standard solution of sodium carbonate then determination of concentration of sodium hydroxide and carbonate sodium in mixture. |
| **Week 4** | Determination of ammonia using standard solution of HCl. |
| **Week 5** | Determination the percentage of ethanoic acid (acetic acid) in vinegar. |
| **Week 6** | Standardization of potassium permanganate using oxalic acid. |
| **Week 7** | Silver nitrate titrations by Mohr method. |

## Learning and Teaching Resources

مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | 1. Fundamental of Analytical Chemistry.<br>by Skoog & West, Holler , Crouch. 10th-Ed 2022<br>2. **Handbook of Green Analytical Chemistry**<br>**MIGUEL DE LA GUARDIA**<br>**SALVADOR GARRIGUES 1st Ed. 2012**<br>3. Principle of Instrumental Analysis 7Th Edition<br>By Douglas A. Skoog, F.Games Holler, Stanley R. Crouch<br>2016. | No |
| **Recommended Texts** | 1. Analytical Chemistry.<br>by Christian. 2004<br>2. Fundamental Chemistry for Medical Science<br>By Dr. Jameel M. Dhabab<br>2020 | No |
| **Websites** | None | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# اللغة العربية

**University Name**: ALkarkh University of Sciences

**College** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | اللغة العربية | | | **Module Delivery** | |
| **Module Type** | **B** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | KUS1106 | | | | |
| **ECTS Credits** | **4** | | | | |
| **SWL (hr/sem)** | **100** | | | | |
| **Module Level** | 1 | | **Semester of Delivery** | 1 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Dr. Ahmed kahlaf | | **e-mail** | Ahmed.k@kus.edu.iq | |
| **Module Leader's Acad. Title** | Assistant lecturer | | **Module Leader's Qualification** | Ph.D. | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1- تعلم العربية السليمة كونها اللغة الرسمية للوطن<br>2- اللغة جوهر الهوية ورمزها<br>3- اللغة تختلف عن اللهجة، فالاولى عالمية والثانية محلية<br>4- توظيف المفردات الفصيحة في الصياغة الاكاديمية للبحوث العلمية مترجمة بنظيرها الفصيح<br>5- التمكّن من كتابة البحوث والمقالات ذات المحتوى العلمي الصرف باللغة العربية الفصحى<br>6- تجنب الاخطاء الشائعة في الكتابة واختيار المفردات الصائبة<br>7- اثراء الخزين المعجمي لدى الطالب للمساعدة في بناء كاريزما التواصل الكلامي<br>8- الاطلاع على نماذج من الادب العربي شعرا ونثرا لما لها من اساس في بناء الجانب الثقافي المتنوع لدى الطالب<br>9- كتابة الاعداد بتمكّن فضلا الكتابة الصحيحة في صياغة الطلبات الرسمية<br>10- التعرف على الدرس الصوتي في اللغة العربية وعلاقته بعلم الفيزياء |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | عند انتهاء مفردات المادة الدراسية يكون الطالب متمكنا من:<br>1- الكتابة السليمة خالية من الاخطاء<br>2- التعبير العلمي الاكاديمي الصحيح<br>3- استعمال المفردات الفصيحة توظيفا ونطقا<br>4- اضافة رصيد لغوي ومفاهيم جديدة لمعاني الكلمات<br>5- القدرة على المخاطبة الادارية في الطلبات الرسمية |
| **Indicative Contents** | 1. لكل تخصص لغته التي تومئ اليه، وتدل عليه، ولغة كل علم تنبع من طبيعة كننه، فالاختصاصات العلمية لها معجم خاص بها يعبر عن جوهرها ومضمونها، فضلا عن المصطلحات الخاصة بها التي تدل عليها، وكذلك المصادر العلمية التي يُرجع اليها، والحال كما في اللغة الادبية؛ فهي ايضا لها مفرداتها وطريقة كتابتها والتعبير بها وعبرها، ومصطلحاتها الخاصة بها التي تعبر عنها وتدل عليها. [4 **hrs**]<br><br>2. المعاجم – بشكل عام - على اختلاف موارها تمثل محتوىً وكنفا لمفردات اي لغة مقترنة بالشرح والتفسير لتلك المفردات، اما المعاجم في اللغة العربية فهي واسعة ومتنوعة؛ فهناك معاجم غير معجمات اللغة، فالعربية فيها اول معجم جغرافي في التاريخ، معجم البلدان لـ (ياقوت الحموي)، فضلا عن المعاجم المتخصصة في جزئية معينة، مثل معاجم البلاغة، فضلا عن تنوع المدارس في تأليف المعاجم وتبويبها وطريقة البحث عن المفردة فيها. [4 **hrs**]<br><br>3. العلامة تندرج ضمن حقل علم السيمياء او السيميائية، وعلامات الترقيم من المواضيع المهمة بالأخص في البحوث الاكاديمية، بغض النظر عن التخصص، سواء كان التخصص علميا، او انسانيا، من هنا تأتي اهمية |

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|---|---|
| المحتويات الإرشادية | علامات الترقيم؛ فلها دور سيميائي، ودلاليّ مهم في الكتابة النّصيّة وفي بناء النص، فهي تُسهّل الفهم على القارئ، وتوضح المعنى المقصود، عبر القراءة والتلفّظ بالعبارة، فعلامات التّرقيم خير وسيلة لإظهار الصّراحة وبيان الوضوح في الكلام المكتوب؛ لأنّه يدلّ النّاظر إلى تلك العلامات الاصطلاحيّة وعلى العلاقات التي تربط أجزاء الكلام بعضها ببعض بوجه عام، وأجزاء كلّ جملة بوجه خاص، وكما يقول المتخصصون عن علامات الترقيم: بأن الوقف ليس مستقلّاً، وإنّما هو من توابع التّفكير، أي: إنّ السّكتات المقرّرة بمقادير مضبوطة في مواضع معينة، ليست مجرد محطّات تنفسيّة بالمعنى البيولوجيّ للتّنفس، وإنّما في المقام الأوّل وقفات معنويّة. فالعبرة من النّاحية اللّغويّة ليست بأن يستعيدَ القارئ نفسَه، بل المهم أن يتعاطى القارئ السكتَ بمقاديرَ معلومة، وفي مواضعَ محددة من السلسلة المنطوقة رفعاً للَبس، وصوناً لمقصد المتكلّم عن التبدّل، فهذه العلامات تجسيد لمشاعر الكاتب وقصدياته فيها. [4 **hrs**]<br><br>4. الاسلوب الكتابي يمثل بصمة للكاتب الذي يصدر عنه، ويتجسد عند القارئ، ولكل كاتب اسلوبه الخاص به، ينعكس ذلك في نتاج الكاتب، وللأسلوب انواع مختلفة، فهناك الاسلوب العلمي، والاسلوب الادبي، والاسلوب الخطابي، ولكل نوع خصائصة، وقالبه الذي يتكون فيه. [4 **hrs**]<br><br>5. الاحداث التي تقترن بالزمن تمثل الافعال، والأفعال في العربية تناظر الازمنة في اللغات الاخرى من جانب معين، او من جزئية معينة، والعربية تحتوي على عدد كبير من الجذور، جذور الأفعال، ففي العربية أفعال ثلاثية ورباعية وخماسية وسداسية، والفعل جزء مهم من اجزاء الكلام الاساسية، فضلا عن الجانب الصوتي في هذه الجذور، فعلم (الأصوات الفيزيائي) من العلوم المهمة في اللغة العربية، إذ يُعد علم (الأصوات الأكوستيكي) علما أقرب إلى الفيزياء منه للعلوم الإنسانية، وهو يمثل المرحلة الوسطى بين علم الأصوات النطقي وعلم الأصوات السمعي، وعلاقته مع اللغة العربية انطلاقا من البذرة الاولى في دراسة مخارج الحروف فيزيائيا ودلاليا. [4 **hrs**]<br><br>6. الكلام عن الشعر لا ينتهي؛ فالشعر تجسيد لمشاعر الفرد المتمثل بالشاعر، والمشاعر الجمعية للانسانية جمعاء، فهو موجود لدى كل بني البشر، والشعر العربي القديم كان بمثابة نشيدا وطنيا لهم، يمثل هويتهم الثقافية الرصينة ويمثل سجلا لتاريخهم وأمجادهم، على اختلاف اغراضه من غزل ومدح ورثاء وغير ذلك، وبحور الشعر في الشعر العربي مبنية بناء صوتيا فريدا عبر التفعيلات التي وضعها الخليل بن احمد الفراهيدي ووضع فلسفتها وكنهها وقواعدها، والشعر رصيد ثقافي، وحجة في الكلام، وزينة ورونقا يضاف على شخصية الفرد والمجتمع بشكل عام. [4 **hrs**]<br><br>7. الهمزة من المواضيع الاجرائية لدى الفرد الكاتب، بغض النظر عن التخصص، فيحتاجها كل فرد ناطق كاتب بها، فلها قواعدها التي تصدر عنها، وتُكتب بالشكل السليم منها، فموضوع رسم الهمزة من الاهمية بمكان؛ فرسمها يغير من المعنى، فلا بد من وضعها ورسمها بالشكل الصحيح لتوخي التعبير الدقيق عن المعنى المقصود. [8 **hrs**] |
| **Indicative Contents**<br>المحتويات الإرشادية | 8. المفاعيل في اللغة العربية، من الموضوعات المهة في درس اللغة العربية، ولا بد لكل دارس من معرفتها بشكل عام، وهناك آراء مختلفة بين البلاغيين والنحويين عن المفاعيل، هل ان تلك المفعولات فضلة، أم أنها ركن رئيس في الجملة ؛ فالنحويون يرون انها فضلةً في الجملة، وأن ركني الجملة الأساسيين هما: الفعل، والفاعل ، وأما البلاغيون فيرون :إنها ليست فضلة، وإنما هي ركن أساسي في الجملة؛ لأن كل كلمة تَدُل على معنى في الجملة، واذا ما دلت على معنى فلا تُعد فضلة، وإنما هي ركن رئيس في الجملة وبنائها، ورأي البلاغيين أقرب للصواب من رأي النحويين، فدراستها في العربية لغير المختصين مما يضيف لهم خزينا تعبيريا متنوعا. [4 **hrs**]<br><br>9. من المعروف وجود ظاهرة الأخطاء اللغوية نحويةً كانت أو املائية أو اسلوبية ،عند متحدّثي اللغة العربية وبالأخص عند غير المختصين بها ولا سيما مَن يعملون في مجال الاعلام، وهذه الظاهرة اتسعت وزاد انتشارها في العصر الحديث، فأخذت هذه الأخطاء تغزو مجالات الدراسة جميعها، من ذلك موضوع) العدد (في اللغة العربية، فنجد كثيراً من الطلبة وكذلك من عامة الناس يستعملون الأرقام بدلاً من كتابتها بالحروف؛ وذلك لتجنب الوقوع في الخطأ وهذا دليل ضعف لا يليق بالدارس أياً كان تخصصه؛ ولهذا فموضوع العدد وقواعد كتابته في اللغة العربية موضوع لا غنىً عنه في زمن لغة الأرقام.**[8 hrs]**<br><br>10. هناك مجموعة من الالفاظ متداولة بشكل كبير، تُستعمل في غير مكانها الصحيح، وفي غير ما وُضعت له وهذه الالفاظ تُستعمل في المخاطبات الرسمية الادارية بالمعنى غير الصحيح او الدقيق الذي تحمله تلك الألفاظ من معاني، فضلا عن أهمية توخي الدقة في هذه الألفاظ توظيفا لها في الطلبات الرسمية التي تُقدم على اختلاف موضوعاتها، فالطلب لا بد من ان يكون مختصرا مركزا، يعطي الفكرة الموجزة، والهدف المقصود منه ازاء صاحب الادارة الذي تُقدم اليه الطلبات، وما في ذلك من ايجابيات العمل في التخفيف واختصار للجهد والوقت في تنفيذ المهام الادارية الموكلة الافراد على اختلاف درجاتهم.**[8 hrs]** |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | صناعة شخصية متكاملة للطالب الجامعي من حيث التخصص العلمي الدقيق والتخصص المساند |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 3.2 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 3.46 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5, 10 | |
| | **Assignments** | 2 | 10% (10) | 2, 12 | |
| | **Projects / Lab.** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 10% (10) | 13 | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | |
| | **Final Exam** | 2hr | 50% (50) | 16 | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | الفرق بين اللغة العلمية واللغة الادبية |
| **Week 2** | المعاجم العربية وانواعها |
| **Week 3** | علامات الترقيم |
| **Week 4** | الاسلوب |

| | |
|---|---|
| **Week 5** | الأفعال – أنواعها وتقسيماتها |
| **Week 6** | نماذج مختارة من الشعر العربي القديم - الشعر الاسلامي - الشعر الاموي |
| **Week 7** | Mid-term Exam |
| **Week 8** | رسم الهمزة / همزة الوصل وهمزة القطع |
| **Week 9** | كتابة الهمزة بداية الكلام وآخره |
| **Week 10** | المبتدأ والخبر – مهارات كتابة العدد |
| **Week 11** | المفاعيل / المفعول به – المفعول لأجله |
| **Week 12** | المفعول معه – المفعول فيه – المفعول المطلق |
| **Week 13** | النثر العربي |
| **Week 14** | الأخطاء الشائعة – طريقة كتابة الطلبات الرسمية |
| **Week 15** | نماذج مختارة من الشعر العباسي والشعر الحديث |
| **Week 16** | Preparatory week before the final Exam |

## Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

| | **Material Covered** |
|---|---|
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

## Learning and Teaching Resources

مصادر التعلم والتدريس

| | | **Available in the Library?** |
|---|---|---|
| **Required Texts** | **1-** كتاب: العربية الجامعية لغير المتخصصين / د. عبده الراجحي<br>**2-** كتاب: النحو التطبيقي / د. عبده الراجحي<br>**3-** الصرف التطبيقي / د. عبده الراجحي<br>**4-** النحو الوافي / عباس حسن<br>**5-** تاريخ الادب العربي / شوقي ضيف | |
| **Recommended Texts** | | |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF FUNDAMENTAL OF COMPUTER SCIENCE

| Module Information<br>معلومات المادة الدراسية | | | |
|---|---|---|---|
| **Module Title** | **Fundamental of computer Science** | | **Module Delivery** |
| **Module Type** | **B** | | ☒ **Theory**<br>☒ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☒ **Practical**<br>☐ **Seminar** |
| **Module Code** | KUS1104 | | |
| **ECTS Credits** | **6** | | |
| **SWL (hr/sem)** | **150** | | |
| **Module Level** | 1 | **Semester of Delivery** | 1 |
| **Administering Department** | Energy and Environmental Science | **College** | College of Energy and Environmental Science |
| **Module Leader** | Ahmed Adnan | **e-mail** | a.algbory@kus.edu.iq |
| **Module Leader's Acad. Title** | Assistant lecturer | **Module Leader's Qualification** | M.SC |
| **Module Tutor** | / | **e-mail** | / |
| **Peer Reviewer Name** | / | **e-mail** | / |
| **Scientific Committee Approval Date** | | **Version Number** | 1.0 |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Objectives**<br>أهداف المادة الدراسية | 1. Hardware: Computers consist of physical components, including the central processing unit (CPU), memory (RAM), storage devices (hard drives or solid-state drives), input/output devices (keyboard, mouse, monitor), and other peripheral devices.<br><br>2. Software: Software refers to the programs and instructions that enable computers to perform specific tasks. This includes the operating system, applications, and utilities that facilitate user interaction and manage hardware resources.<br><br>3. Central Processing Unit (CPU): The CPU is the "brain" of a computer, responsible for executing instructions and performing calculations. It performs tasks such as fetching, decoding, and executing program instructions.<br><br>4. Memory (RAM): Random Access Memory (RAM) is a volatile type of computer memory that provides temporary storage for data and instructions needed by the CPU in real-time. It allows for faster data access compared to permanent storage.<br><br>5. Storage: Computers use various types of storage devices to store data and programs permanently. Hard disk drives (HDDs) and solid-state drives (SSDs) are common examples. They retain data even when the computer is powered off.<br><br>6. Input and Output Devices: Input devices like keyboards and mouse allow users to provide instructions and interact with the computer. Output devices such as monitors and printers display or produce the results of computations or data processing.<br><br>7. Operating System (OS): The operating system is software that manages computer hardware and software resources. It provides a user interface, controls system functions, and facilitates the execution of programs.<br><br>8. Algorithms and Programming: Algorithms are step-by-step procedures or instructions for solving problems or accomplishing specific tasks. Programming involves writing code using programming languages to create software that instructs the computer to perform desired functions. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Understand the basic components of a computer system, including the CPU, memory, storage devices, and input/output devices.<br><br>2. Explain the role and functioning of the operating system in managing computer |

| | |
|---|---|
| | resources and facilitating user interaction.<br><br>3. Describe the binary number system and understand how data is represented and manipulated in digital computers.<br><br>4. Comprehend the concept of algorithms and their importance in solving computational problems.<br><br>5. Demonstrate knowledge of computer hardware and software interaction, including how the CPU executes instructions and interacts with memory and input/output devices.<br><br>6. Explain the basics of computer networking, including protocols, IP addressing, and network topologies.<br><br>7. Understand the principles of data storage and retrieval, including file systems and database management systems.<br><br>8. Evaluate the impact of emerging technologies on the field of computing, such as cloud computing, artificial intelligence, and cybersecurity.<br><br>9. Apply programming concepts to solve simple problems, including variables, control structures, and functions.<br><br>10. Demonstrate effective and safe use of computer systems, including understanding security measures and ethical considerations in computing. |
| **Indicative Contents**<br>المحتويات الإرشادية | 1. Introduction to Computers:<br>- Evolution and history of computers<br>- Basic computer components and their functions<br>- Types of computers and their applications<br><br>2. Computer Hardware:<br>- Central Processing Unit (CPU) and its architecture<br>- Memory (RAM) and storage devices (hard drives, solid-state drives)<br>- Input devices (keyboard, mouse, etc.) and output devices (monitor, printer, etc.)<br>- Motherboard, power supply, and other peripheral devices<br><br>3. Computer Software:<br>- Operating systems and their functions<br>- Application software and utilities<br>- Programming languages and software development tools |

| | |
|---|---|
| | 4. Data Representation:<br>- Binary number system and conversions<br>- Character encoding (ASCII, Unicode)<br>- Representation of integers, floating-point numbers, and characters<br><br>5. Algorithms and Problem Solving:<br>- Introduction to algorithms and problem-solving approaches<br>- Pseudocode and flowcharts<br>- Fundamental algorithms like sorting, searching, and recursion<br><br>6. Computer Networks:<br>- Basics of computer networking<br>- Network topologies and protocols<br>- IP addressing and subnetting<br><br>7. Programming Concepts:<br>- Introduction to programming languages and paradigms<br>- Variables, data types, and operators<br>- Control structures (conditionals, loops) and functions<br><br>8. Emerging Technologies:<br>- Cloud computing and its applications<br>- Artificial intelligence and machine learning<br>- Cybersecurity and data privacy considerations |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | Lecture<br>Discussion<br>Practical Experience<br>Clarification and Ask Questions<br>reflect on what you have learned<br>Research and reports |

| Student Workload (SWL)<br>الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 94 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 6 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 56 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 3.7 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **150** | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 5% (10) | 5 and 10 | LO #1, #2 and #9, #10 |
| | **Assignments** | 2 | 5% (10) | 2 and 12 | LO #3, #4 and #6, #7 |
| | **Projects / Lab.** | 1 | 10% (10) | 14 | All |
| | **Report** | 1 | 10% (10) | 13 | LO #5, #8 and #10 |
| **Summative assessment** | **Midterm Exam** | 2hr | 10% (10) | 7 | LO #1 - #6 |
| | **Final Exam** | 3hr | 60% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Enabling students to Know about computers and computing |
| **Week 2** | Enabling students to define binary representation and data storage |
| **Week 3** | Definition of Computer Hardware and CPU Operations |
| **Week 4** | Definition of Software and Operating Systems |
| **Week 5** | Understanding the algorithms and problem solving |
| **Week 6** | Empowering students to understand computer networks and the Internet |
| **Week 7** | Empowering students to become acquainted with data representation and encoding |
| **Week 8** | Empowering students to Introduction to database systems |
| **Week 9** | Empowering students about programming concepts and Constructs |

| | |
|---|---|
| **Week 10** | Empowering students to get an overview of the software development |
| **Week 11** | Empowering students to acquire knowledge about fundamentals of computer security |
| **Week 12** | Review and Final Assessment |
| **Week 13** | Empowering students to acquire knowledge about artificial Intelligence and machine Learning |
| **Week 14** | Enabling students to get an overview of emerging technologies in computing |
| **Week 15** | Empowering students to understand the privacy concerns and data protection regulations |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | Lab 1: Familiarization with computer components: CPU, RAM, storage devices |
| **Week 2** | Lab 2: Installation and configuration of an operating system (e.g., Windows or Linux) |
| **Week 3** | Lab 3: Binary number system conversion exercises |
| **Week 4** | Lab 4: Implementing simple algorithms using pseudocode |
| **Week 5** | Lab 5: Setting up a small computer network |
| **Week 6** | Lab 6: Network troubleshooting exercises |
| **Week 7** | Lab 7: Working with file systems and organizing files |
| **Week 8** | Lab 8: Introduction to a programming language |
| **Week 9** | Lab 9: Implementing user-defined functions |
| **Week 10** | Lab 10: Discussing ethical implications of computer use |
| **Week 11** | Lab 11: Collaborative project to apply learned concepts or review sessions |
| **Week 12** | Lab 12: Practice with conditional statements and loops |
| **Week 13** | Lab 13: Sorting algorithms: (e.g., bubble sort or selection sort) |
| **Week 14** | Lab 15: Implementing algorithms to solve specific problems |
| **Week 15** | Lab 15: Familiarization with Stacks and queues |
| **Week 16** | **Preparatory week before the final Exam** |

| **Learning and Teaching Resources**<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Brookshear, J. Glenn, Dennis Brylow, and S. Manasa. "Computer science: An overview." (2009). | Yes |

| | | |
|---|---|---|
| **Recommended Texts** | Patterson, David A., and John L. Hennessy. Computer organization and design ARM edition: the hardware software interface. Morgan kaufmann, 2016.<br>Petzold, Charles. Code: The hidden language of computer hardware and software. Microsoft Press, 2000. | No |
| **Websites** | Computer Science YouTube Channels: Channels like "Computerphile" Computer Science," and "MIT Open Courseware". | |

**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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# MATHEMATICS

**University Name**: ALkarkh University of Science

College: Renewable Energy and Environmental Sciences

Dept: Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Mathematics | | **Module Delivery** | | |
| **Module Type** | B | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | | |
| **Module Code** | Kus1102 | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 125 | | | | |
| **Module Level** | 1 | | **Semester of Delivery** | 1 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Haleema swaidan ali | | **e-mail** | haleemaswaidan@kus.edu.iq | |
| **Module Leader's Acad. Title** | Proof. | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | NONE | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | NONE | **Semester** | |
| **Co-requisites module** | NONE | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Introducing students to mathematical concepts in the subject of linear algebra and matrices.<br>2. Use and apply these concepts to solve applied problems.<br>3. Teach students to analyze results using mathematical methods.<br>4. Teaching students some special functions and their properties.<br>5. Teaching students to mix and combine mathematical concepts with practical problems.<br>6. Introducing students to the importance of mathematics |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Solving mathematical problems with scientific material.<br>2. Writing scientific reports and analyzing data.<br>3. Self learning method.<br>4. Solving problems relevant with mathematical subject.<br>5. Testing the student's ability to solve mathematical problems related to the subjects he studied. |
| **Indicative Contents**<br>المحتويات الإرشادية | 1. Introduction to Linear Algebra.<br>2. Linear system -Linear Equations –Solution Of Linear Equations.<br>3. Matrix Algebra.<br>4. Logarithmic function.<br>5. Trigonometric functions.<br>6. Exponential function.<br>7. Techniques of integrations. |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | 1. Lectures: Providing students with basic mathematical concepts and their practical applications.<br>2. Forming discussion groups during lectures to discuss mathematics topics and solve practical problems.<br>3. Ask the students a set of thinking questions during the lectures, such as what, how, when and why for specific topics in mathematics.<br>4. Giving students homework that requires self-explanations in different ways.<br>5. Writing scientific reports and analyzing data.<br>6. solving problems relevant with mathematical subject. |

| Student Work load (SWL)<br>الحمل الدراسي للطالب ل 15 اسبوعاً | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | **48** | **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 5 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | **77** | **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 5.3 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 125 **(h/sem)** | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5 and 10 | Lo #2,#4,#6,#8,#10 |
| | **Assignments** | 2 | 10% (10) | 2 and 12 | Lo #1, #3,#5,#7,#9,#11 |
| | **Projects / Lab.** | 1 | 5%(5) | 13 | All |
| | **Report** | 1 | 5% (5) | 14 | All |
| **Summative assessment** | **Midterm Exam** | 2 hr | 20% (20) | 8 | Lo #1-#8 |
| | **Final Exam** | 3hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Matrices - the concept of matrices - some types of matrices- operations on matrices |
| **Week 2** | Determinants, Properties of the determinants ,Calculate the determinant of a 2x2 matrix and a nxn matrix. |
| **Week 3** | The Inverse - Matrix - Properties Of The Inverse - Matrix, The Transpose OperationProperties. |
| **Week 4** | practical - method for finding the Inverse the cofactor method. |
| **Week 5** | solution of linear systems using the inverse matrix- the adjutant inverse. |
| **Week 6** | solution of linear systems using The Cramer's rule. |
| **Week 7** | solution of linear systems using Gauss_ Jordan Elimination method. |
| **Week 8** | Slop of a line, equation of a line, types of line equation. |
| **Week 9** | Trigonometric functions - Derivation of trigonometric functions. |
| **Week 10** | Integration of Trigonometric Functions - Applications to Trigonometric Functions. |
| **Week 11** | Logarithmic function - properties of logarithmic function – derivation of logarithmic function. |
| **Week 12** | Integration of the logarithmic function-Applications to the logarithmic function. |
| **Week 13** | Exponential function - properties of the exponential function- derivation of the exponential function - integration of the exponential function. |
| **Week 14** | Techniques of integrations (by parts, tables) |
| **Week 15** | Techniques of integrations ( partial fractions) |
| **Week 16** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | non |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Larson, Ron, and Bruce H. Edwards. Calculus. Cengage Learning , Calculus 2022. | yes |
| **Recommended Texts** | Larson, Ron. Precalculus with limits. Cengage Learing. | yes |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

## GENERAL PHYSICS

**University Name**: ALkarkh University of Science

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **General physics** | | | **Module Delivery** | |
| **Module Type** | **S** | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | **CRE1101** | | | | |
| **ECTS Credits** | 7 | | | | |
| **SWL (hr/sem)** | 175 | | | | |
| **Module Level** | **1** | | **Semester of Delivery** | 1 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Mohammed Ali Hassan GHlem | | **e-mail** | Albeaty33@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecture doctor | | **Module Leader's Qualification** | Ph.D. | |
| **Module Tutor** | Mohammed Obaid | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 2023/06/20 | | **Version Number** | 1.0 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | 1- becomes able to know<br>1. Measurement units and coordinates.<br>2. Object movement and the use of vectors.<br>3. Distinguish between work and energy and the relationship between them<br>4- Understand electric charge and electric field.<br>5- Knowing the materials.<br>6- Identify the electric field of charges and electric field lines.<br>7- Identifying the forces, moments and electric potential energy.<br>8- Learn about Causs' law ,Ohm's Law, Coulomb's law. |
| **Module Learning Outcomes** | Make the student able to:<br>1- Determine the coordinates and units of measurement used.<br>2. Applying Newton's laws of motion<br>3-Understand electric charge and electric field.<br>4- Knowing the composition of the material.<br>5- Know the types of matter.<br>6- Know the types of electric charge.<br>7- Learn about Coulomb's law.<br>8- Identify the electric field of charges and electric field lines.<br>9- Identifying the forces, moments and electric potential energy.<br>10- Learn about Causs' law. |
| **Indicative Contents** | Indicative content includes the following.<br>Physical Quantities Units, and vectors ,Motion Along a straight Line, Motion in two dimensions,Newton's Laws of Motion,Work and kinetic energy electric charge and electric field, electric charge and structure of matter, types of matter, charge is conserved, charging by induction and friction,electric forces on uncharged objects, Coulomb's law, electric field, electric field on a point charge, electric field calculations, electric field lines, electric dipole, forces, moments and electric potential energy, Causs' law. |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students and by oral, written exams and homeworks |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 79 | | |
| **Unstructured SWL (h/sem)** | 96 | | |
| **Total SWL (h/sem)** | 175 | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 4 | 20% (20) | 2, 5, 10, 12 | |
| | **Assignments** | 2 | 5%(5) | 2, 12 | |
| | **Projects / Lab.** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 5% (5) | 13 | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 8 | |
| | **Final Exam** | 2hr | 50% (50) | 16 | |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

| | Material Covered |
|---|---|
| **Week 1** | 1. Fundamentals of physics. |
| **Week 2** | 2. Coordinates and units of measurement used in the field of physics |
| **Week 3** | 3. The motion of bodies and the application of Newton's laws. |
| **Week 4** | 4. The relationship between work and energy |
| **Week 5** | 5 - Analysis of the influencing forces |
| **Week 6** | Analysis of the influencing forces |
| **Week 7** | electric charge, electric field, electric charge and structure of matter. |

| | |
|---|---|
| **Week 8** | Mid exam + types of matter, charge is conserved, charging by induction and friction |
| **Week 9** | electric forces on uncharged objects, Coulomb's law |
| **Week 10** | electric forces on uncharged objects, Coulomb's law |
| **Week 11** | electric field, electric field on a point charge, |
| **Week 12** | electric field calculations, electric field lines, |
| **Week 13** | electric dipole, forces, moments and electric potential energy |
| **Week 14** | Causs' law, electric flux and the enclosed charge |
| **Week 15** | |
| **Week 16** | Preparative for final exam |

| **Delivery Plan (Weekly Lab. Syllabus)** | |
|---|---|
| | **Material Covered** |
| **Week 1** | Lab 1: Ohms law and Ohmic and Non Ohmic materials |
| **Week 2** | Lab 2: Diffraction grating |
| **Week 3** | Lab 3: Archimedes principle |
| **Week 4** | Lab 4: Spiral spring |
| **Week 5** | Lab 5: Simple pendulum |
| **Week 6** | Lab 6: speed and sound |
| **Week 7** | Lab 7: The flywheel |

| **Learning and Teaching Resources** | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Edward M.Purcell, Electrisity and magnetism,3rd edition | yes |
| **Recommended Texts** | University physics with modern physics, 13th edition | Yes |
| | University Physics, 13th Edition<br>Hugh D. Young and Roger A. Freedman<br>Addison-Wesley publishing. | yes |
| | Physics for Scientists and Engineers with Modern Physics, Ninth Edition<br>.Raymond A. Serway and John W. Jewett, Jr | yes |

| Grading Scheme | | | | |
|---|---|---|---|---|
| **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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF

# PRINCIPLE OF RENEWABLE ENERGIES

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Principle of New and Renewable Energies** | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE1105** | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 125 | | | | |
| **Module Level** | | 1 | **Semester of Delivery** | | 1 |
| **Administering Department** | | REE | **College** | CRE | |
| **Module Leader** | Firas Abdulrazzaq Hadi | | **e-mail** | Firas.A.Hadi@kus.edu.iq | |
| **Module Leader's Acad. Title** | | Asst. Prof. | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | | NONE | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | | 20/6/2023 | **Version Number** | | 1 |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | NONE | **Semester** | No |
| **Co-requisites module** | NONE | **Semester** | No |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | The Renewable and Sustainable Energy Systems course provides a graduate-level understanding of the conversion principles and technology behind various renewable energy sources. It also examines the issues involved in the integration of various renewable energy sources and their economics for heat, power, and transportation needs. Based on the technical and sustainability challenges, the future outlook for each of the sources and systems is discussed. This is a required core course for the Master of Professional Studies in Renewable Energy and Sustainability Systems Program.<br>When you successfully complete this course, you will be to:<br>● understand the principles of operation of the broad spectrum of renewable energy technologies;<br>● conduct preliminary resource assessments for a variety of renewable energy technologies;<br>● analyze energy technologies from a systems perspective;<br>● articulate the technical challenges for each of the renewable sources; and<br>● discuss economic, technical, and sustainability issues involved in the integration of renewable energy systems. |
| **Module Learning Outcomes** | 1. demonstrate an ability to use critical thinking and problem-solving skills to evaluate business energy use and how and when to apply renewable energy solutions<br>2. demonstrate an understanding of, and assess the obstacles associated with implementation of renewable energy systems<br>3. evaluate the advantages, limitations and potential of various clean energy sources for buildings and businesses .<br>4. demonstrate an understanding and familiarity with engineering and financial aspects of projects .<br>5. demonstrate an understanding and familiarity with the regulatory aspects of renewable energy projects .<br>6. demonstrate an understanding and familiarity with the State policies, financing and utility-led programs in CT<br>7. produce a clean energy project proposal |
| **Indicative Contents** | Introduction to conventional and Renewable energy sources environmental impacts, challenges and future trends, fundamentals, potential, estimation and, applications: Solar Energy Wind Energy Hydropower Biomass Geothermal Energy Ocean Energy |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | 1- Speaking 2- Discussion 3- Reports 4- Projects 5- Assignments |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 64 | **Structured SWL (h/w)** | 4 |
| **Unstructured SWL (h/sem)** | 61 | **Unstructured SWL (h/w)** | 4 |
| **Total SWL (h/sem)** | 125 | | |

| Module Evaluation | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5,10 | |
| | **Assignments** | 2 | 10% (10) | 2,12 | |
| | **Projects / Lab.** | 1 | 10% (10) | - | |
| | **Report** | 1 | 10% (10) | 13 | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | |
| | **Final Exam** | 2hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | Energy Sources |
| **Week 2** | Solar Photovoltaics |
| **Week 3** | PV system components |
| **Week 4** | Solar Power Systems - Electrical |
| **Week 5** | Solar Power Systems - Thermal |
| **Week 6** | Wind Power Fundamentals |
| **Week 7** | Wind Power Systems |

| | |
|---|---|
| **Week 8** | Wind Turbine Control |
| **Week 9** | Biomass Technologies |
| **Week 10** | Geothermal Power Generation |
| **Week 11** | Hydropower |
| **Week 12** | Fuel Cells |
| **Week 13** | Environmental Effects |
| **Week 14** | Connecting to The Grid |
| **Week 15** | Economics of RE |
| **Week 16** | Preparatory week before the final Exam |

| **Delivery Plan (Weekly Lab. Syllabus)** | |
|---|---|
| | **Material Covered** |
| **Week 1** | / |
| **Week 2** | / |
| **Week 3** | / |
| **Week 4** | / |
| **Week 5** | / |
| **Week 6** | / |
| **Week 7** | / |

| **Learning and Teaching Resources** | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Renewable Energy Systems, David Buchla, Thomas Kissell and Thomas Floyd, Pearson, 2015, ISBN: 978-0-13-262251-6. Hardcopy available in the bookstore, eBook | |
| **Recommended Texts** | 1. Reneweble energy resources: Tiwari and ghosal, Narosa publication. 2. Non conventional Energy Sources,Khanna Publication | |
| **Websites** | • Wind LCA Harmonization (NREL/FS-6A20-57131 • June 2013) (link is external)(link is external)<br>•<br>• *Solar Energy Industry Association's Solar Market Insight Report for 2013* | |

| Grading Scheme | | | | |
|---|---|---|---|---|
| **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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR ENGLISH LANGUAGE

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **English** | | | **Module Delivery** | |
| **Module Type** | **B** | | | ☒ **Theory**<br>☒ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | KUS12012 | | | | |
| **ECTS Credits** | **4** | | | | |
| **SWL (hr/sem)** | **78** | | | | |
| **Module Level** | 1 | | **Semester of Delivery** | 1 | |
| **Administering Department** | Energy and Environmental Science | | **College** | College of Energy and Environmental Science | |
| **Module Leader** | Ahmed Adnan | | **e-mail** | a.algbory@kus.edu.iq | |
| **Module Leader's Acad. Title** | Assistant lecturer | | **Module Leader's Qualification** | M.SC | |
| **Module Tutor** | / | | **e-mail** | / | |
| **Peer Reviewer Name** | / | | **e-mail** | / | |
| **Scientific Committee Approval Date** | | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Objectives**<br>أهداف المادة الدراسية | 1. Vocabulary and Grammar: Introduce learners to essential English vocabulary and grammar structures, allowing them to understand and construct basic sentences and expressions.<br><br>2. Listening Skills: Develop learners' ability to comprehend simple spoken English in various contexts, such as greetings, introductions, and everyday conversations.<br><br>3. Speaking Skills: Enable learners to engage in basic conversations using appropriate vocabulary, grammar, and pronunciation. Learners will gain confidence in expressing their ideas, opinions, and preferences.<br><br>4. Reading Skills: Improve learners' reading comprehension skills by exposing them to short texts and passages on familiar topics. Learners will practice extracting meaning from the text and understanding main ideas and details.<br><br>5. Writing Skills: Enhance learners' ability to write simple sentences and short paragraphs with correct grammar, spelling, and punctuation. Learners will focus on expressing themselves coherently and accurately in written form.<br><br>6. Pronunciation and Intonation: Help learners develop clear pronunciation and intonation patterns, enabling effective oral communication and comprehension.<br><br>7. Cultural Awareness: Introduce learners to cultural aspects of English-speaking countries, promoting understanding and sensitivity toward cultural differences in language use.<br><br>8. Everyday Communication: Provide learners with practical language skills for everyday situations, such as greetings, introducing themselves and others, ordering food, asking for directions, and making basic inquiries.<br><br>9. Language Strategies: Equip learners with strategies to improve their language learning, including techniques for vocabulary acquisition, self-study, and independent practice.<br><br>10. Confidence and Fluency: Foster learners' confidence in using English and develop their fluency through various speaking and interactive activities.<br><br>11. Lifelong Learning: Encourage learners to cultivate a lifelong learning attitude towards English language acquisition, motivating them to continue expanding their language skills beyond the module. |

| | |
|---|---|
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Understand and use basic English vocabulary and expressions related to daily life, including greetings, introductions, and common objects.<br><br>2. Comprehend and respond appropriately to simple spoken English in familiar contexts, such as basic conversations, instructions, and short presentations.<br><br>3. Construct grammatically correct and meaningful sentences using basic grammar structures, including verb tenses, pronouns, and basic sentence patterns.<br><br>4. Read and understand simple texts and passages on familiar topics, extracting main ideas and specific details.<br><br>5. Write simple sentences and short paragraphs with appropriate grammar, spelling, and punctuation, expressing ideas clearly and coherently.<br><br>6. Engage in basic conversations and interactions, demonstrating effective communication skills in everyday situations.<br><br>7. Demonstrate improved pronunciation and intonation patterns, enabling clearer oral communication.<br><br>8. Develop cultural awareness and sensitivity towards English-speaking cultures, recognizing and respecting cultural differences in language use.<br><br>9. Demonstrate increased confidence and fluency in using English to communicate ideas, opinions, and preferences.<br><br>10. Apply critical thinking skills to analyze and evaluate simple texts and language use. |
| **Indicative Contents**<br>المحتويات الإرشادية | 1. Unit 1: Introduction<br>- Greetings and introductions<br>- Personal information (name, age, nationality)<br>- Basic expressions for everyday communication<br><br>2. Unit 2: Everyday Life<br>- Describing daily routines and activities<br>- Expressing likes and dislikes<br>- Talking about hobbies and interests<br><br>3. Unit 3: People and Places<br>- Describing people's appearances and personalities<br>- Talking about family members and relationships<br>- Asking for and giving directions |

| | |
|---|---|
| | 4. Unit 4: Food and Drinks<br>- Vocabulary related to food and beverages<br>- Ordering food and drinks at a restaurant or café<br>- Talking about preferences and dietary restrictions<br><br>5. Unit 5: Shopping<br>- Vocabulary related to shopping and clothes<br>- Describing clothing items and sizes<br>- Making inquiries and purchasing items<br><br>6. Unit 6: Travel and Transport<br>- Vocabulary related to travel and transportation<br>- Asking for and giving travel information<br>- Describing modes of transportation and travel experiences<br><br>7. Unit 7: Leisure Activities<br>- Talking about leisure activities and hobbies<br>- Discussing weekend plans and free time activities<br>- Making suggestions and invitations<br><br>8. Unit 8: Daily Life Skills<br>- Talking about personal routines and habits<br>- Describing abilities and skills<br>- Making requests and giving instructions<br><br>9. Unit 9: Health and Well-being<br>- Discussing health and common ailments<br>- Describing symptoms and seeking medical assistance<br>- Giving advice and talking about healthy habits<br><br>10. Unit 10: Social Interactions<br>- Engaging in small talk and social conversations<br>- Discussing current events and popular topics<br>- Sharing opinions and perspectives |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | Lecture<br>Discussion<br>Experimental<br>Quizzes |

| | |
|---|---|
| | Speaking tasks<br>Written assignments<br>Evaluation methods to track their language development |

| Student Workload (SWL)<br>الحمل الدراسي للطالب محسوب لـ ١٣ اسبوعا | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 78 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 5 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 47 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 3.1 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **125** | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 5% (10) | 5 and 10 | LO #1, #2 and #9, #10 |
| | **Assignments** | 2 | 5% (10) | 2 and 12 | LO #3, #4 and #6, #7 |
| | **Projects / Lab.** | 1 | 10% (10) | 14 | All |
| | **Report** | 1 | 10% (10) | 13 | LO #5, #8 and #10 |
| **Summative assessment** | **Midterm Exam** | 2hr | 10% (10) | 7 | LO #1 - #7 |
| | **Final Exam** | 3hr | 60% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction to English Language Basics |
| **Week 2** | Language Basics |
| **Week 3** | Greetings and Introductions |
| **Week 4** | Everyday Conversations |
| **Week 5** | Everyday Conversations |

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|---|---|
| **Week 6** | Vocabulary Expansion |
| **Week 7** | Expressing Likes and Dislikes |
| **Week 8** | Describing People and Places |
| **Week 9** | Describing Objects |
| **Week 10** | Daily Activities |
| **Week 11** | Daily Routines |
| **Week 12** | Reading Skills Development |
| **Week 13** | Reading Skills Development |
| **Week 14** | Writing Skills Development |
| **Week 15** | Writing Skills Development |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| | None |

| **Learning and Teaching Resources**<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Soars, John, and Liz Soars. New headway: Beginner student's book. Oxford: Oxford University Press, 2010. | Yes |
| **Recommended Texts** | Soars, Liz, John Soars, and Amanda Maris. "American Headway Starter: Teacher's Book." | No |
| **Websites** | English language learning websites and mobile applications for additional practice and reinforcement | |

| **Grading Scheme**<br>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.

# MODULE DESCRIPTION FOR

# Fundamentals of electricity

**University Name**: ALkarkh University of Science

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Fundamentals of electricity | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE1208 | | | | |
| **ECTS Credits** | 7 | | | | |
| **SWL (hr/sem)** | 175 | | | | |
| **Module Level** | **1** | | **Semester of Delivery** | **2** | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | omar Kanaan noori | | **e-mail** | Omareng27@gmail.com | |
| **Module Leader's Acad. Title** | Lecturer Dr | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | The overview of development and current trends in electrical engineering and computer science. Fundamentals of electricity, capacitance. Electric current and electrical phenomena. Fundamentals of magnetism, inductance and mutual inductance. Concepts, elements and topology of electric circuits. Kirchhoff's laws. Elementary DC circuits. Circuits with capacitors. Complex DC circuits (bridge circuit, star-delta transformation, circuits with multiple sources). Superposition, Thevenin's, Norton's and Millman's theorem. Current and voltage waveforms. Complex calculus in analysis of AC circuits. RLC circuits. Topographic and locus diagrams. Frequency characteristics. Instantaneous, real, reactive and apparent power. AC circuits with multiple sources. Polyphase system. Harmonic analysis, applications in circuit analysis. Transients. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. define and understand the fundamental concepts related to electricity, magnetism and electric circuit theory.<br>2. understand and apply Kirchhoff's Laws to DC and AC circuit analysis.<br>3. understand and apply phasors for sinusoidal steady-state AC circuit analysis.<br>4. analyze DC and AC circuits by following circuit analysis methods and theorems: nodal analysis, star-delta transformation, transformation between real source models, Millman's, Thévenin's and Norton's theorems.<br>5. understand and apply the principle of linearity and superposition to AC and DC circuits.<br>6. analyze circuits with non-sinusoidal sources by harmonic analysis.<br>7. analyze transient response of first order circuits (series RC and RL).<br>8. use basic laboratory measurement equipment including the power supplies, ammeters, voltmeters, ohmmeters, digital multimeters, function generators, and oscilloscopes as well as to conduct experiments, to measure basic quantities in electric circuits, and to interpret data. |
| **Indicative Contents**<br>المحتويات الإرشادية | The course gives understanding of concepts, laws and principles regarding electrical circuits. After finishing this course students will be able to analyze DC and AC electrical circuits and understand underlying physical phenomena. |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | **Lectures**: Traditional lectures can be used to deliver foundational knowledge on conductive polymers, their properties, and applications. Lectures can also include discussions on historical developments and key concepts.<br>**Case Studies**: Case studies can be used to explore real-world applications of conductive polymers. Students can analyze and discuss the challenges, opportunities, and outcomes of specific projects or industry collaborations, allowing them to gain insights into practical applications.<br>**Group Discussions and Debates**: Group discussions encourage active participation and critical thinking. Students can engage in debates on topics such as the future of |

| | |
|---|---|
| | conductive polymers, ethical considerations, or emerging applications. This promotes collaborative learning and develops communication skills.<br>**Problem-Based Learning**: Students can be presented with open-ended problems or scenarios related to conductive polymers. They can work in groups to analyze the problem, propose solutions, and present their findings. This fosters analytical thinking and problem-solving skills.<br>**Research Projects**: Assigning research projects to students allows them to explore specific aspects of conductive polymers in depth. They can conduct literature reviews, design experiments, and analyze data, contributing to the advancement of knowledge in the field.<br>**Online Resources and Virtual Tools**: Utilizing online resources, digital simulations, and virtual tools can enhance learning. These resources can provide interactive demonstrations, virtual experiments, and supplementary materials for self-paced learning.<br>**Presentations and Poster Sessions**: Assigning presentations or poster sessions allows students to communicate their research findings or assigned topics effectively. This develops their presentation skills, promotes peer learning, and encourages critical evaluation of information.<br>**Formative and Summative Assessments**: Regular formative assessments, such as quizzes or group projects, can help monitor students' progress. Summative assessments, such as examinations or research reports, evaluate students' understanding and mastery of the curriculum. |

## Student Workload (SWL)
الحمل الدراسي للطالب

| | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 94 | **Structured SWL (h/w)** | 7 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 81 | **Unstructured SWL (h/w)** | 6 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 175 | | |

## Module Evaluation
تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Course description with the overview of development and current trends in electrical engineering and computer science. Fundamentals of electricity, (atoms and their structure, electric charge, electric force, electric field, electric potential, capacitance and capacitor, capacitor energy. |
| **Week 2** | Electric current and electrical phenomena (resistance, Ohm's and Joule's Law, electrical energy and power). Concepts, elements and topology of electric circuits. Kirchhoff's laws. |
| **Week 3** | Elementary DC circuits. Circuits with capacitors. |
| **Week 4** | More complex DC circuits (bridge circuit, star-delta transformation, circuits with multiple sources). Superposition principle. |
| **Week 5** | Current and voltage waveforms. Complex calculus in analysis of AC circuits. Phasors |
| **Week 6** | Fundamentals of magnetism (magnetic force, magnetic field, Faraday's Law, inductance and mutual inductance, inductor energy). |
| **Week 7** | 1. RLC circuits. Frequency characteristics. |
| **Week 8** | 1. Midterm exam. |
| **Week 9** | 1. Power and energy in AC circuits |
| **Week 10** | 1. Topographic and locus diagrams. Complex AC circuits. |
| **Week 11** | 1. Circuit analysis methods. |
| **Week 12** | 1. Poliphase systems. |
| **Week 13** | 1. Transients. Characteristics of nonsinusoidal periodical waveforms. |
| **Week 14** | 1. Waveform harmonic analysis |
| **Week 15** | **Seminars for students on recent developments in conductive polymers** |
| **Week 16** | **Preparatory week before the final Exam** |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | V. Pinter (1989.), *Osnove elektrotehnike, I i II dio*, Tehnička knjiga, Zagreb | No |
| **Recommended Texts** | E. Šehović, M. Tkalić, I Felja (1992.), *Osnove elektrotehnike - zbirka primjera, I dio*, Školska knjiga, | No |

| | |
|---|---|
| **Websites** | |

| **Grading Scheme**<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# Geology

**University Name**: ALkarkh University of Science

**College** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Geology** | | | **Module Delivery** | |
| **Module Type** | **S** | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | **CRE12010** | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 125 | | | | |
| **Module Level** | | 1 | **Semester of Delivery** | | 1 |
| **Administering Department** | | REE | **College** | | CRE |
| **Module Leader** | Ahmed Askar Najaf | | **e-mail** | | drahmed@kus.edu.iq |
| **Module Leader's Acad. Title** | | Professor | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | NONE | | **e-mail** | | NONE |
| **Peer Reviewer Name** | | NONE | **e-mail** | | NONE |
| **Scientific Committee Approval Date** | | 20/06/2023 | **Version Number** | | 1.0 |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Objectives** | 1. Clarification of how micropaleontology can make significant contributions to a wide range of scientific problems in geosciences.<br>2. Identify two microfossil groups ( ostracode and calcareous nannofossil) which are useful in Geosciences.<br>3. This course deals with the basic concept of the most important and discriminatory morphological characters, anatomical, and taxonomic aspects of each fossil group.<br>4. Learn about the most important scientific terms (Terminology) and their definitions related to this topic.<br>5. To understand and comprehend the impact of these groups on ecology, distribution, and paleoecology.<br>6. To perform different micropaleontology applications. |
| **Module Learning Outcomes** | Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks.<br>1. List with description, the different groups of organisms and the kingdoms that belong to them.<br>2. Define the various terms associated with micropaleontology.<br>3. What is ostracode? Definition, measurement of valves, orientation and importance in geoscience.<br>4. Summarize what is meant by external and internal features and structures of ostracode.<br>5. Discuss the reaction and involvement of ostracode in paleoecology, distribution, paleoclimat and stratigraphy.<br>6.Define Coccoliths, coccolithophores and Coccolithophores and the Biosphere.<br>7. Identify the Coccoliths and Coccolithogenesis.<br>8. Explain the Coccolith morphology and formation.<br>9. List and Describe the Ecology and distribution of Coccolithophores.<br>10. Discuss the Functions of coccoliths.<br>11. Identify the relation of coccolith with climate changes.<br>12. Terminology. |
| **Indicative Contents** | Indicative content includes the following.<br><u>Part A – Theoretical lectures</u><br>Introduction, organisms groups , types of microfossils, taxonomic position , general characteristic of ostracoda, importance of ostracoda study (as microfossils), morphology of ostracoda, calcareous parts , outer lamella, inner lamella, description |

| | |
|---|---|
| | of margins, features and structures used for the orientation of the carapace, external feature, internal features, terminology of ostracode, dimorphism. [*10* hrs]<br><br>,Ecology, distribution of marine ostracoda, factors controlled of the distribution of ostracoda, distribution of environments according to the salinity levels, Paleoecology. [*8* hrs]<br><br>Primary producers in the sea, primary Production, coccolithophores, coccolithophores and the biosphere coccoliths and coccolithogenesis, nannofossils, nannoplankton, coccolith morphology and formation, heterococcoliths, holococcoliths, nannoliths. [*10* hrs]<br><br>Ecology of coccolithophores, coccoliths and sedimentology, functions of coccoliths, geologic distribution, effect of global climate change on distribution, evolutionary responses, terminology of calcareous nannofossils. [8 hrs]<br><br>Revision problem classes [3 hrs]<br><br><u>Part B – Practical labs</u><br><br>Shape, Overlap, measurements of carapace and valves, orientation, external features, external structures, internal features, internal structures, inner lamella, outer lamella, Hinge line, ornamentation, description of some index species. [18 hrs]<br><br>coccolith shape, coccoliths orientation, Coccolith size, ultrastructure, types of ultrastructural component, element arrangement , structures spanning central-area, orientation in plan view, structures closing central-area, crystallography, systematic paleontology, description of some index species. [18 hrs |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | Expanding students' perceptions about this science and its contents it includes that help in stratigraphic, paleoecologic, and paleoclimatic analysis. In addition to the use of different microscopes in distinguishing the types of microfossils through observations of the external and internal structures and their diagnosis. This will be achieved through lectures, labs, and interactive tutorials and by types of practical diagnostic methods for microfossils and involving some sampling activities that are interesting to the students. |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 94 | **Structured SWL (h/w)** | 6 |
| **Unstructured SWL (h/sem)** | 31 | **Unstructured SWL (h/w)** | 2 |
| **Total SWL (h/sem)** | **125** | | |

| Module Evaluation | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5 and 10 | LO #1, #2 and #10, #11 |
| | **Assignments** | 2 | 10% (10) | 2 and 12 | LO #3, #4 and #6, #7 |
| | **Projects / Lab.** | 1 | 10% (10) | Continuous | All |
| | **Report** | 1 | 10% (10) | 13 | LO #5, #8 and #10 |
| **Summative assessment** | **Midterm Exam** | 2hr | 10% (10) | 7 | LO #1 - #7 |
| | **Final Exam** | 3hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | Structure of earth |
| **Week 2** | Crust and mantle and core composition |
| **Week 3** | Types of spheres |
| **Week 4** | Crystal |
| **Week 5** | Minerals ( classifications ) |
| **Week 6** | Rocks type |
| **Week 7** | Igneous and sedimentary and metamorphic |
| **Week 8** | Rock cycle in nature |
| **Week 9** | Soils types and classifications |
| **Week 10** | Structure geology |
| **Week 11** | Bedding strata |
| **Week 12** | Folding type and component |
| **Week 13** | Faulting types and component |
| **Week 14** | Joints type and classification |
| **Week 15** | Geological map and topographic |

| Week 16 | Preparative of final exam |
|---|---|

| Learning and Teaching Resources | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Kious, Jacquelyne; Tilling, Robert I. (1996). "Understanding Plate Motions". This Dynamic Earth: The Story of Plate Tectonics. Kiger, Martha, Russel, Jane (Online ed.). Reston, VA: United States Geological Survey. ISBN 978-0-16-048220-5. Archived from the original on 10 August 2011. Retrieved 13 March 2009. | Yes<br><br>Yes |
| **Recommended Texts** | Zheng, Y؛ Fu، Bin؛ Gong، Bing؛ Li، Long (2003). "Stable isotope geochemistry of ultrahigh pressure metamorphic rocks from the Dabie–Sulu orogen in China: implications for geodynamics and fluid regime". Earth-Science Reviews. ج. 62: 105–161. Bibcode:2003ESRv...62..105Z. DOI:10.1016/S0012-8252(02)00133-2.<br>Condomines, M؛ Tanguy، J؛ | Yes<br><br>No |
| **Websites** | | |

| Grading Scheme | | | | |
|---|---|---|---|---|
| **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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# Human rights

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Human rights** | | | **Module Delivery** | |
| **Module Type** | **B** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | KUS1209 | | | | |
| **ECTS Credits** | 3 | | | | |
| **SWL (hr/sem)** | 75 | | | | |
| **Module Level** | 1 | | **Semester of Delivery** | 2 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Dr.Mohanad Basim Ibrahim | | **e-mail** | mohanad.al.sallami@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | none | | **e-mail** | none | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | تهدف المادة إلى بيان اهمية الحقوق الاصلية اللصيقة بالانسان، التي تتفق مع فطرته، والتي يقبلها العقل المجرد، والتي لا تختلف باختلاف الزمان والمكان، وهذه هي حقوق الانسان. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | تسهم المادة العلمي (لحقوق الانسان) إلى تثقيف الطالب من الناحية القانونية؛ ليكون مطلع على ماهية الحقوق الانسانية، وأصلها التاريخي، وتعريف ماله من حقوق وما عليه من التزامات، من خلال معرفة حقه وحدود ذلك الحق، وحقوق الآخرين، وما سعت إلية الدول والمنظمات الدولية والاقليمية في تعزيز مفاهيم تلك الحقوق، وإلزام الدول للنص عليها في التشريعات الداخلية، والضمانات التي تكفل تطبيق تلك الحقوق العالمية. |
| **Indicative Contents**<br>المحتويات الإرشادية | إن المحتويات الارشادية لمادة حقوق الانسان تتلخص بتهذيب سلوك الطالب، [hr20]<br>وتعريفه إن تعامله مع غيره من بني البشر يقوم على مبدأ: ((إن الناس صنفان؛ إما أخوٌ لك في الدين، أو نظيرٌ لك في الخلق)).[hr 20] |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | نعمد في هذا الجانب إلى ما يلي:<br>1- يعرف الطالب إبتداءً بمضمون موجز عن المفردات التي سيتم تناولها خلال المحاضرة، ثم نوجه له بعض الإسئلة التي تحرك ذهنه، وتشد إنتباهه؛ لضمان حسن الاستماع.<br>2- يتم التعمق بشرح المفردات العلمية في حدود تناسب متوسط المستويات العلمية لضمان عدم تجاوز الفروق الفردية عند عموم الطلبة.<br>3- يتم ترك مساحة للنقاش الحر في إطار الموضوع المخصص للمحاضرة.<br>4- الحرص على جانب التغذية الراجعة للمعلومات قبل نهاية المحاضرة.<br>5- التواصل الكترونيًا مع الطلبة لنشر المحاضرات المسجلة، والمكتوبة من خلال الموقع الرسمي للجامعة. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 33 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 2 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 42 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 2.8 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 75 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5, 10 | |
| | **Assignments** | 2 | 10% (10) | 2, 12 | |
| | **Projects / tutorial.** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 10% (10) | 13 | |
| **Summative assessment** | **Midterm Exam** | 1 hr | 10% (10) | 7 | |
| | **Final Exam** | 2hr | 50% (50) | 16 | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | تعريف وطبيعة حقوق الإنسان |
| **Week 2** | التطور التاريخي لحقوق الإنسان |
| **Week 3** | مميزات حقوق الإنسان عن غيرها من الحقوق |
| **Week 4** | حقوق الإنسان في الديانات السماوية |
| **Week 5** | حقوق الإنسان في المواثيق الدولية |
| **Week 6** | حقوق الإنسان في التشريعات الداخلية |
| **Week 7** | حقوق الإنسان الشخصية |
| **Week 8** | حقوق الإنسان الاجتماعية |
| **Week 9** | حقوق الإنسان الثقافية |
| **Week 10** | حقوق الانسان الاقتصادية |
| **Week 11** | ضمانات حقوق الإنسان الدولية |
| **Week 12** | ضمانات حقوق الإنسان الإقليمية |
| **Week 13** | ضمانات حقوق الإنسان الداخلية (الوطنية) |
| **Week 14** | الجزاءات المترتبة على المساس بحقوق الإنسان |
| **Week 15** | امتحان |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | كتاب/ حقوق الانسان (تطورها، مضامينها، حمايتها)<br>د. رياض عزيز هادي. | Yes |
| **Recommended Texts** | كتاب/ حقوق الانسان<br>د. حميد حنون. | No |
| **Websites** | https://www.noor-book.com/<br>https://www.un.org/ar/about-us/universal-declaration-of-human-rights<br>https://ar.wikipedia.org/wiki/ | |

| Grading Scheme<br>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 |
| | | | | |

**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.

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Optics** | | | **Module Delivery** | |
| **Module Type** | **Core learning activity** | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE1217** | | | | |
| **ECTS Credits** | **7** | | | | |
| **SWL (hr/sem)** | **175** | | | | |
| **Module Level** | **UGI** | **Semester of Delivery** | **2** | | |
| **Administering Department** | REE | **College** | CRE | | |
| **Module Leader** | Dr. Ethar Yahya Salih | **e-mail** | ethar@kus.edu.iq | | |
| **Module Leader's Acad. Title** | Dr. | **Module Leader's Qualification** | Ph.D. | | |
| **Module Tutor** | Dr. Ethar Yahya Salih | **e-mail** | ethar@kus.edu.iq | | |
| **Peer Reviewer Name** | Name | **e-mail** | | | |
| **Scientific Committee Approval Date** | 01/07/2023 | **Version Number** | 1.0 | | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | General Physics (CRE1101) | **Semester** | 1 |
| **Co-requisites module** | None | **Semester** | None |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. To develop problem solving skills and understanding of optics through the application of techniques.<br>2. To understand electromagnetic radiation, nature of light, & optical systems.<br>3. A central theme is a description of phase and coherence that enables a discussion of applications of modern optics including interference & diffraction by introducing interferometers, interference in multilayer films, & diffracting gratings.<br>4. This course deals with the basic concept of optical systems.<br>5. To understand how different types of lenses and mirrors are used for solar energy. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Qualitatively describe the diffraction pattern techniques.<br>2. Explain how various optical instruments work.<br>3. Calculate the properties of optical systems.<br>4. Develop a deep understanding of how mirrors or other optics collect incoming sunlight and focus it efficiently onto a photovoltaic cell array, which then converts sunlight into useable, storable energy.<br>5. Review and justify the commercial advantage of different forms of mirrors & lenes for solar energy. |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br>**Part 1**<br>Introduction to Electromagnetic Wave, The Nature of Light & Ligh Propagation, Speed of Light in Matter, The Ray Model of Light & the Ray Model of Light, Reflection & Refraction, & Dispersion & Polarization [**30 hrs.**].<br>**Part 2**<br>Introduction to Mirrors & their uses in Renewable Energy, Spherical Mirrors & Ray Tracing (The Mirror Equation), Introduction to Thin Lenses & their uses in Renewable Energy, & Types of Lenses (convex & Concave Lenses) [**30 hrs.**].<br>**Part 3**<br>Interference & Young's Double-Slit Interference [**12 hrs.**].<br>**Part 4**<br>Applications of optics for Renewable Energies I & II [**18 hrs.**]. |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | 1. Visualization<br>2. Cooperative Learning<br>3. Differentiated Instruction<br>4. Using Technology to your Advantage<br>5. Student Centered Inquiry<br>6. Professional Development |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | **94** | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | **6** |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | **81** | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | **5.4** |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **175** | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5, 11 | LO #1, 2, 10 and 11 |
| | **Assignments** | 2 | 10% (10) | 4, 13 | LO # 3, 4, 6 and 7 |
| | **Projects / Lab.** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 10% (10) | 13 | LO # 5, 8 and 10 |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | LO # 1-7 |
| | **Final Exam** | 3 hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction to Electromagnetic Wave |
| **Week 2** | The Nature of Light & Ligh Propagation |
| **Week 3** | Speed of Light in Matter |
| **Week 4** | The Ray Model of Light & the Ray Model of Light |
| **Week 5** | Reflection & Refraction |
| **Week 6** | Dispersion & Polarization |
| **Week 7** | Introduction to Mirrors & their uses in Renewable Energy |
| **Week 8** | Spherical Mirrors & Ray Tracing (The Mirror Equation) |
| **Week 9** | Introduction to Thin Lenses & their uses in Renewable Energy |
| **Week 10** | Types of Lenses (convex & Concave Lenses) |
| **Week 11** | Interference |
| **Week 12** | Young's Double-Slit Interference |
| **Week 13** | Applications of optics for Renewable Energies I |
| **Week 14** | Applications of optics for Renewable Energies II |
| **Week 15** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | Lab 1: Snell’s law (Refractive index) |
| **Week 2** | Lab 2: Convex Lens |
| **Week 3** | Lab 3: Concave Lens |
| **Week 4** | Lab 4: Spherometer |
| **Week 5** | Lab 5: Diffraction grating |
| **Week 6** | Lab 6: The Spectrometer |
| **Week 7** | Lab 7: Young’s double slit |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Fundamental of physics, Textbook by David Halliday, Jearl Walker, and Robert Resnick | No |
| **Recommended Texts** | University physics, Textbook by Hugh Young and Roger Freedman. | No |
| **Websites** | https://phet.colorado.edu/en/simulations/geometric-optics | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# ORGANIC CHEMISTRY

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Organic chemistry** | | | **Module Delivery** | |
| **Module Type** | S | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | CRE12011 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | 1 | | **Semester of Delivery** | 2 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Alaa Joied Hamad | | **e-mail** | alaajoied@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | Organic chemistry | **Semester** | 2 |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. To know the structure and bonding in orgainc compound<br>2. Nomenclature of different organic compounds<br>3. Physical properties<br>4. Preparation of some organic compounds<br>Reaction of some organic compounds |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks.<br><br>1. Alkyl halide and elimination reaction<br>2. Alcohol,ethers and epoxides<br>3. Benzene and oromatic compounds<br>4. Carboxylic acid and acidity of O-H<br>5. Aldehydes and ketones<br>1. Amines |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br>Theoretical lectures<br>Introduction, , types organic compounds structure and bonding physical properties and naming of compounds |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 64 | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 36 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

## Module Evaluation

تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| Formative assessment | Quizzes | 2 | 10% (10) | 5 and 10 | LO #1, #2 and #10, #11 |
| | Assignments | 2 | 10% (10) | 2 and 12 | LO #3, #4 and #6, #7 |
| | Projects / Lab. | 1 | 10% (10) | Continuous | All |
| | Report | 1 | 10% (10) | 13 | LO #5, #8 and #10 |
| Summative assessment | Midterm Exam | 2 hr | 10% (10) | 7 | LO #1 - #7 |
| | Final Exam | 2hr | 50% (50) | 16 | All |
| Total assessment | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

| | Material Covered |
|---|---|
| Week 1 | Alkyl halide name , structure, physical properties |
| Week 2 | Preparation , reaction. |
| Week 3 | Structure of alcohol ethers and epoxides physical properties name. |
| Week 4 | Reaction and preparation of alcohol. |
| Week 5 | Reaction and preparation of ether. |
| Week 6 | Reaction and preparation of epoxides |
| Week 7 | Carboxylic acid structure, physical properties acidity. |
| Week 8 | Preparation and reaction of carboxylic acids |
| Week 9 | Structure of aldehydes and ketones physical properties and naming |
| Week 10 | Preparation of aldehydes and ketones |
| Week 11 | Reaction of aldehydes and ketones |
| Week 12 | The difference between aldehydes and ketones |
| Week 13 | Structure and bonding in amines Physical properties and naming |
| Week 14 | Preparation of amine |
| Week 15 | Reaction of amine |
| Week 16 | **Preparatory week before the final Exam** |

## Delivery Plan (Weekly Lab. Syllabus)

| المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | laboratory safety |
| **Week 2** | Melting point measurement |
| **Week 3** | Boiling point measurement |
| **Week 4** | Recrystallization |
| **Week 5** | extraction |
| **Week 6** | Preparation of detergents |
| **Week 7** | Detection of compounds using reagents |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | **Text** | **Available in the Library?** |
|---|---|---|
| **Required Texts** | **Morrison and boyde 1972 organic chemistry** | |
| **Recommended Texts** | **Janice G 2006 organic chemistry** | |
| **Websites** | ----- | |

## 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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# Circuit analysis

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| **Module Information**<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Circuit analysis | | | **Module Delivery** | |
| **Module Type** | C | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | REE23114 | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 125 | | | | |
| **Module Level** | **2** | | **Semester of Delivery** | **3** | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | omar Kanaan noori | | **e-mail** | Omareng27@gmail.com | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | NONE | | **Version Number** | NONE | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | FUNDEMNTALS OF ELECTRICITY (RE1208) | **Semester** | 2 |
| **Co-requisites module** | | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | ● To learn the basic concepts and behaviour of DC and AC circuits.<br>● To understand various methods of circuit/ network analysis using network theorems.<br>● To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations.<br>● To learn the concept of coupling in circuits and topologies. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | Explain the concept and applications of operational amplifiers [a]. Understand the concept, modes of operation and applications of operational amplifiers Study the design of analog systems using operational amplifiers [b, c]. Understand the methodology for using op-amps to design op-amp base amplifiers, oscillators and comparators. Students will understand how to apply this circuit in the medical instrumentation. Understand the operating principle and parameters of TTL and MOSFET logic gates circuits [b, c]. Understand the operating principle, design and applications of TTL and MOSFET logic gates Understand the types, parameters and operation of multivibratrs [a]. Be familiar with the principle of astable, monostable and bi-stable multivibrators with their applications in biomedical engineering Understand the use and operation of A/D and D/A converters [a, b]. Be familiar with the principles of DTL, RTL and TTL logic gates |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>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. - A typical lecture would start with a short review (~ 5 minutes) using both PowerPoint presentations and the blackboard. This review will also depend on |

| | |
|---|---|
| | discussions which will gauge the students' digestion of the previous material. Then, the students would have a lecture on new materials using PowerPoint presentations and blackboard. The lecture presentation will be paused every 15 – 20 minutes with brainstorming questions and discussions that will allow the students to reflect and think in more depth about what they learned in that presentation. Then, some example problems will be presented and discussed with the students to illustrate the appropriate problem solving skills that the students should learn. The lecture will be continued for another 15 – 20 minutes, followed by examples and/or a quiz covering the materials taught in the previous two weeks. |

## Student Workload (SWL)
الحمل الدراسي للطالب

| | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 79 | **Structured SWL (h/w)** | 7 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 46 | **Unstructured SWL (h/w)** | 6 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 125 | | |

## Module Evaluation
تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

| | Material Covered |
|---|---|
| **Week 1** | Operational Amplifiers Theory of operation, inverting amplifier, |
| **Week 2** | summing amplifier, non-inverting amplifier, current to voltage converter, difference amplifier, instrumentation amplifier, integrator, differentiator, and oscillators |

| | |
|---|---|
| **Week 3** | Op-amp Based Oscillators Conditions of oscillation, |
| **Week 4** | Wien bridge oscillator |
| **Week 5** | Transistor-Transistor Logic (TTL) Family BJT Inverter Voltage transfer characteristic, |
| **Week 6** | logic levels, noise margin, fan-out, transient response, |
| **Week 7** | 1. MOSFET Logic Circuits NMOSET inverter, |
| **Week 8** | 1. complementary NMOSFET (CMOS) Inverter, |
| **Week 9** | 1. Regenerative Logic Circuits Bistable multivibrator Monostable multivibrator A stable multivibrtor |
| **Week 10** | 1. Analog-Digital Data Converters Digital-to-Analog (D/A) |
| **Week 11** | 1. converters Analog-to-Digital (A/D) converters |
| **Week 12** | 1. MOSFET logic gates, interfacing CMOS and TTL logic gates. |
| **Week 13** | switching speed, and basic TTL inverter, basic TTL NAND gate |
| **Week 14** | |
| **Week 15** | **Seminars for students on recent developments in conductive polymers** |
| **Week 16** | **Preparatory week before the final Exam** |

## Learning and Teaching Resources

مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | Adler, Jerry, “Another Bright Idea,” *Newsweek*, June 15, 1992, p. 67.<br>Albean, D. L., “Single Pot Swings Amplifier Gain Positive or Negative,” *Electronic Design*, January 1997, p. 153.<br>Barnes, R., and Wong, K. T., “Unbalanced and Harmonic Studies for the Channel Tunnel Railway System,” *IEE Proceedings*, March 1991, pp. 41–50.<br>Bernstein, Theodore, “Electrical Shock Hazards,” *IEEE Transactions on Education*, August 1991, pp. 216–222.<br>Brown, S. F., “Predicting Earthquakes,” *Popular Science*, June 1989, pp. 124–125. | No |
| **Recommended Texts** | | No |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# ELECTRONICS

**University Name**: ALkarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Electronics** | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE23013** | | | | |
| **ECTS Credits** | 7 | | | | |
| **SWL (hr/sem)** | 175 | | | | |
| **Module Level** | | 1 | **Semester of Delivery** | | 3 |
| **Administering Department** | | **REE** | **College** | **CRE** | |
| **Module Leader** | Mohammed Ali Hassan GHlem | | **e-mail** | Albeaty33@kus.edu.iq | |
| **Module Leader's Acad. Title** | | Lecture doctor | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | | NONE | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | | 2023/06/20 | **Version Number** | | 1.0 |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | 1- Describe the basics, principles and concepts of electronic circuits<br>2- Presentation of the physical and electrical properties of semiconductors and insulating materials<br>3- Designing electronic circuits<br>4- Identify the most important circuits for converting electrical energy<br>5- Using the tools to expand the student's understanding of the electronic bite and energy transfers<br>6- Learn how diodes work and focus on solar energy to generate solar energy. |
| **Module Learning Outcomes** | Cognitive objectives (after teaching the course, the student will be able to)<br>1- Understand the classification of naturally occurring substances by their electrical properties.<br>2- Able to apply the basic principles of electronic circuits in dealing with electronic devices<br>3- Understanding the mechanism of solar cell work, in addition to the basic design of solar cells<br>4- Understanding the conversion mechanism between the types of electrical energy (alternating - continuous)<br>5- The soft skills objectives of the course. (After teaching the vocabulary of the course, the student will be able to)<br>6- Analyzing electronic circuits and solving their problems that hinder the operation of systems used in renewable energy<br>7- Designing and implementing electronic circuits from raw materials for the production of clean energy<br>8- Designing and implementing electronic circuits to convert between types of electrical energy (alternating-continuous) to reach the final goal of operation.<br>9- Able to fix solar cell problems |
| **Indicative Contents** | Indicative content includes the following.<br>Conduction in semiconductors ,PN junction ,Solar cells structure and design<br>Diode applications (Rectifiers) ,Diode applications (Clipper circuits)<br>Diode applications (Voltage multiplier) ,Zener diodes,Transistors |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | Search for the latest developments and designs in the field of solar energy production and distribution, in addition to the latest scientific research in the development of electronic circuits to achieve the widest benefit from clean energy |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 94 | | |
| **Unstructured SWL (h/sem)** | 81 | | |
| **Total SWL (h/sem)** | 175 | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 4 | 20% (20) | 2, 6, 10, 12 | |
| | **Assignments** | 2 | 5%(5) | 2, 12 | |
| | **Projects / Lab.** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 5% (5) | 13 | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 8 | |
| | **Final Exam** | 2hr | 50% (50) | 16 | |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

| | Material Covered |
|---|---|
| **Week 1** | Conduction in semiconductors |
| **Week 2** | Conduction in semiconductors |
| **Week 3** | PN junction |
| **Week 4** | PN junction |
| **Week 5** | Solar cells structure and design |
| **Week 6** | Solar cells structure and design |
| **Week 7** | Diode applications (Rectifiers) |
| **Week 8** | Mid-term exam +Diode applications (Rectifiers) |
| **Week 9** | Diode applications (Clipper circuits) |
| **Week 10** | Diode applications (Clipper circuits) |
| **Week 11** | Diode applications (Voltage multiplier) |
| **Week 12** | Diode applications (Voltage multiplier) |
| **Week 13** | Zener diodes |

| | |
|---|---|
| **Week 14** | |
| **Week 15** | Zener diodes |
| **Week 16** | **Preparatory week for Final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)** | |
|---|---|
| | **Material Covered** |
| **Week 1** | Lab 1: |
| **Week 2** | Lab 2: |
| **Week 3** | Lab 3: |
| **Week 4** | Lab 4: |
| **Week 5** | Lab 5: |
| **Week 6** | Lab 6: |
| **Week 7** | Lab 7: |

| **Learning and Teaching Resources**<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Boylestad, Robert L., and Louis Nashelsky. "Electronic Devices and Circuit Theory 11th ed." (2018). | yes |
| **Recommended Texts** | 1. Millman, Jacob, Christos C. Halkias, and Satyabrata Jit. *Millman's Electronic Devices and Circuits*. Tata McGraw-Hill, 2010.<br>FLOYD, Thomas L., and David BUCHLA. "Electromics Fundamentals Circuits Devices and Applications." (2014). | Yes |
| **Recommended Texts** | https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=55 | yes |
| **Websites** | https://www.youtube.com/watch?v=Fwj_d3uO5g8&ab_channel=TheEngineeringMindset | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# Energy Sources

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** renewable energy Sciences

| **Module Information**<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Energy Sources | | | **Module Delivery** | |
| **Module Type** | C | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ ☐ **Seminar** | |
| **Module Code** | REE23015 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | 2 | | **Semester of Delivery** | 3 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Luma jamal abbas | | **e-mail** | Luma.jamal@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | NONE | | **Version Number** | NONE | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | At the end of the course, the student will be able to understand:<br>● Different types of conventional energy resources,<br>● Different types of renewable energy resources,<br>● Energy conversion technologies. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | Practicals:<br>● Measurement of Solar Radiation with Pyranometer<br>● Determine the performance of liquid heating solar collector from open -loop through flow test setup<br>● Determination of the performance of Study of Solar Water Heater<br>● Study the construction and operation of wind turbine<br>● Study of Bio gas plant and its principle of operation<br>● Study of Micro/Small hydro power systems |
| **Indicative Contents**<br>المحتويات الإرشادية | 1. Introduction of Renewable Energy Sources.<br>2. Photovoltaic Energy System<br>3. Wind Energy System<br>4. Energy Storage Devices<br>5. Integration of Renewable Energy Sources<br>6 . Distributed Generation |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The lectures will consist of interactive power point presentations, videos, handouts, and other educational materials. Students are responsible for the material covered in the course materials. The knowledge will be evaluated via homework assignments, short quizzes and take-home exams.<br><br>Different assignments will be given over the semester to allow the student to demonstrate understanding of course material. Some assignments are completed in class. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | الحمل الدراسي المنتظم للطالب اسبوعيا | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | الحمل الدراسي غير المنتظم للطالب اسبوعيا | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5,10 | 1-5 |
| | **Assignments** | 2 | 10% (10) | 2,12 | 5-10 |
| | **Projects / Lab.** | 1 | 10% (10) | continuous | |
| | **Report** | 1 | 10% (10) | 13 | 10-12 |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 17 | 13-15 |
| | **Final Exam** | 2hr | 50% (50) | 16 | 16 |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | **Fossil fuels and their characteristics**<br>1. Classification of traditional fuels<br>2. Refining of crude oil<br>3. Properties of gasoline and diesel |
| **Week 2** | **Solar energy**<br>1. Movement of earth and Solar radiation, solar radiation measuring devices.<br>2. Solar radiation fundamentals and solar angles |

| | |
|---|---|
| | |
| **Week 3** | **Bio energy**<br><br>1. Biogas generation and factors affecting bio digestion or generation of gas<br>2. Biomass and biochemical conversion to fuels<br>3. Biogas plants |
| **Week 4** | **Wind energy**<br><br>1. Principles of wind energy conversion<br>2. Types and characteristics of Horizontal & vertical axis wind turbines<br>3. Wind farming |
| **Week 5** | **Micro and small hydro power systems**<br><br>1. Micro/Mini hydropower systems, principles and related technologies<br>2. Site investigation<br>3. Determination of flow |
| **Week 6** | 1. Construction and operation of the different types of water turbines within the range of micro and small hydro power systems<br>2. Characteristics of turbines used for micro and small hydro power plants |
| **Week 7** | **Non conventional forms of energy and batteries**<br><br>1. Introduction to fuel cells and Hydrogen fuel system<br>2. Hydrogen production processes<br>3. General introduction to infrastructure requirement for hydrogen production, storage, and utilization |
| **Week 8** | 1. Battery fundamentals<br>2. Different types of batteries |
| **Week 9** | **Nuclear energy**<br><br>1. Introduction<br>2. Nuclear fusion and reactions<br>3. Requirements for nuclear fusion |
| **Week 10** | 1. Health hazards<br>2. Radiation protection & shielding |
| **Week 11** | Nuclear fission |
| **Week 12** | Interaction radiation with matter |
| **Week 13** | Biogas plants |
| **Week 14** | 1. Role of microstructure (single crystal, multicrystalline, polycrystalline, amorphous and nanocrystalline) in electrical and optical properties of the materials<br>2. Applications of Photovoltaic for power generation |

| | |
|---|---|
| | |
| **Week 15** | 1. Flat plate collectors, solar water heaters, Solar Concentrators<br>2. Photovoltaic materials; Materials in bulk and thin film forms |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| **Learning and Teaching Resources**<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Basic properties of nucleus, Springer,2003.<br>NUCLEAR FISSION AND FUSION, Welter Class publishing. | |
| **Recommended Texts** | NUCLEAR PHYSICS, of the European Physical Society<br>October 2016 | |
| **Websites** | https://www-nds.iaea.org/ | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

## Inorganic Chemistry

**University Name**: ALkarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energies Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Inorganic Chemistry** | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE23016 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | **2** | | **Semester of Delivery** | 3 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Al-Hamza Dheyaa Hameed | | **e-mail** | | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | none | | **e-mail** | none | |
| **Peer Reviewer Name** | none | | **e-mail** | none | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Objectives** | 1. Acquisition of skills in General Chemistry and Inorganic Chemistry.<br>2. To develop the ability to correlate the chemical and physical properties of elements and their compounds with their positions in the periodic table.<br>3. To establish the link between theory and laboratory practice by conducting laboratory experiments.<br>4. To acquire expertise in chemistry laboratory in handling of reagents and solvents as well as in analytical techniques. |
| **Module Learning Outcomes** | The intended subject specific learning outcomes.<br>On successfully completing the module students will be able to:<br>1. Use chemical terminology.<br>2. Explain the trend in the periodic table using theoretical models.<br>3. Write and balance equations.<br>4. Understand the principles of electronegativity.<br>5. Explain the reactivity series and give example reactions.<br>6. Begin to comprehend the inter-relationship of scientific disciplines. |
| **Indicative Contents**<br>المحتويات الإرشادية | Introduction, Matter, Atom, Electronic structure of the atom<br>Classical theory, Bohr Theory, Quantum theory: Examples<br>Practical examples using quantum numbers<br>Periodic Table of the Elements: s-block, p-block, d-block, f-block<br>Important Notes,<br>Some periodic properties of atoms, Shielding constant<br>To calculate the shielding constant of the electron in orbital s, p:<br>Periodic Properties:Atom radius , Ionization Energy, Electron Affinity, Electronegativity<br>The basic conditions for the composition of ionic compound.[15 hr]<br>Group I (1A): Introduction, The Alkali Metals, General propertie<br>The diagonal relation ships:<br>Sodium (Na): Chemical properties, Sodium: reactions of elements<br>Alkaline Earth Metals Group II (IIA): Calcium, Chemical properties, Calcium: reactions of elements<br>Elements of Group IIIA, Boron: reactions of element, Aluminum, Aluminum: reactions of elements<br>Fourth group IVA: Carbon: reactions of elements, Silicon: reactions of elements.<br>Ionic Compound Polarization<br>Factors affecting the increase or decrease of polarization<br>Hydrogen: Preparation Methods of Hydrogen, Reactions of Hydrogen |

| | |
|---|---|
| | Hydrogen Compounds: Nitrogen Hydrogen Compounds, Phosphorus Hydrogen Compounds, Sulfur Hydrogen Compounds, Halogen Hydrogen Compounds<br>Hydrogen isotopes [15 hr]<br>Hybridization: Types of Hybridization: sp Hybridization, sp2 Hybridization, sp3 Hybridization<br>Applications of hybridization: Linear molecule: Trigonal planar molecules, Tetrahedral molecules, Tetrahedral molecule (Pyramidel), Tetrahedral molecule (V-Shape), Trigonal bipyramid molecule, Octahydral molecule, Conclusion.<br>Valence bond theory: Examples [15 hrs} |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | Expanding students' perceptions about this science and its contents it includes that help in acquisition of skills in General Chemistry and Inorganic Chemistry. To develop the ability to correlate the chemical and physical properties of elements and their compounds with their positions in the periodic table and involving some examples activities that are interesting to the students. |

| **Student Workload (SWL)**<br>الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **100** | | |

## Module Evaluation

تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| Formative assessment | Quizzes | 2 | 10% (10) | 5 and 10 | |
| | Assignments | 2 | 10% (10) | 2 and 12 | |
| | Projects | 1 | 10% (10) | Continuous | |
| | Report | 0 | 10% (10) | 13 | |
| Summative assessment | Midterm Exam | 2hr | 10% (10) | 7 | |
| | Final Exam | 3hr | 50% (50) | 16 | |
| Total assessment | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

المنهاج الأسبوعي النظري

| | Material Covered |
|---|---|
| Week 1 | Introduction, Matter, Atom, Electronic structure of the atom |
| Week 2 | Classical theory, Bohr Theory, Quantum theory: Examples, Practical examples using quantum numbers |
| Week 3 | Periodic Table of the Elements: s-block, p-block, d-block, f-block, Important Notes. |
| Week 4 | Some periodic properties of atoms, Shielding constant, To calculate the shielding constant of the electron in orbital s, p: |
| Week 5 | Periodic Properties:Atom radius , Ionization Energy, Electron Affinity, Electronegativity |
| Week 6 | The basic conditions for the composition of ionic compound. |
| Week 7 | Group I (1A): Introduction, The Alkali Metals, General properties, The diagonal relation ships: |
| Week 8 | Sodium (Na): Chemical properties, Sodium: reactions of elements |
| Week 9 | Alkaline Earth Metals Group II (IIA): Calcium, Chemical properties, Calcium: reactions of elements |
| Week 10 | Elements of Group IIIA, Boron: reactions of element, Aluminum, Aluminum: reactions of elements |
| Week 11 | Fourth group IVA: Carbon: reactions of elements, Silicon: reactions of elements. |
| Week 12 | Ionic Compound Polarization, Factors affecting the increase or decrease of polarization |
| Week 13 | Hydrogen: Preparation Methods of Hydrogen, Reactions of Hydrogen Hydrogen Compounds: Nitrogen Hydrogen Compounds, Phosphorus Hydrogen Compounds, Sulfur Hydrogen Compounds, Halogen Hydrogen Compounds, Hydrogen isotopes |
| Week 14 | Hybridization: Types of Hybridization: sp Hybridization, $sp^2$ Hybridization, $sp^3$ Hybridization |

| | |
|---|---|
| **Week 15** | Applications of hybridization: Linear molecule: Trigonal planar molecules, Tetrahedral molecules, Tetrahedral molecule (Pyramidel), Tetrahedral molecule (V-Shape), Trigonal bipyramid molecule, Octahydral molecule, Conclusion.Valence bond theory: Examples. |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر( لا يوجد مختبر) | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |
| **Week 8** | |
| **Week 9** | |
| **Week10** | |
| **Week 11** | |
| **Week 12** | |

| **Learning and Teaching Resources**<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | 1- Cotton, F.A. and Wilkinsan, D. 2000 . Advanced Inorganic Chemistry. 5th ed. Wiley-Interscience, New York,.<br>2- Martel,A. E. ,2009. Coordination Chemistry. Van Nostrans Reinhold, NewYork. | Yes<br><br>Yes |
| **Recommended Texts** | | |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Optoelectronics** | | | **Module Delivery** | |
| **Module Type** | **Core learning activity** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE23018** | | | | |
| **ECTS Credits** | **4** | | | | |
| **SWL (hr/sem)** | **100** | | | | |
| **Module Level** | | **UGII** | **Semester of Delivery** | | **3** |
| **Administering Department** | | REE | **College** | CRE | |
| **Module Leader** | Dr. Ethar Yahya Salih | | **e-mail** | ethar@kus.edu.iq | |
| **Module Leader's Acad. Title** | | Dr. | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | Dr. Ethar Yahya Salih | | **e-mail** | ethar@kus.edu.iq | |
| **Peer Reviewer Name** | | Name | **e-mail** | | |
| **Scientific Committee Approval Date** | | 01/07/2023 | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | None |
| **Co-requisites module** | None | **Semester** | None |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | This class focuses on the physics of the interaction of photons with semiconductor materials. The band theory of solids is used to calculate the absorption and gain of semiconductor media. The rate equation formalism is used to develop the concepts of laser threshold, population inversion and modulation response. Matrix methods and coupled mode theory are applied to resonator structures such as distributed feedback lasers, tunable lasers and mirroring devices. The course is also intended to introduce students to noise models for semiconductor devices and to applications of optoelectronic devices to fiber optic communications. Homework problems will be drawn from the current research literature. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Explain fundamental physical and technical base of Optoelectronic systems<br>2. Describe basic laws and phenomena that define behavior of optoelectronic systems,<br>3. Analyze various solid states devices and geometries related to optoelectronic systems.<br>4. Components, devices and equipment of optoelectronic systems.<br>5. Interpret the acquired data and measured results (IV curve).<br>6. Describe development and application of optoelectronic systems<br>7. Take part in team work and be able to independently present various professional materials. |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br>**<u>Part 1</u>**<br>Wave Nature of Light – Conceptual Overview & Polarization and Modulation of light [**10 hrs.**].<br>**<u>Part 2</u>**<br>Introduction to Semiconductor Physics and Devices, PN Junction Introduction<br>The IV Characteristics, Diodes, Photovoltaic Devices, & Light Emitting Diodes (LED) [**35 hrs.**].<br>**<u>Part 3</u>**<br>Optical computing, Practical organic optoelectronic devices, & Optical computing (if time permits) [**15 hrs.**]. |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | 1. Visualization<br>2. Cooperative Learning<br>3. Differentiated Instruction<br>4. Using Technology to your Advantage<br>5. Student Centered Inquiry<br>6. Professional Development |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | **48** | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | **3** |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | **52** | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | **3.5** |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **100** | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5, 11 | LO #1, 2, 10 and 11 |
| | **Assignments** | 2 | 10% (10) | 4, 13 | LO # 3, 4, 6 and 7 |
| | **Seminar** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 10% (10) | 13 | LO # 5, 8 and 10 |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | LO # 1-7 |
| | **Final Exam** | 3 hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Wave Nature of Light – Conceptual Overview |
| **Week 2** | Polarization and Modulation of light |
| **Week 3** | Introduction to Semiconductor Physics and Devices |
| **Week 4** | PN Junction Introduction |
| **Week 5** | The IV Characteristics I |
| **Week 6** | The IV Characteristics II |
| **Week 7** | Diodes I |
| **Week 8** | Diodes II |
| **Week 9** | Diodes III |
| **Week 10** | Photovoltaic Devices |
| **Week 11** | Light Emitting Diodes (LED) |
| **Week 12** | Optical computing |
| **Week 13** | Practical organic optoelectronic devices (if time permits) |
| **Week 14** | Optical computing (if time permits) |
| **Week 15** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | ***NOT APPLICABLE*** |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | John Wilson and John Hawkes, Optoelectronics, an introduction - 3rd Edition, Prentice Hall 1998. | No |
| **Recommended Texts** | Semiconductor Optoelectronic Devices, J. Piprek, Academic Press, New York, 2003. | No |
| **Websites** | https://www.rp-photonics.com/optoelectronics.html | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF

# Thermodynamics

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Thermodynamics | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | REE23017 | | | | |
| **ECTS Credits** | 6 | | | | |
| **SWL (hr/sem)** | 150 | | | | |
| **Module Level** | **2** | | **Semester of Delivery** | **3** | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Marwah Mohammed Jasim | | **e-mail** | m.m.shuwaili@gmail.com | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | ____ |
| **Co-requisites module** | None | **Semester** | ____ |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims** | **Provide a Solid Foundation in Thermodynamics**: Develop a comprehensive understanding of the fundamental principles and laws of thermodynamics; and enable students to analyze and solve thermodynamics problems using appropriate mathematical and analytical techniques.<br>**Apply Thermodynamics Principles to Energy Systems**: Demonstrate the application of thermodynamics principles to various energy systems, such as power plants, renewable energy systems, and energy storage; Develop the ability to analyze and evaluate the performance of energy conversion processes and systems based on thermodynamics principles; And understand the thermodynamic aspects of energy efficiency, optimization, and sustainability in energy systems.<br>**Enhance Problem-Solving and Critical Thinking Skills**:<br>Cultivate problem-solving skills by applying thermodynamics principles to analyze and solve complex energy-related problems; Foster critical thinking and analytical skills in evaluating and interpreting thermodynamics data and experimental results; And develop the ability to think critically and make informed decisions based on thermodynamic principles and their implications in energy systems.<br>**Foster Laboratory Skills and Experimental Techniques**:<br>Provide practical laboratory experiences to reinforce theoretical concepts and develop skills in conducting thermodynamics experiments; Familiarize students with experimental techniques, data acquisition, and analysis methods specific to thermodynamics and energy systems; And enhance the ability to interpret and communicate experimental results effectively through laboratory reports and presentations.<br>**Cultivate Awareness of Emerging Trends and Technologies**:<br>Explore emerging trends, technologies, and advancements in the field of thermodynamics and energy systems; Foster an understanding of the role of thermodynamics in addressing energy challenges, renewable energy integration, and sustainable energy solutions; And develop an awareness of the importance of continuous learning and staying updated with the latest developments in thermodynamics and energy-related fields. |
| **Module Learning Outcomes** | 1. Demonstrate a comprehensive understanding of the fundamental principles and laws of thermodynamics.<br>2. Explain the concepts of energy, heat transfer, and work, and their application in energy systems.<br>3. Identify and describe thermodynamic processes, cycles, and equations relevant to energy conversion and storage.<br>4. Apply thermodynamics principles to analyze and solve complex problems in energy systems, such as power plants, renewable energy technologies, and |

| | |
|---|---|
| | energy storage.<br>5. Analyze the performance and efficiency of energy conversion processes based on thermodynamics principles.<br>6. Evaluate and interpret thermodynamics data and experimental results to draw conclusions and make informed decisions.<br>7. Demonstrate proficiency in conducting thermodynamics experiments, including data acquisition, analysis, and interpretation.<br>8. Apply experimental techniques and instrumentation specific to thermodynamics and energy systems.<br>9. Utilize software tools and simulation software to model and analyze thermodynamic processes and systems. |
| **Indicative Contents**<br>المحتويات الإرشادية | **Introduction to Thermodynamics** includes Basic concepts and definitions in thermodynamics; Energy, heat transfer, and work; and Properties of substances and ideal gases. (15 hrs)<br>**Laws of Thermodynamics** encompasses First law of thermodynamics (energy conservation), Second law of thermodynamics (entropy and heat transfer) and Carnot cycle and thermodynamic efficiency. (15 hrs)<br>**Thermodynamic Processes and Cycles** contain Thermodynamic processes (isobaric, isochoric, isothermal, adiabatic), Power cycles (Rankine cycle, Brayton cycle) and Refrigeration cycles (vapor compression cycle). (10 hrs)<br>**Energy Conversion Systems**: Renewable energy systems (solar, wind, hydroelectric) Heat Transfer: Conduction, convection, and radiation heat transfer and Heat exchangers and their applications in energy systems. (16 hrs)<br>**Energy Storage**: Thermodynamics of energy storage systems (batteries, flywheels, pumped hydro, compressed air); Energy storage technologies for grid integration and load management; and Thermodynamic analysis of energy losses and efficiency in storage systems. (15 hrs) |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | **Establish Learning Objectives**: Clearly define the learning objectives for the thermodynamics curriculum, aligned with the program goals and industry requirements; Identify the specific knowledge, skills, and competencies students should acquire by the end of the course.<br>**Plan the Curriculum**: Develop a well-structured curriculum with a logical flow of topics, starting from fundamental concepts to more advanced applications; Consider incorporating case studies, real-world examples, and hands-on experiments to enhance understanding and relevance to energy systems.<br>**Engage Students Actively**: Encourage active learning by incorporating interactive activities, discussions, and problem-solving exercises; Use multimedia resources, simulations, and virtual labs to enhance engagement and facilitate visualization of thermodynamic processes. |

| | |
|---|---|
| | **Make Connections to Energy Systems**: Emphasize the applications of thermodynamics in energy systems throughout the course; Relate thermodynamics concepts to specific energy technologies, such as power plants, renewable energy systems, and energy storage.<br>**Provide Practical Laboratory Experiences**:<br>Design laboratory experiments that align with the theoretical concepts covered in lectures; Allow students to apply thermodynamics principles through hands-on experiments, data analysis, and interpretation of results.<br>**Utilize Technology**:<br>Utilize educational technology tools, such as interactive simulations and modeling software, to enhance understanding of complex thermodynamic processes.<br>Incorporate online learning platforms or learning management systems to facilitate content delivery, assessments, and student engagement. |

## Student Workload (SWL)

| | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 79 | **Structured SWL (h/w)** | 5.2 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 71 | **Unstructured SWL (h/w)** | 4.7 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 150 | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 4,7,11 | |
| | **Assignments** | 2 | 10% (10) | 2, 5,7,12 | |
| | **Projects / Lab.** | 1 | 10% (10) | continuous | |
| | **Report** | 1 | 10% (10) | 12 | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 8 | |
| | **Final Exam** | 2hr | 50% (50) | 16 | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | **Introduction to Thermodynamics**: Overview of thermodynamics and Definition of key |
| **Week 2** | **System and Surroundings**: Definition of a system and its boundaries; Distinguishing between an open, closed, and isolated system; and Identifying the surroundings as everything external to the system. |
| **Week 3** | **Energy and the First Law of Thermodynamics**: Energy forms and conversions in energy systems; Conservation of energy and the first law of thermodynamics; and Application of the first law to analyze energy transfers, work, and heat interactions. |
| **Week 4** | **State Variables and Equilibrium**: Definition of state variables, such as temperature, pressure, and volume; Describing the concept of equilibrium and its importance in thermodynamics; and Understanding the difference between equilibrium and steady-state conditions. |
| **Week 5** | **Energy Analysis of Systems**: Analysis of closed and open systems; Control volume analysis and the application of the conservation equations; and Calculation of work and heat transfer for various energy devices and processes. |
| **Week 6** | **Processes and Cycles**: Differentiating between various types of processes (e.g., isothermal, adiabatic, isobaric). |
| **Week 7** | **Second Law of Thermodynamics and Entropy**: Introduction to the second law of thermodynamics and its different formulations; Entropy as a measure of system disorder and irreversibility; and Carnot cycle and the concept of maximum efficiency. |
| **Week 8** | **Midterm exam + Thermodynamic Cycles and Power Systems**: Analysis and optimization of power cycles, including Rankine and Brayton cycles; Combined cycles and their efficiency enhancements; and Introduction to renewable energy systems, such as solar thermal power plants and geothermal power plants. |
| **Week 9** | **Thermodynamic Properties and Equations of State**: Explaining intensive and extensive properties; Describing equation of state and its application to ideal gases (e.g., ideal gas law); and Introduction to specific heat capacity and its significance. |
| **Week 10** | **Refrigeration and Heat Pump Systems**: Principles of refrigeration and heat pump systems; Vapor compression and absorption refrigeration cycles; and Performance analysis and optimization of refrigeration systems. |

| | |
|---|---|
| **Week 11** | **Heat Engines and Efficiency**: Defining a heat engine and its components (e.g., source, sink, working fluid); and Describing the efficiency of a heat engine and its relationship with temperature. |
| **Week 12** | **Phase Transitions and Equilibrium**: Discussing the behavior of substances during phase transitions (e.g., solid to liquid, liquid to gas); Explaining phase diagrams and critical points; and Understanding the equilibrium conditions for coexisting phases. |
| **Week 13** | **Heat Transfer**: Conduction, convection, and radiation heat transfer and Application of heat transfer principles in energy systems, including heat exchangers |
| **Week 14** | **Applications in Energy Systems**: Applying thermodynamics to power plants, including steam turbines and gas turbines; Exploring the principles of refrigeration and heat pumps; and Discussing energy conversion and efficiency in renewable energy systems. |
| **Week 15** | **Advanced Topics in Thermodynamics**: Irreversibility and availability analysis; Chemical thermodynamics and combustion analysis; and Introduction to statistical thermodynamics and its applications. |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)** | |
|---|---|
| | **Material Covered** |
| **Week 1** | **Introduction to Laboratory Safety and Equipment**:<br>Safety procedures; and Introduction to common laboratory equipment and instruments used in thermodynamics experiments |
| **Week 2** | **Measurement Techniques and Data Analysis**:<br>Introduction to measurement techniques for temperature, pressure, and volume; Calibration of instruments and uncertainty analysis; and Data acquisition and analysis using software tools. |
| **Week 3** | **Properties of Pure Substances**:<br>Experimental determination of thermodynamic properties, such as specific heat capacity and enthalpy; Measurement of vapor pressure and boiling point for pure substances; and Construction of pressure-temperature phase diagrams. |
| **Week 4** | **Heat Transfer Experiments**:<br>Conduction experiment: Determination of thermal conductivity of materials. |

| | |
|---|---|
| | Convection experiment: Investigation of convective heat transfer coefficients.<br>Radiation experiment: Measurement of radiation heat transfer using different surfaces and configurations. |
| **Week 5** | **Analysis of Thermodynamic Cycles**:<br>Rankine cycle experiment: Performance analysis of a steam power plant setup; Brayton cycle experiment: Study of a gas turbine power plant; Combined cycle experiment: Analysis of a combined gas-steam power plant. |
| **Week 6** | **Renewable Energy Systems**:<br>Solar thermal experiment: Analysis of a solar collector and heat storage system.<br>Wind energy experiment: Measurement and evaluation of wind turbine performance.<br>Geothermal experiment: Investigation of geothermal energy extraction and utilization. |
| **Week 7** | **Energy Conversion and Efficiency Analysis**:<br>Performance analysis of different energy conversion devices, such as turbines and engines; Efficiency measurements and comparisons for various energy systems; and Energy efficiency optimization experiments. |

| **Learning and Teaching Resources** | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Introduction to Thermodynamics and Heat Transfer, Yunus A. Cengel and Afshin J. Ghajar.<br>Thermodynamics: Concepts and Applications, Stephen R. Turns | No |
| **Recommended Texts** | Experimental Thermodynamics: Experimental Thermodynamics Volume X, Richard J. Goldstein, Michael I. Mackley, and H.S. Uhlherr | No |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FORM OF DIGITAL ELCTRONICS

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Digital electronics** | | | **Module Delivery** | |
| **Module Type** | **Core** | | | ☒ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | **REE24119** | | | | |
| **ECTS Credits** | **6** | | | | |
| **SWL (hr/sem)** | **150** | | | | |
| **Module Level** | | UGII | **Semester of Delivery** | | Four |
| **Administering Department** | | Renewable Energy | **College** | College of Environment & Renewable Energy Sciences | |
| **Module Leader** | Layth Kadhim Turki | | **e-mail** | Layth.kadhim@kus.edu.iq | |
| **Module Leader's Acad. Title** | | Lecturer | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | Layth Kadhim Turki | | **e-mail** | Layth.kadhim@kus.edu.iq | |
| **Peer Reviewer Name** | | N.A. | **e-mail** | N.A. | |
| **Scientific Committee Approval Date** | | 20/06/2023 | **Version Number** | 1.0 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | Electronics, REE23013 | **Semester** | Three |
| **Co-requisites module** | None | **Semester** | ----- |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Objectives** | 1. To develop problem solving skills and understanding of Digital electronics theory by means of the practical applications.<br>2. To understand the basic construction of logic gates.<br>3. To understand the Boolean Algebra operation of logic functions and simplification.<br>4. Logic express simplification based on Karnaugh map.<br>5. To understand how to design a small system using different types of logic gates.<br>6. To understand the all types of adders and subtractors.<br>7. To has the ability to design the the decoders and encoders.<br>8. To has the ability to design the Multiplexor and Demultiplexer.<br>9. The student has the acquire skills for digital system design. |
| **Module Learning** | 1. Recognize digital signals means.<br>2. List the various terms associated with logic gates. |

| | |
|---|---|
| **Outcomes** | 3. Summarize what is meant by a basic gates.<br>4. Discuss the reaction and involvement of gates minimization.<br>5. How to manage the logic expression according to the logic algebra?<br>6. Understand the logic expression representation in POS and SOP.<br>7. Analysis the operation of multiple types of adders.<br>8. Analysis the circuit and operation of multiple types of adders.<br>9. Analysis the circuit and operation of multiple types of decoders.<br>10. Analysis the circuit and operation of multiple types of encoders.<br>11. Analysis the circuit and operation of multiple types of multiplexer.<br>12. Analysis the circuit and operation of multiple types of demultiplexer.<br>13. Design of some practical complete systems. |
| **Indicative Contents** | Indicative content includes the following.<br>Introduction to the digital electronics [4 hrs]<br>Numbering systems: Decimal system, binary number, octal numbers and hex. Numbers, number base conversions, Complements, signed numbers binary codes [7 hrs]<br>Boolean algebra and logic gates: SOP, POS, NAND and NOR implementation [9 hrs]<br>Kmap building, representation and design [7 hrs]<br>Don't care combinational logic circuits [4 hrs]<br>Analysis and design procedure of a logic circuit [5 hrs]<br>Binary adders and subtractors [5 hrs]<br>Decimal adders [5 hrs]<br>Comparators [5 hrs]<br>Decoders [5 hrs]<br>Encoders [5 hrs]<br>Multiplexer [5 hrs]<br>Demultiplexer [5 hrs] |

| **Learning and Teaching Strategies** | |
|---|---|
| **Strategies** | This course description provides a necessary summary of the most important course characteristics and expected learning outcomes for the student Evidence of whether he made the most of the available learning opportunities. It must be linked to the description the program. Thus, the main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students. |

| **Student Workload (SWL)** | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 79 | **Structured SWL (h/w)** | 5.2 |

| | | | |
|---|---|---|---|
| **Unstructured SWL (h/sem)** | 71 | **Unstructured SWL (h/w)** | 4.7 |
| **Total SWL (h/sem)** | **150** | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 3 | 10% (10) | 5, 8 and 12 | LO #1, #2 and #10, #11 |
| | **Assignments** | 4 | 10% (10) | 3, 6, 9, 12 | LO #3, #4 and #6, #7 |
| | **Lab.** | 1 | 10% (10) | Continuous | All |
| | **Report** | 1 | 10% (10) | 13 | LO #5, #8 and #10 |
| **Summative assessment** | **Midterm Exam** | 2hr | 10% (10) | 7 | LO #1 -6 |
| | **Final Exam** | 3hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

| | **Material Covered** |
|---|---|
| **Week 1** | Introduction |
| **Week 2** | Dif. Between analog and digital signals, and types of data transfer. |
| **Week 3** | Numbering systems- 1. |
| **Week 4** | Numbering systems- 2. |
| **Week 5** | Complements, signed numbers, binary codes and algebra. |
| **Week 6** | Theory and operation of Logic gates- 1. |
| **Week 7** | Mid. Term Exam + theory and operation of Logic gates- 2. |
| **Week 8** | SOP, POS, NAND and NOR implementation. |
| **Week 9** | Kmap, don’t care; combinational logic circuits. |
| **Week 10** | Introduction to binary adder and subtractor and design procedure. |
| **Week 11** | Decimal adders and comparators circuits design. |
| **Week 12** | Decoders and encoders circuits design, |
| **Week 13** | Multiplexers circuit design. |
| **Week 14** | De-multiplexers circuit design. |
| **Week 15** | **Complete System design.** |
| **Week 16** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | Lab 1: familiarization with instruments and apparatus used in the lab. |
| **Week 2** | Lab 2: Basic logic gates 1 & 2. (Verification of operation of different Logic Gate IC (AND, OR, NOT, NAND, NOR and XOR). |
| **Week 3** | Lab 3: Verifying Boolean algebra 1 & 2 by implementation of Boolean function by basic logic gates. |
| **Week 4** | Lab 4: Design and Verification by Implementation of half and full adder. |
| **Week 5** | Lab 5: Familiarization with Seven segment display and BCD to seven segment decoder IC. |
| **Week 6** | Lab 6: Implementation of multiplexer and de-multiplexer. |
| **Week 7** | Lab 7: Familiarization with Seven display and BCD to seven segment decoder IC. |

| Learning and Teaching Resources | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Thomas L. Floyd "Digital Fundamentals", Eleventh Edition Global, Edition 2015. | No |
| **Recommended Texts** | 1. M. Morris Mano, "Digital Design", 2015. | No |
| **Websites** | https://tooabstractive.com/ebooks/ee-files/digital-fundamentals-11th-edition/ | |

| Grading Scheme | | | | |
|---|---|---|---|---|
| **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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF

# FLUID FLOW

**University Name**: ALkarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energies Sciences

| Module Information<br>معلومات المادة الدراسية | | | | |
|---|---|---|---|---|
| **Module Title** | FLUID FLOW | | **Module Delivery** | |
| **Module Type** | C | | ☒ Theory<br>☐ Lecture<br>☒ Lab<br>☒ Tutorial<br>☐ Practical<br>☒ Seminar | |
| **Module Code** | REE24020 | | | |
| **ECTS Credits** | 7 | | | |
| **SWL (hr/sem)** | 175 | | | |
| **Module Level** | 2 | **Semester of Delivery** | 4 | |
| **Administering Department** | REE | **College** | CRE | |
| **Module Leader** | Ammar w. saeed | **e-mail** | ammar.waleed@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | **Module Leader's Qualification** | PhD. | |
| **Module Tutor** | none | **e-mail** | none | |
| **Peer Reviewer Name** | none | **e-mail** | none | |
| **Scientific Committee Approval Date** | 20/6/2023 | **Version Number** | 1 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | none | **Semester** | |
| **Co-requisites module** | none | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | 1. understanding basic laws, principles and phenomena in the area of fluid mechanics<br>2. to solve simplified examples of fluid mechanics<br>3. theoretical and practical preparation enabling students to apply the acquired knowledge and skills in professional and specialist courses. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | Students who successfully complete the course should:<br><br>1. understand the basic concepts of fluid mechanics.<br><br>2. understand the mathematical description of fluid flow.<br><br>3. understand the conservation principles governing fluid flows.<br><br>4. be able to solve inviscid flow problems using stream functions and velocity potentials.<br><br>5. be able to compute forces on bodies in fluid flows.<br><br>6. be able to solve (analytical and numerical) viscous flow problems.<br><br>7. be able to use mathematical software packages in solution methods. |
| **Indicative Contents**<br>المحتويات الإرشادية | Part 1: Topics, Introduction, fluid properties, fluid properties Hydrostatics, Bernoulli equation<br>Part 2: Fluid kinematics, conservation of mass, Conservation of momentum, energy, Inviscid flow<br>Part 3: Dimensional analysis, Viscous flows, Pipe flow, Boundary layers, Drag and lift forces, Computational fluid dynamics, Open channel flow |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 94 | | |
| **Unstructured SWL (h/sem)** | 81 | | |
| **Total SWL (h/sem)** | 175 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | **Topic** |
| **Week 2** | **Introduction, fluid properties** |
| **Week 3** | **fluid properties** |
| **Week 4** | **Hydrostatics, Bernoulli equation** |
| **Week 5** | **Bernoulli equation** |
| **Week 6** | **Fluid kinematics, conservation of mass** |
| **Week 7** | **Conservation of momentum, energy** |
| **Week 8** | **Inviscid flow** |
| **Week 9** | **MID EXAM,** |
| **Week 10** | **Dimensional analysis** |

| | |
|---|---|
| **Week 11** | **Viscous flows, Pipe flow** |
| **Week 12** | **Boundary layers** |
| **Week 13** | **Drag and lift forces** |
| **Week 14** | **Computational fluid dynamics** |
| **Week 15** | **Open channel flow** |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | Hydrostatic pressure |
| **Week 2** | Viscosity of a liquid by Stoke's method |
| **Week 3** | Calibration of a Bourdon Gauge |
| **Week 4** | U-tube manometer |
| **Week 5** | Venturimeter experiment |
| **Week 6** | Orifice meter experiment |
| **Week 7** | |

| **Learning and Teaching Resources**<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | White, Frank M. *Fluid Mechanics*. 7th ed. McGraw-Hill, 2010. ISBN: 9780077422417. | Not found |
| **Recommended Texts** | Robert W. Fox, Alan T. McDonald, and P. J. Pritchard, "Introduction to Fluid Mechanics", Seventh Edition, John Wiley & Sons Inc., New York, 2010. | Not found |
| **Websites** | | |

| **Grading Scheme**<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

## the Freedom and Democracy

**University Name**: ALkarkh University of Sciences

**College** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **the Freedom and Democracy** | | | **Module Delivery** | |
| **Module Type** | **B** | | | ☒ **Theory**<br>☐**Lecture**<br>☐ **Lab**<br>☐**Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | MPH22024 | | | | |
| **ECTS Credits** | 3 | | | | |
| **SWL (hr/sem)** | 75 | | | | |
| **Module Level** | 2 | | **Semester of Delivery** | 4 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Othman marwan abd | | **e-mail** | Othman.marwan@kus.edu.iq | |
| **Module Leader's Acad. Title** | LECTURER | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | none | | **e-mail** | none | |
| **Peer Reviewer Name** | none | | **e-mail** | none | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | This course aims to educate the student about democratic practices and personal and public freedoms, and enable him to use his rights in practical life on the basis of awareness and knowledge of those practices guaranteed by law. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | The learning outcomes of the Freedom and Democracy course are to introduce the student and provide him with the legal culture related to his exercise of all freedoms, as well as the practice of democracy according to the correct legal foundations. |
| **Indicative Contents**<br>المحتويات الإرشادية | The subject of freedom and democracy is a theoretical subject of the general requirements of the university, which the student studies through understanding the implications of each of the terms freedom and democracy.[27 hr] |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | Learning strategy This aspect includes the use of the following requirements:<br>First, the use of electronic methods in education, including the international network system<br>Secondly, trying to retrieve the previous lectures by allocating time out from the lecture to ask oral questions and interactive discussion.<br>Third, ask intellectual questions to ensure the extent of students' comprehension of the material<br>Fourthly, directing the students to the discreet legal sources that deal with the subject of human rights and public freedoms. Fifthly, assigning the students to prepare reports and research, in order to eliminate students from researching, in-depth, and perusing the content of the subject in terms of accurate and important details, which are related to public freedoms and private freedoms, in addition to their relationship with democracy. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 33 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 2 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 27 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 1.8 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 50 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5, 10 | LO #1, 2, 10 and 11 |
| | **Assignments** | 2 | 10% (10) | 2, 12 | LO # 3, 4, 6 and 7 |
| | **Projects / tutorial.** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 10% (10) | 13 | LO # 5, 8 and 10 |
| **Summative assessment** | **Midterm Exam** | 1 hr | 10% (10) | 7 | LO # 1-7 |
| | **Final Exam** | 2hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | مفهوم الحرية |
| **Week 2** | الحريات الشخصية |
| **Week 3** | الحريات العامة |
| **Week 4** | حرية الدين والعقيدة |
| **Week 5** | حرية التعبير عن الراي والمساواة امام القانون |
| **Week 6** | حرية التنظيم/والاقليات |
| **Week 7** | مفهوم الديمقراطية |
| **Week 8** | مميزات الديمقراطية |

| | |
|---|---|
| **Week 9** | الديمقراطية في الدستور |
| **Week 10** | **)**انواع الديمقراطية (المباشرة |
| **Week 11** | الديمقراطية شبه المباشرة |
| **Week 12** | الديمقراطية النيابية |
| **Week 13** | العلاقة بيت حقوق الانسان والديمقراطية |
| **Week 14** | المجتمع المدني والديمقراطية |
| **Week 15** | **EXAM** |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | **Text** | **Available in the Library?** |
|---|---|---|
| **Required Texts** | مبادئ حقوق الانسان والديمقراطية والحرية<br>ا.م فيصل شلال عباس<br>**2020** | No |
| **Recommended Texts** | الأصول تأصيل القديمة الحضارات في البدائية والديمقراطية الحرية<br>الخفاجي مزهر ل<br>2019 | No |
| **Websites** | https://mawdoo3.com/ | |

## 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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# Geothermal energy

**University Name**: ALkarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Geothermal energy | | | **Module Delivery** | |
| **Module Type** | **Core** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | Ree24123 | | | | |
| **ECTS Credits** | | | | | |
| **SWL (hr/sem)** | | | | | |
| **Module Level** | 2 | | **Semester of Delivery** | 4 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | | | **e-mail** | | |
| **Module Leader's Acad. Title** | | | **Module Leader's Qualification** | | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | | **Semester** | |
| **Co-requisites module** | | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. 1- Describe the basics, principles and concepts of underground energy<br>2. 2- Knowledge and application of measurements and efficiency factors for underground energy<br>3. 3- Understanding students and increasing their awareness about the possibility of applying the principles and properties of underground energy<br>4. 4- Knowing the most important practical and theoretical bases for the energy of the earth's interior and the work steps to build an integrated unit<br>5. 5- Recognizing that the energy of the earth's interior is one of the ways to achieve sustainable development and expel pollution |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Knows the concept of underground energy<br>2. Know the most important methods used to benefit from the energy of the earth's interior<br>3. Calculate the energy capacity generated from the ground<br>4. Calculate efficiency |
| **Indicative Contents**<br>المحتويات الإرشادية | 1. Evaluation of underground energy sources<br>2. Conduct physical and chemical tests to determine the forms of energy in the Earth's interior<br>3. Finding the total energy calculated from the Earth's interior<br>4. A census of the most important areas of underground energy sources |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Power plant design |
| **Week 2** | Drilling methods |

| | |
|---|---|
| **Week 3** | Heat exchanger design |
| **Week 4** | Engineered Geothermal Systems, Ground source heat pumps |
| **Week 5** | Estimate of resource potential |
| **Week 6** | Power generation |
| **Week 7** | Review & exam |
| **Week 8** | Classifation of Geothermal resources |
| **Week 9** | Deep geothermal vs. Shallow geothermal |
| **Week 10** | Geological mapping |
| **Week 11** | Geothermal electricity performance |
| **Week 12** | Geothermal Energy efficiency |
| **Week 13** | Geothermal energy Economics |
| **Week 14** | Uses of geothermal energy around the world |
| **Week 15** | missions to air and ground waters during power production |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Geothermal handbook :Planning and financing power generation | |
| **Recommended Texts** | | |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

## Module Information

معلومات المادة الدراسية

| | | | |
|---|---|---|---|
| **Module Title** | **Materials Science** | **Module Delivery** | |
| **Module Type** | **C** | ☒ **Theory** | |
| **Module Code** | **REE1217** | ☐ **Lecture** | |
| **ECTS Credits** | **4** | ☐ **Lab** | |
| **SWL (hr/sem)** | **100** | ☒ **Tutorial** | |
| | | ☐ **Practical** | |
| | | ☒ **Seminar** | |

| | | | |
|---|---|---|---|
| **Module Level** | **UGI** | **Semester of Delivery** | **4** |
| **Administering Department** | REE | **College** | CRE |
| **Module Leader** | Dr. Ethar Yahya Salih | **e-mail** | ethar@kus.edu.iq |
| **Module Leader's Acad. Title** | Dr. | **Module Leader's Qualification** | Ph.D. |
| **Module Tutor** | Dr. Ethar Yahya Salih | **e-mail** | ethar@kus.edu.iq |
| **Peer Reviewer Name** | Name | **e-mail** | |
| **Scientific Committee Approval Date** | | **Version Number** | 1.0 |

## Relation with other Modules

العلاقة مع المواد الدراسية الأخرى

| | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | None |
| **Co-requisites module** | None | **Semester** | None |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Describe the basics, principles and concepts of materials science.<br>2. Describe the crystal structure of materials.<br>3. Definition of crystal systems (lattices).<br>4. Define and understand how to apply the fill operator and coefficients.<br>5. Knowledge of the mechanical properties of materials. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Knows the science of materials and the extent of materials and learn about their physical, chemical, mechanical, electrical, optical and synthetic properties, methods of preparing nanomaterials and the possibility of using the prepared product in the field of renewable energy such as solar cells.<br>2. Checks and analyzes the identity of the material using available standards<br>3. Employing the prepared materials in many applications, especially in the field of alternative energy |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br>**Part 1**<br>Introduction to materials science and its applications, types of crystals, lattice cubic of features, and fabrication packing [**12 hrs.**].<br>**Part 2**<br>Atomic Bonding, Atom and types of bonds Materials in Defect, Mechanical Properties of Materials [**8 hrs.**].<br>**Part 3**<br>Alloys, Polymers, Glass and Ceramic [**4 hrs.**]. |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | 1. Visualization<br>2. Cooperative Learning<br>3. Differentiated Instruction<br>4. Using Technology to your Advantage<br>5. Student Centered Inquiry<br>6. Professional Development |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | **63** | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | **4** |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | **37** | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | **2.5** |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **100** | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5, 11 | LO #1, 2, 10 and 11 |
| | **Assignments** | 2 | 10% (10) | 4, 13 | LO # 3, 4, 6 and 7 |
| | **Projects / Lab.** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 10% (10) | 13 | LO # 5, 8 and 10 |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | LO # 1-7 |
| | **Final Exam** | 3 hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction to Materials Science, Terms Basic: Crystallography, Crystal…etc |
| **Week 2** | |
| **Week 3** | Types of Crystals, Space lattices (3D) and crystalline systems |
| **Week 4** | |
| **Week 5** | Lattice cubic of Features, Fraction Packing or fraction Filling, indices Miller |
| **Week 6** | |
| **Week 7** | Atomic Bonding, Atoms between FORCESBINDING & Types of Bonds |
| **Week 8** | |
| **Week 9** | Materials in Defect, Mechanical Properties of Materials |
| **Week 10** | |
| **Week 11** | Corrosion, Failure |
| **Week 12** | |
| **Week 13** | Alloys, Polymers |
| **Week 14** | Glass and Ceramic |
| **Week 15** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | **NOT APPLICAPLE** |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | W.D. Callister, Jr., "Materials Science and Engineering, An Introduction" Wiley -- 7th Edition | No |
| **Recommended Texts** | Kittel, Charles - Introduction 7, 6, 8Th Ed. | No |
| **Websites** | Internet resources | |

| Grading Scheme<br>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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# MODULE DESCRIPTION FOR

# Solar cells PV

**University Name**: ALkarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energies Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Solar cells Pv | | | **Module Delivery** | |
| **Module Type** | **Core** | | | ☒ **Theory**<br>**Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REF24022 | | | | |
| **ECTS Credits** | 6 | | | | |
| **SWL (hr/sem)** | 150 | | | | |
| **Module Level** | **2** | | **Semester of Delivery** | | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Dr. Mohammad AL dharob | | **e-mail** | Dr.m.aldharob@kus.edu.iq | |
| **Module Leader's Acad. Title** | LECTURER | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | NON | | **e-mail** | NON | |
| **Peer Reviewer Name** | NON | | **e-mail** | NON | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | NONE | **Semester** | |
| **Co-requisites module** | | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Understand PV characteristics<br>2. Explain PV electrical properties<br>3. Study Ideal PV<br>4. Describe optical properties<br>5. Understand typical solar cell structure |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. able to understand the types of solar cells.<br>2. Understand the pv solar cell principal work.<br>3. Understand the preparation of solar cell |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 78 | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 72 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 150 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | introduction to the concept of solar cells |
| **Week 2** | Electrical Characteristics of solar cell |
| **Week 3** | Ideal Solar Cell & Solar Cell Characteristics in Practice |
| **Week 4** | Optical Properties of solar cell |
| **Week 5** | Typical Solar Cell Structures |
| **Week 6** | The p-n Junction Solar Cell |
| **Week 7** | Mid exam |
| **Week 8** | The p-n Junction of solar cell |
| **Week 9** | Uniform Emitter and Base of solar cell and Diffused Emitter |
| **Week 10** | |

| | |
|---|---|
| **Week 11** | Solar cell preparation |
| **Week 12** | Heterojunction Cells and the p-i-n Structure Series Resistance, |
| **Week 13** | |
| **Week 14** | Solving mathematical problems related to dams |
| **Week 15** | |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | لا يوجد |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| **Learning and Teaching Resources**<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Physics of solar cells<br>Peter Wurfel | Not found |
| **Recommended Texts** | High Efficiency Solar Cells<br>Xiaodong Wang Zhiming M. Wang | Not found |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# BIO ENERGY

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Bio Energy | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☐ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE35026 | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 125 | | | | |
| **Module Level** | 3 | | **Semester of Delivery** | 5 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Luma jamal abbas | | **e-mail** | Luma.jamal@kuc.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | The objective of the course is to apply energy efficiency concept in day to day life in order to save Money and Energy and thereby protect the Environment. By obtaining necessary knowledge and information on the main operating principles of devices/appliances that are in common use and information on which to make the right decision in selecting the most energy efficient and economical choice |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Knowledge and understanding:<br><br>The student will be aware from a technical point of view of energy plants where biomasses and organic wastes are used.<br>2. Applying Knowledge and understanding:<br><br>The student will be capable to apply the acquired knowledge to design biomass energy plants and to evaluate their performances.<br>3. Making judgments:<br><br>The student will became capable to judge the different options available given the nature of the feedstock available (kind of biomass, kind of organic waste) and the technological opportunities to valorize it as bioenergy.<br>4. Communication skills:<br><br>The student will be capable to efficiently communicate concerning bio-energy options, processes and plants.<br>5. Learning skills<br><br>The student will be taught that significant bioenergy process advancements are in progress, and that he/she should keep him/herself updated on the last technological outcomes that face the bio-energy market. |
| **Indicative Contents** | |

| | |
|---|---|
| المحتويات الإرشادية | The course focuses on Bio-Energy and in particular on the exploitation of biomass and organic waste for energy recovery. The course encompasses thermochemical energy processes (combustion, gasification, pyrolysis, reforming, hydrothermal conversion), mechanical and chemical processes (oil extraction and trans-esterification), finally biochemical processes (fermentation and anaerobic digestion). Emphasis is given to thermochemical processes and anaerobic digestion.<br>The course provides chemical engineering tools applied to the analysis of energy conversion processes involving biomass and organic waste.<br><br>The student at the end of the course<br>• will be able to analyze the various technologies available to energetically valorize the various types of biomass and organic waste;<br>The course accounts for frontal lectures (50 hours), during which the lecturer will address both informative and formative topics. The informative activity will provide a comprehensive overview of the bio-energy sector. The training activity will be divided into a discussion of the theoretical topics and the development and solution of some "practical" problems, where the theory will be applied. The lecturer will use PowerPoint presentations, while the exercises will be held on the blackboard. |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The lectures will consist of interactive power point presentations, videos, handouts, and other educational materials. Students are responsible for the material covered in the course materials. The knowledge will be evaluated via homework assignments, short quizzes and take-home exams. |

| | |
|---|---|

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 62 | الحمل الدراسي المنتظم للطالب اسبوعيا | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 63 | الحمل الدراسي غير المنتظم للطالب اسبوعيا | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 125 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5,10 | 1-5 |
| | **Assignments** | 2 | 10% (10) | 2,12 | 5-10 |
| | **Projects / Lab.** | 1 | 10% (10) | continuous | |
| | **Report** | 1 | 10% (10) | 13 | 10-12 |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 17 | 13-15 |
| | **Final Exam** | 2hr | 50% (50) | 16 | 16 |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | Material Covered |
| Week 1 | Bioenergy concepts – Introduction<br>Systems thinking<br>Biopower, bioheat<br>Biofuels, advanced liquid fuels, drop-in fuels<br>Biobased products |
| Week 2 | Biomass, Bio-Energy and Bio-Refinery<br>Basic concepts of circular economy based on organics |

| | |
|---|---|
| Week 3 | Bio energy<br><br>1. Biogas generation and factors affecting bio digestion or generation of gas<br>2. Biomass and biochemical conversion to fuels<br>3. Biogas plants |
| Week 4 | Environmental Laws<br><br>Federal Environmental Statutes.<br><br>Common Law Liabilities.<br><br>International Treaties |
| Week 5 | Environmental Economics, Politics, and Worldviews |
| Week 6 | Biomass conversion: Physical conversion |
| Week 7 | Dewatering, drying, size reduction, steam explosion, densification, pelleting, chipping, oil extraction. |
| Week 8 | Biomass conversion: Chemical conversion |
| Week 9 | Oil trans-esterification (biodiesel production). |
| Week 10 | Hydrolysis. |
| Week 11 | Biomass conversion: Biochemical conversion |
| Week 12 | Anaerobic digestion (biogas production from organic waste and wastewater). |
| Week 13 | Fermentation (bioethanol production) |
| Week 14 | Chemical engineering tools for analysis and design of energy processes |
| Week 15 | Reaction stoichiometry. |
| Week 16 | Preparatory week before the final Exam |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Basic properties of nucleus, Springer,2003.<br>NUCLEAR FISSION AND FUSION, Welter Class publishing. | |
| **Recommended Texts** | NUCLEAR PHYSICS, of the European Physical Society October 2016 | |
| **Websites** | https://www-nds.iaea.org/ | |

| Grading Scheme<br>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 |
| | | | | |

**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.

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Energy Transmission & Storage** | | | **Module Delivery** | |
| **Module Type** | **Core learning activity** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | **REE35028** | | | | |
| **ECTS Credits** | **4** | | | | |
| **SWL (hr/sem)** | **100** | | | | |
| **Module Level** | **UGIII** | **Semester of Delivery** | **5** | | |
| **Administering Department** | REE | **College** | CRE | | |
| **Module Leader** | Dr. Ethar Yahya Salih | **e-mail** | ethar@kus.edu.iq | | |
| **Module Leader's Acad. Title** | Dr. | **Module Leader's Qualification** | Ph.D. | | |
| **Module Tutor** | Dr. Ethar Yahya Salih | **e-mail** | ethar@kus.edu.iq | | |
| **Peer Reviewer Name** | Name | **e-mail** | | | |
| **Scientific Committee Approval Date** | 01/07/2023 | **Version Number** | 1.0 | | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | None |
| **Co-requisites module** | None | **Semester** | None |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. This course is intended to provide students an overview on energy storage and transport schemes/devices with a major focus on electrochemical energy including fuel cells, ionic batteries and super-capacitors. This course is appropriate for engineering and natural science students interested in having an overview of electrochemical energy storage/transport schemes covering their basic operating principles, fundamental physics behind them and technological advantages/issues.<br>2. Basic theory behind different energy storage systems and working principles of all types of energy storage systems. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Determine the main parameters of a storage system by applying thermodynamics, heat and mass transfer and chemistry.<br>2. Able to evaluate the storage process (based on mass and energy balances, calculation of efficiencies).<br>3. Identify the optimal solutions to any potential energy storage application, whether in the electrical, heat or transport sector. |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br>**Part 1**<br>Types of Energy & Basic Thermodynamics [**6 hrs.**].<br>**Part 2**<br>Fuel Cell – Introduction & Open Circuit Voltage, Fuel Cell – Activation & Ohmic Losses, Fuel Cell – Mass Transport Loss, & Fuel Cell – Modeling, Types, Systems [**12 hrs.**].<br>**Part 3**<br>Electrochemical Characterization – Polarization Curve, EIS, Ionic Batteries – Terminology & Principles, Phase Diagram, Ionic Batteries –Electrodes, Ionic Batteries –Modeling; Flow Battery [**12 hrs.**].<br>**Part 4**<br>Super Capacitor – Principles & Operation, Electrochemical Characterization – Cyclic Voltametry, & Thermal and Mechanical Energy Storage [**12 hrs.**]. |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | 1. Visualization<br>2. Cooperative Learning<br>3. Differentiated Instruction<br>4. Using Technology to your Advantage<br>5. Student Centered Inquiry<br>6. Professional Development |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | **48** | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | **3** |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | **52** | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | **3.5** |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **100** | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5, 11 | LO #1, 2, 10 and 11 |
| | **Assignments** | 2 | 10% (10) | 4, 13 | LO # 3, 4, 6 and 7 |
| | **Seminar** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 10% (10) | 13 | LO # 5, 8 and 10 |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | LO # 1-7 |
| | **Final Exam** | 3 hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Types of Energy |
| **Week 2** | Basic Thermodynamics |
| **Week 3** | Fuel Cell – Introduction & Open Circuit Voltage |
| **Week 4** | Fuel Cell – Activation & Ohmic Losses |
| **Week 5** | Fuel Cell – Mass Transport Loss |
| **Week 6** | Fuel Cell – Modeling, Types, Systems |
| **Week 7** | Review Session & Midterm Exam |
| **Week 8** | Electrochemical Characterization – Polarization Curve, EIS |
| **Week 9** | Ionic Batteries – Terminology & Principles, Phase Diagram |
| **Week 10** | Ionic Batteries –Electrodes |
| **Week 11** | Ionic Batteries –Modeling; Flow Battery |
| **Week 12** | Super Capacitor – Principles & Operation |
| **Week 13** | Electrochemical Characterization – Cyclic Voltametry |
| **Week 14** | Thermal and Mechanical Energy Storage |
| **Week 15** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | ***NOT APPLICABLE*** |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Energy Storage, Robert A. Huggins, Springer | No |
| **Recommended Texts** | Fuel Cell Fundamentals, 2nd Edition, Ryan et al., Wiley | No |
| **Websites** | https://abet.eng.ucmerced.edu/courses | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# HYDROELECTRIC ENERGY

**University Name**: AlKarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energies Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Hydroelectric Energy | | | **Module Delivery** | |
| **Module Type** | C | | | ☐ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE35030 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | 3 | | **Semester of Delivery** | 5 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Ammar w. saeed | | **e-mail** | ammar.waleed@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | PhD. | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

## Relation with other Modules

| العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | NONE | **Semester** | |
| **Co-requisites module** | NONE | **Semester** | |

| **Module Aims, Learning Outcomes and Indicative Contents**<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Energy production, efficacy and efficiency of hydropower.<br>2. Economic structural design conditions for hydropower plants.<br>3. Calculate flow rate loads for dams.<br>4. Structural design and function of the various types of dams.<br>5. Structural design and dimensioning of spillways, slots, hydropower inlets, tunnels for operation and transmission, pipelines and concrete plugs.<br>6. Water hammer pressure surge and mass fluctuations, as well as installations to control them.<br>7. Structural design of hydropower plants.<br>8. Structure and function of the various types of turbines.<br>9. Regulations related to the various elements of a hydropower plant. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Perform cost-benefit analyses of hydropower plants.<br>2. Calculate flow rate loads of dams.<br>3. Select the right dam type according to local conditions.<br>4. Calculate structural design of dam for stability based on the regulations and accepted methods.<br>5. Calculate structural design of simple spillways, slots, hydropower intakes, tunnels for operation and transmission, pipelines and concrete plugs.<br>6. Select the right type of turbine.<br>7. Perform analysis of water hammer pressure surge and mass fluctuations and design of installations for controlling mass fluctuations. |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 63 | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 37 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | introduction to the concept of hydroelectric energy sources, types and types |
| **Week 2** | Energy production stations and their classification, types of water sources for these stations |
| **Week 3** | Solving mathematical problems related to turbines used in energy production |
| **Week 4** | Performing mathematical calculations to choose the appropriate turbine for power stations |
| **Week 5** | How the turbine works, with reference to models and diagrams of hydroelectric stations |
| **Week 6** | How the turbine works, with reference to models and diagrams of hydroelectric stations |
| **Week 7** | Mid exam |
| **Week 8** | Description of dams, their types, advantages and disadvantages of each type, |
| **Week 9** | Some necessary calculations for dams |
| **Week 10** | The construction of dams and their relationship to society and the environment and the resulting environmental damage |
| **Week 11** | |
| **Week 12** | Designing and conducting the necessary calculations for water drainage outlets in dams and conducting their calculations |
| **Week 13** | |
| **Week 14** | Solving mathematical problems related to dams |
| **Week 15** | |
| **Week 16** | Preparatory week before the final Exam |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | لا يوجد |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | P. K. Nag, Power Plant Engineering, Third Edition, the McGraw-Hill Companies, 2008. | Not found |
| **Recommended Texts** | Fundamentals of renewable energy<br>N,S Rathore and N.L. Panwar | Not found |
| **Websites** | 1. http://www.hydrolink.cz/en/pelton-turbines/<br>2. https://www.slideshare.net/gauravhtandon1/gravity-dam | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# Measurements and Control

**University Name**: AlKarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Measurements and Control | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☐ **L Theory**<br>☐ **L lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | REE35025 | | | | |
| **ECTS Credits** | 3 | | | | |
| **SWL (hr/sem)** | 75 | | | | |
| **Module Level** | **3** | | **Semester of Delivery** | **5** | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Dr. Omar Kanaan Nori | | **e-mail** | omareng27@gmail.com | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Develop a Comprehensive Understanding: Provide students with a comprehensive understanding of the fundamental principles, theories, and concepts related to measurements and control in the energy domain. This includes knowledge of sensors, transducers, signal conditioning, data acquisition, control systems, and communication networks.<br><br>2. Foster Technical Skills: Develop practical skills in acquiring, analyzing, and interpreting data from various sensors and transducers used in energy systems. Enhance proficiency in signal conditioning, data acquisition, control system design, and troubleshooting techniques. Enable students to operate measurement and control equipment effectively.<br><br>3. Promote Critical Thinking and Problem-Solving: Cultivate students' ability to think critically and analytically when faced with measurement and control challenges in the energy sector. Enable students to identify problems, evaluate potential solutions, and make informed decisions based on data analysis and interpretation.<br><br>4. Encourage Safety and Reliability: Instill a strong emphasis on safety considerations in measurement and control systems, particularly within the energy sector. Raise awareness of potential hazards, risk assessment, and mitigation strategies. Develop an understanding of reliability analysis and maintenance practices to ensure system performance and uptime.<br><br>5. Foster Industry Relevance: Align the curriculum with current industry practices, standards, and emerging trends in measurement and control technologies. Equip students with the knowledge and skills needed to meet the demands of the energy sector, including smart grid technologies, automation, and digitalization.<br><br>6. Enhance Collaboration and Communication: Foster teamwork and collaboration skills through group projects, case studies, and laboratory exercises. Develop effective communication skills, both oral and written, to articulate measurement and control concepts, present findings, and collaborate with industry professionals. |

| | |
|---|---|
| | 7. Encourage Ethical and Professional Conduct: Promote ethical behavior, professionalism, and responsible practices in measurement and control activities. Emphasize the importance of integrity, accuracy, and adherence to standards and regulations within the energy industry.<br><br>8. Facilitate Lifelong Learning: Instill a sense of curiosity and a passion for continuous learning and professional development in the field of measurements and control. Prepare students for further education, research, and adaptation to evolving technologies in the energy sector. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Understand the principles and concepts of measurements and control systems in the energy sector.<br>2. Explain the importance of accurate and reliable data in energy systems and its impact on energy efficiency and performance.<br>3. Identify different types of sensors and transducers used in energy systems and select appropriate sensors based on application requirements.<br>4. Apply signal conditioning techniques to acquire and process sensor signals for accurate measurement.<br>5. Demonstrate proficiency in using data acquisition systems and instrumentation interfaces for acquiring and analyzing measurement data.<br>6. Perform measurements of various electrical parameters, temperature, pressure, flow, and level in energy systems.<br>7. Design and implement control systems using feedback control principles and algorithms such as PID control.<br>8. Program and configure programmable logic controllers (PLCs) for automation and control applications in energy systems.<br>9. Utilize supervisory control and data acquisition (SCADA) systems for remote monitoring and control of energy processes.<br>10. Understand communication protocols and networks used in measurement and control systems, and integrate them into energy systems.<br>11. Analyze measurement data using statistical techniques and interpret the results for energy system optimization and decision-making.<br>12. Identify safety considerations in measurement and control systems and implement appropriate safety measures.<br>13. Diagnose faults and troubleshoot measurement and control systems in energy applications.<br>14. Apply reliability analysis techniques to assess and maintain the performance of measurement and control systems in energy systems.<br>15. Work effectively in a laboratory setting, conduct experiments, and demonstrate proficiency in using measurement and control equipment.<br>16. Analyze real-world case studies of measurement and control systems in the energy sector, identify challenges, and propose solutions.<br>17. Stay updated with emerging technologies and trends in measurement and control for energy systems.<br>18. Communicate effectively, both orally and in writing, about measurement and control concepts, methods, and findings. |

| | |
|---|---|
| **Indicative Contents**<br>المحتويات الإرشادية | **Introduction to Measurements and Control:** Overview of measurements and control systems in the energy sector<br>**Sensors and Transducers:** Principles of operation for various types of sensors and transducers<br>**Techniques for signal conditioning and amplification:** Analog-to-digital conversion and digital signal processing<br>**Measurement Techniques in Energy Systems:** Measurement of electrical parameters (voltage, current, power)<br>**Control Systems and Feedback Control: Principles of feedback control systems**<br>**Programmable Logic Controllers (PLCs) and SCADA Systems:** Introduction to PLCs and their applications in energy systems<br>**Communication Networks in Measurement and Control:** Overview of communication protocols (e.g., Modbus, Profibus)<br>**Data Analysis and Visualization:** Statistical analysis of measurement data<br>**Safety and Reliability in Measurement and Control:** Safety considerations in measurement and control systems<br>**Case Studies and Industry Applications:** Analysis of real-world measurement and control systems in the energy sector<br>**Emerging Technologies and Future Trends:** Exploration of advanced measurement techniques and sensors |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | **Lectures: Traditional lectures can be used to deliver theoretical concepts**<br><br>**Case Studies: Presenting real-world case studies of measurement and control systems in the energy sector can provide students with practical insights.**<br><br>**Group Projects: Assigning group projects related to measurement and control can encourage collaboration and peer learning.**<br><br>**Problem-Based Learning: Presenting students with real-world problems or scenarios related to measurements and control can encourage critical thinking and problem-solving skills.**<br><br>**Online Resources and Interactive Materials: Supplementing learning with online resources, interactive modules, and multimedia materials can provide additional learning opportunities.** |

| | |
|---|---|
| | **Continuous Assessment: Implementing regular assessments, such as quizzes, tests, or practical assignments, can help monitor students' progress and understanding of the measurement and control concepts.**<br><br>**Communication and Presentation Skills: Incorporating activities that develop communication and presentation skills, such as report writing, oral presentations, or poster sessions, can help students effectively communicate their findings and analysis in measurement and control.** |

## Student Workload (SWL)
الحمل الدراسي للطالب

| | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/w)** | 3 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 27 | **Unstructured SWL (h/w)** | 2 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 75 | | |

## Module Evaluation
تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

| | **Material Covered** |
|---|---|
| **Week 1** | Introduction to Measurements and Control |
| **Week 2** | Sensors and Transducers |
| **Week 3** | Signal Conditioning and Data Acquisition |
| **Week 4** | Measurement Techniques in Energy Systems |

| | |
|---|---|
| **Week 5** | Control Systems and Feedback Control |
| **Week 6** | Programmable Logic Controllers (PLCs) and SCADA Systems |
| **Week 7** | Communication Networks in Measurement and Control |
| **Week 8** | Data Analysis and Visualization |
| **Week 9** | Safety and Reliability in Measurement and Control |
| **Week 10** | Laboratory Work and Hands-on Projects |
| **Week 11** | Case Studies and Industry Applications |
| **Week 12** | Emerging Trends and Future Directions |
| **Week 13** | Seminars part1 for students on recent developments in Measurement and Control |
| **Week 14** | Industry Engagement and Case Studies |
| **Week 15** | Seminars part2 for students on recent developments in Measurement and Control |
| **Week 16** | Preparatory week before the final Exam |

## Learning and Teaching Resources

مصادر التعلم والتدريس

| | **Text** | **Available in the Library?** |
|---|---|---|
| **Required Texts** | Karsilayan, A. (2019). Industrial Measurement and Control Systems: Principles and Concepts. CRC Press.<br><br>Datta, S. (2015). Process Control and Instrumentation. PHI Learning Pvt. Ltd. | No |
| **Recommended Texts** | Eren, H. (2019). Measurement and Instrumentation Principles (3rd ed.). Butterworth-Heinemann. | No |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF

# MODELING OF RENEWABLE ENERGY

**University Name**: AlKarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Modeling of renewable energy** | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☐ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE35029** | | | | |
| **ECTS Credits** | 7 | | | | |
| **SWL (hr/sem)** | 175 | | | | |
| **Module Level** | | 3 | **Semester of Delivery** | | 5 |
| **Administering Department** | | RE | **College** | CRE | |
| **Module Leader** | Firas Abdulrazzaq Hadi | | **e-mail** | Firas.A.Hadi@kus.edu.iq | |
| **Module Leader's Acad. Title** | | Asst. Prof. | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | | NONE | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | | 20/6/2023 | **Version Number** | | 1 |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | ● Develop a computer based tool to design an electricity generating system consisting of solar PV, WTGs, FFPPs and energy storage;<br>● Use the tool to design an electricity generating system<br>● Modeling and assessment of variable and constant renewable energy resources<br>● Modeling renewable energy systems on a system level, such as solar photovoltaic and wind energy systems<br>● Modeling energy demand and energy storage systems<br>● Economic assessment of renewable energy systems with storage option<br>● Integrating individual components/models of renewable energy systems for a complete system level model and its usage for design purposes or hybrid systems |
| **Module Learning Outcomes** | 1. Developing, programming, and verifying/validating mathematical models; 2. Using the programed models for parametric, simulation and what-if design studies 3. Post processing, visualization, and interpretation of results; 4. Written and oral communication of the design process and outcomes 5. Modeling and assessing renewable energy resources 6. Modeling renewable energy conversion process 7. Modeling energy storage and demand 8. Integrating individual models into a system level model and its application to design. |
| **Indicative Contents** | Design of a renewable energy system based on modeling and simulations. Development, programing, and verification of mathematical models for renewable energy resources, energy conversion processes, energy storage, energy demand, and environmental impact. Integration of models for system level modeling. Application of programmed models for simulation, parametric and what-if studies. Post processing, visualization, and interpretation of results. |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | 1- Speaking 2- Discussion 3- Reports 4- Projects 5- Assignments |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 94 | **Structured SWL (h/w)** | 6 |
| **Unstructured SWL (h/sem)** | 81 | **Unstructured SWL (h/w)** | 5.4 |
| **Total SWL (h/sem)** | 175 | | |

| Module Evaluation | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5,10 | |
| | **Assignments** | 2 | 10% (10) | 2,12 | |
| | **Projects / Lab.** | 1 | 10% (10) | - | |
| | **Report** | 1 | 10% (10) | 13 | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | |
| | **Final Exam** | 2hr | 50% (50) | 16 | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction to modeling systems |
| **Week 2** | Modeling of renewable energy system for a specific application |
| **Week 3** | Modeling of solar energy |
| **Week 4** | Modeling of wind energy |
| **Week 5** | Modeling energy demand and energy storage systems |
| **Week 6** | Economic assessment of renewable energy systems with storage option |

| | |
|---|---|
| **Week 7** | Measurements and resource assessment |
| **Week 8** | Post-processing and interpretation of results |
| **Week 9** | Integrating individual components/models of renewable |
| **Week 10** | Meteorological data analysis |
| **Week 11** | Analysis of energy storage systems and energy demand |
| **Week 12** | Economic metrics for energy systems |
| **Week 13** | Environmental aspects of renewable energy systems. |
| **Week 14** | Developing, programming and validating mathematical models using software such as MS Excel, Matlab, etc. |
| **Week 15** | Meteorological data analysis |
| **Week 16** | Preparatory week before the final Exam |

| **Delivery Plan (Weekly Lab. Syllabus)** | |
|---|---|
| | **Material Covered** |
| **Week 1** | learning how to install the modeling software |
| **Week 2** | Modeling and Simulating a Power System |
| **Week 3** | Using the programed models for parametric, simulation |
| **Week 4** | Use simulation software to model renewable energy |
| **Week 5** | Sizing of WTGs |
| **Week 6** | Sizing of PV energy systems. |
| **Week 7** | Design of WTG + PV energy systems |

| **Learning and Teaching Resources** | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | 1. Energy Simulation in Building Design, J A Clarke, 2002 (2nd Edn) 1. 2001 ASHRAE Handbook: Fundamentals, IP or SI edition, hard copy or CD 2. Numerical Heat Transfer and Fluid Flow, S V Patankar, 1980 3. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, 1991 4. Design of Thermal Systems, W. F. Stoecker, 1998 | |
| **Recommended Texts** | 1- AJ Wood and BF Wollenberg: Power Generation, Operation and Control (John Wiley & Sons, New York, 1996).<br>2- Nick Jenkin, Janaka Ekavayake: Wind Energy Generation Modeling and Control (Wiley and Sons) | |

| | | |
|---|---|---|
| | | |
| **Websites** | 1. SketchUp 2017. Either Sketchup Make or Sketchup Pro will work. http://www.sketchup.com/download/all<br>2. OpenStudio v2.20- Create a username and password to log in. https://www.openstudio.net Recommended Software Text Editor for PC: Notepad ++ https://notepad-plus-plus.org/ with the EnergyPlus syntax highlighting tool available at: http://energyplus.helpserve.com/Knowledgebase/List/Index/44/utilities Text Editor for Mac: Text Wrangler https://itunes.apple.com/us/app/textwrangler/id404010395?mt=12 | |

# MODULE DESCRIPTION FOR

# SOLAR ENERGY SYSTEMS

**University Name**: AlKarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energies Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Solar energy systems | | | **Module Delivery** | |
| **Module Type** | C | | | ☒ Theory<br>☐ Lecture<br>☒ Lab<br>☒ Tutorial<br>☐ Practical<br>☒ Seminar | |
| **Module Code** | REE35027 | | | | |
| **ECTS Credits** | 7 | | | | |
| **SWL (hr/sem)** | 175 | | | | |
| **Module Level** | 3 | | **Semester of Delivery** | 5 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Dr. Mohammad AL dharob | | **e-mail** | Dr.m.aldharob@kus.edu.iq | |
| **Module Leader's Acad. Title** | LECTURER | | **Module Leader's Qualification** | Ph.D. | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | NONE | **Semester** | |
| **Co-requisites module** | NONE | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Study solar energy systems<br>2. Distinguish between solar energy systems<br>3. How to choose parts of solar energy systems |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Known the main parts of solar energy system<br>2. Known the best design of solar cell system<br>3. Calculation of best power for parts of solar system.<br>4. |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 94 | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 81 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 175 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | introduction to solar energy systems |
| **Week 2** | Parts of solar energy systems |
| **Week 3** | Kinds of energy solar systems |
| **Week 4** | Solar inverters and their Kinds |
| **Week 5** | Solar Agriculture inverters |
| **Week 6** | Solar panels and their kinds |
| **Week 7** | Solar batteries |
| **Week 8** | Mid exam |
| Week 9 | Off grid solar energy system |
| Week 10 | |

| | |
|---|---|
| **Week 11** | On grid energy systems |
| **Week 12** | Microgrid energy systems |
| **Week 13** | |
| **Week 14** | Hybrid energy systems |
| **Week 15** | |
| **Week 16** | Preparatory week before the final Exam |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | Measuring of solar voltage characteristics of solar energy system |
| **Week 2** | Measuring of solar power characteristics of solar energy |
| **Week 3** | The effect of direction of solar panels on the solar energy system |
| **Week 4** | The effect of slope of solar panels on the solar energy system efficiency |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Physics of solar cells<br>Peter Wurfel | Not found |
| **Recommended Texts** | High Efficiency Solar Cells<br>Xiaodong Wang Zhiming M. Wang | Not found |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# CLIMATE CHANGE

**University Name**: AlKarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| **Module Information**<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Climate change | | | **Module Delivery** | |
| **Module Type** | **S** | | | ☐ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒**Tutorial**<br>☐ **Practical**<br>☒**Seminar** | |
| **Module Code** | Cre36032 | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 125 | | | | |
| **Module Level** | 3 | | **Semester of Delivery** | 6 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | | | **e-mail** | | |
| **Module Leader's Acad. Title** | | | **Module Leader's Qualification** | | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| **Relation with other Modules**<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | NONE | **Semester** | |
| **Co-requisites module** | NONE | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Know the concept of climate change<br>2- Know the physical bases affecting the concentration and distribution of pollutants<br>3- Know ways to reduce the effects of climate change and adapt<br>4- Identify the goals of sustainable development<br>5- Knowledge of sustainable cities |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Evaluation of the types of sources of pollutants<br>2. The most important weather phenomena that affect the increase and concentration of pollutants<br>3. There is a background on the most important ways to adapt to the effects of climate change<br>4. Knowledge of climate conventions<br>5. Knowledge of sustainable development goals |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 63 | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 62 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 125 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction to the concept of the layers of atmosphere |
| **Week 2** | Boundary layer (definition and importance) |
| **Week 3** | Thickness of boundary layer |
| **Week 4** | sources of pollutants |
| **Week 5** | Stability and the pollutants |
| **Week 6** | The behavior of pollutants in chimneys and its relationship to atmospheric stability |
| **Week 7** | Review & exam |
| **Week 8** | climate change |
| **Week 9** | The effects of climate change |
| **Week 10** | Temperature, precipitation ,dust storm, Vegetation |
| **Week 11** | Climate change and biodiversity |
| **Week 12** | Adapting to climate change and Sustainable development goals |
| **Week 13** | climatic displaced |
| **Week 14** | sustainable cities and simens index |
| **Week 15** | climate agreements |
| **Week 16** | Preparatory week before the final Exam |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Handbook of climate change mitigation and adaptation | |
| **Recommended Texts** | Fundamentals of Atmospheric stability handbook | |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

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# MODULE DESCRIPTION OF

# HEAT TRANSFER

**University Name**: AlKarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | HEAT TRANSFER | | | **Module Delivery** | |
| **Module Type** | C | | | ☐ **Theory**<br>☐ **Lecture**<br>☒ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE36034 | | | | |
| **ECTS Credits** | 7 | | | | |
| **SWL (hr/sem)** | 175 | | | | |
| **Module Level** | 3 | | **Semester of Delivery** | 6 | |
| **Administering Department** | Renewable Energy | | **College** | Renewable Energy and Environmental Science | |
| **Module Leader** | Ammar w. saeed | | **e-mail** | ammar.waleed@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | PhD. | |
| **Module Tutor** | none | | **e-mail** | none | |
| **Peer Reviewer Name** | none | | **e-mail** | none | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | FLUID FLOW | **Semester** | 4 |
| **Co-requisites module** | | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | 1. Knowing the most important scientific methods in addressing the problems facing the student, including the process of heat transfer.<br>2. Knowing the most important principles of heat transfer.<br>3. View the initial principles in the design of heat transfer equipment such as (solar heater).<br>.The ability to solve problems related to heat transfer |
| **Module Learning Outcomes** | 1. Knowledge of scientific terms.<br>2. Knowledge of the most important concepts and theories in the field of renewable energy.<br>3. Knowledge of modern methods and techniques.<br>4. Know the main heat and the basic components in the process of heat transfer.<br>5. Knowledge of the most important principles in the design of heat transfer equipment and devices. |
| **Indicative Contents** | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 94 | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 81 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 175 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | **Introduction**<br>-General concepts and definitions, Heat conduction , Convective heat transfer, Thermal radiation |
| **Week 2** | **Conduction heat transfer (general equation)**<br>- General heat conduction equation<br>- One-dimensional, steady state, conduction through plane wall |
| **Week 3** | **Conduction heat transfer (1-D, steady State)**<br>-Composed wall<br>-Cylinder, composed cylinder |

| | |
|---|---|
| | - Sphere, composed sphere |
| **Week 4** | Hollow cylinder<br>- Sphere<br>- Critical thickness of insulation |
| **Week 5** | **Heat transfer through extended surfaces (fins)**<br>- General equation for temperature distribution<br>- Very long fin<br>- Short fin |
| **Week 6** | **2-D, Steady state heat conduction**<br>- Analytical solution with different boundary conditions<br>- Exact Solution with different boundary conditions |
| **Week 7** | MID EXAM |
| **Week 8** | **Convective heat transfer**<br>- Fluid flow background<br>- Laminar and turbulent flow<br>- Boundary layer growth for external flow and internal flow |
| **Week 9** | **Forced convection**<br>- Energy equation<br>- Thermal boundary layer and temperature distribution and heat transfer |
| **Week 10** | - Empirical equation for cross flow for cylinder, sphere and tube bank<br>- Empirical equation for turbulent flow |
| **Week 11** | **Natural convection**<br>- General concepts<br>- Krashof number |
| **Week 12** | **Thermal radiation**<br>- Introduction to thermal radiation<br>- The electromagnetic waves<br>- The black body<br>- The shape factor |
| **Week 13** | Thermal radiation between:<br>Two parallel plates (gray)<br>Two concentric cylinder |
| **Week 14** | Thermal radiation between more than two bodies |
| **Week 15** | Thermal resistance network<br>- Radiation shields |
| **Week 16** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | Searle's bar method |
| **Week 2** | Calibration of Thermocouple |
| **Week 3** | Volumetric expansion of liquid |
| **Week 4** | Latent Heat of fusion of Ice |
| **Week 5** | Double pipe heat exchanger |
| **Week 6** | Forced convection |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Heat Transfer, by J. P. Holman, 10th Edition, McGraw-Hill, 2010 | NOT FOUND |
| **Recommended Texts** | Heat Transfer: A Practical Approach by Y.A. Cengel, McGraw-Hill, 3rd Ed., 2007. | NOT FOUND |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION

# Of Meteorology

**University Name**: AlKarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Meteorology | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐**Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE36033 | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 125 | | | | |
| **Module Level** | 3 | | **Semester of Delivery** | 6 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Sura thamir nassir | | **e-mail** | Sura.thamir91@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | Msc | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | • Provide a solid foundation in the principles and concepts of meteorology and its relevance to climate and weather.<br>• Following up and keeping abreast of the development of climate elements and their devices.<br>• Study the basics of weather and climate elements and phenomena<br>• Harnessing technology to develop education and presenting lectures via computer |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. This course description provides a necessary summary of the most important characteristics of the course and the learning outcomes expected of the student to achieve, demonstrating whether he has made the most of the available learning opportunities. It must be linked to the program description.<br><br>2. Studying climate elements and recent trends in the study of weather and climate, relying on advanced scientific programs and techniques, as well as using PowerPoint and climatic and weather devices available in the department's laboratories. |
| **Indicative Contents**<br>المحتويات الإرشادية | 1. Preparing students to practice the teaching profession after graduation.<br>2. Preparing students to obtain extensive information about weather and climate elements.<br>3. Developing the students' personality, as they will complete their studies to become teachers.<br>4. Contributing to addressing the problems facing students and guiding them professionally. |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | 1. Teaching students how to teach this subject<br>2. Teaching students how to present the material using modern technologies such as data show.<br>3. Teaching students and developing their abilities to study different climatic conditions resulting from the different elements of weather and climate and their phenomena.<br>4. Teaching students the methods of measuring climatic and weather data and determining their accuracy.<br>5.Interest in studies that include the atmosphere and what happens in it.<br>6. Introducing students to weather and climate elements and their measurement devices.<br>7. Introduce students to weather and climate phenomena and their measurement devices.<br>8. Teaching students how to use climatic devices.<br>9. Develop students' ability to identify devices that can be used in the field.<br>10. Teaching students about modern global trends in the study of weather and climate. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 125 | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 125 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |

| | | | | | |
|---|---|---|---|---|---|
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| **Delivery Plan (Weekly Syllabus)**<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | The earth's atmosphere |
| **Week 2** | Warming the earth and the atmosphere |
| **Week 3** | Air temperature |
| **Week 4** | Humidity, condensation and clouds |
| **Week 5** | Cloud development and precipitation |
| **Week 6** | Air pressure and winds |
| **Week 7** | Atmospheric circulation |
| **Week 8** | Air Masses, Fronts, and Cyclones |
| **Week 9** | Weather forecasting |
| **Week 10** | Air pollution |
| **Week 11** | global climate |
| **Week 12** | Lights, colors, atmospheric optics |
| **Week 13** | Thunderstorms and tornados |
| **Week 14** | Hurricanes |
| **Week 15** | **Energy and Temperature** |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |

| | |
|---|---|
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | 1. Renewable and Sustainable Energy Reviews.<br>2. **Essential of meteorology, third edition** | yes |
| **Recommended Texts** | all modern climatic sources and foreign research in the field of weather and climate | |
| **Websites** | www.elsevier.com/locate/rser | |

## 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 |
| | | | | |

# MODULE DESCRIPTION OF PASSIVE SOLAR SYSTEMS

**University Name**: AlKarkh University of Sciences

**College:** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **passive solar systems** | | | **Module Delivery** | |
| **Module Type** | C | | | ☐ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE36031 | | | | |
| **ECTS Credits** | 6 | | | | |
| **SWL (hr/sem)** | 150 | | | | |
| **Module Level** | **3** | | **Semester of Delivery** | 6 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Mohammed Ali Hassan GHlem | | **e-mail** | Albeaty33@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecture doctor | | **Module Leader's Qualification** | Ph.D. | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 2023/06/20 | | **Version Number** | 1.0 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | 1. Learn about passive solar buildings.<br>2. Types of passive solar energy systems<br>3. Identify the characteristics of sunlight and solar radiation.<br>4. Passive solar heating and cooling techniques<br>5. Maximum use of available solar energy and heat storage<br>6. How to maintain indoor air quality in an airtight home<br>7. Identify Energy efficient<br>8. Ways to use green building materials in a naturally conditioned home |
| **Module Learning Outcomes** | A- Cognitive objectives (after teaching the course, the student will be able to)<br>1. Know and understand the basic concepts of passive solar systems.<br>2. Understand the properties of sunlight and solar radiation.<br>3. Know and understand the importance of green buildings.<br>4. Knowledge of green building design mechanisms.<br>5. Estimating load quantities for heating and cooling buildings.<br><br>B - The soft skills objectives of the course. (After teaching the vocabulary of the course, the student will be able to)<br>1. Knowledge of green building design mechanisms.<br>2. Estimating load quantities for heating and cooling buildings.<br>3. Know the design and efficiency limits of passive energy buildings. |
| **Indicative Contents** | Introduction to passive solar systems, Passive solar energy building<br>Solar radiations and irradiance, Properties of solar radiations, Utilization of Passive Solar Technology, Passive solar design, Passive solar system (direct gain), Passive solar system(indirect gain), Passive solar system (isolated gain), Cooling Load Estimation, Heating load estimation . |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | Developing the study material according to the time period for updating the academic programs in the college. |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 78 | | |
| **Unstructured SWL (h/sem)** | 72 | | |
| **Total SWL (h/sem)** | 150 | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 4 | 20% (20) | 2, 6, 10, 12 | |
| | **Assignments** | 2 | 5%(5) | 2, 12 | |
| | **Projects** | 1 | 10% (10) | Continuous | |
| | **Report** | 1 | 5% (5) | 13 | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 8 | |
| | **Final Exam** | 2hr | 50% (50) | 16 | |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

| | Material Covered |
|---|---|
| **Week 1** | **Introduction to passive solar systems** |
| **Week 2** | **Passive solar energy building** |
| **Week 3** | **Solar radiations and irradiance** |
| **Week 4** | **Properties of solar radiations** |
| **Week 5** | **Utilization of Passive Solar Technology** |
| **Week 6** | **Passive solar design** |

| | |
|---|---|
| **Week 7** | **Passive solar system(direct gain)** |
| **Week 8** | **Midterm exam** |
| **Week 9** | **Passive solar system(indirect gain)** |
| **Week 10** | **Passive solar system(isolated gain)** |
| **Week 11** | **Cooling Load Estimation (1)** |
| **Week 12** | **Cooling Load Estimation (2)** |
| **Week 13** | **Heating load estimation (1)** |
| **Week 14** | **Heating load estimation (2)** |
| **Week 15** | **Preparatory Week** |
| **Week 16** | **Preparatory week before the final Exam** |

| **Learning and Teaching Resources** | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | **An Introduction to Passive Solar Buildings, J. Paul Guyer, P.E., R.A., Guyer Partners. 2017** | yes |
| **Recommended Texts** | **Thermal Analysis and Design of Passive Solar Buildings, A. K. Athienitis, Routledge. 2013** | Yes |
| **Websites** | | |

**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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# PHOTOCHEMISTRY

**University Name**: AlKarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| **Module Information**<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Photochemistry | | | **Module Delivery** | |
| **Module Type** | **E** | | | ☐**Theory**<br>☐**Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE36036 E1 | | | | |
| **ECTS Credits** | 3 | | | | |
| **SWL (hr/sem)** | 75 | | | | |
| **Module Level** | **3** | | **Semester of Delivery** | **6** | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Al-Hamzah Dheyaa Hameed | | **e-mail** | Alhamza.dheyaa@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | ● Provide a solid foundation in the principles and concepts of photochemistry and its relevance to energy conversion and storage.<br>● Introduce students to the fundamental processes and mechanisms involved in photochemical reactions and energy transfer.<br>● Develop an understanding of the role of photochemistry in various energy systems, such as solar energy conversion, photocatalysis, and photovoltaics.<br>● Familiarize students with the experimental techniques and instrumentation used in studying and characterizing photochemical processes.<br>● Foster critical thinking and problem-solving skills to analyze and optimize photochemical energy systems.<br>● Explore emerging trends and advancements in photochemistry for energy applications.<br>● Promote awareness of the environmental and sustainability aspects of photochemical processes in energy production.<br>● Cultivate skills in data analysis, interpretation, and effective communication of photochemical concepts and findings.<br>● Encourage interdisciplinary thinking by integrating photochemistry with other energy-related disciplines.<br>● Nurture a passion for continuous learning and research in the field of photochemistry and its applications in energy. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Knowledge and Understanding:<br>● Demonstrate a comprehensive understanding of the principles and concepts of photochemistry in the context of energy conversion and storage.<br>● Explain the fundamental processes and mechanisms involved in photochemical reactions and energy transfer.<br>● Understand the role of photochemistry in various energy systems, such as solar energy conversion, photocatalysis, and photovoltaics.<br>2. Application and Analysis:<br>● Apply photochemical principles and concepts to analyze and solve complex problems in energy systems.<br>● Evaluate the efficiency and performance of photochemical energy conversion processes.<br>● Analyze and interpret experimental data related to photochemical reactions and energy transfer.<br>3. Design and Optimization: |

| | |
|---|---|
| | ● Apply critical thinking and problem-solving skills to design and optimize photochemical energy systems.<br>● Develop strategies to improve the efficiency and performance of photochemical processes.<br>● Evaluate and optimize the parameters and conditions that affect photochemical reactions in energy systems.<br>4. Environmental and Sustainability Awareness:<br>● Recognize the environmental impact of photochemical processes and their implications for sustainable energy production.<br>● Identify strategies for minimizing waste and enhancing the sustainability of photochemical energy systems.<br>● Consider the ethical implications of utilizing photochemical processes in energy production.<br>5. Professional Development and Lifelong Learning:<br>● Demonstrate an awareness of emerging trends, technologies, and advancements in photochemistry for energy applications.<br>● Recognize the importance of continuous learning and staying updated with the latest developments in photochemical energy systems.<br>● Develop skills in research, critical thinking, and self-directed learning to enhance career readiness and adaptability in the energy sector. |
| **Indicative Contents**<br>المحتويات الإرشادية | **1. Introduction to Photochemistry:**<br>**2. Absorption and Emission of Light:**<br>**3. Photochemical Reactions:**<br>**4. Energy Conversion in Photochemical Systems:**<br>**5. Photocatalysis and Energy Applications:**<br>**6. Photothermal Energy Conversion:**<br>**7. Advanced Materials for Photochemistry:**<br>**8. Thermodynamics and Kinetics in Photochemical Processes:**<br>**9. Experimental Techniques in Photochemistry:**<br>**10. Energy Efficiency and Sustainability in Photochemical Systems:**<br>**11. Emerging Trends in Photochemistry and Energy Systems:** |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | **Active Learning:** Incorporate active learning techniques such as group discussions, problem-solving exercises, case studies, and hands-on experiments. Encourage students to actively participate in class and engage with the course material through interactive activities**.**<br><br>**Real-World Applications:** Relate photochemistry concepts to real-world energy applications and industry examples. Show how photochemical reactions play a role in solar energy conversion, photocatalysis, photovoltaics, and other energy |

| | |
|---|---|
| | technologies. Connect the theoretical concepts to their practical significance and impact.<br><br>**Multidisciplinary Approach:** Emphasize the interdisciplinary nature of photochemistry by integrating concepts from chemistry, physics, materials science, and engineering. Highlight the collaborative nature of research and development in energy systems involving photochemical processes.<br><br>**Technology-Enhanced Learning:** Utilize technology tools and resources to enhance learning experiences. Incorporate multimedia presentations, simulations, virtual labs, and online resources to provide interactive and engaging learning opportunities for students.<br><br>**Research Projects and Case Studies**: Assign research projects or case studies that require students to explore current research literature, analyze experimental data, and propose innovative solutions related to photochemistry in energy systems. This allows students to develop critical thinking, problem-solving, and research skills.<br><br>**Continuous Assessment:** Implement regular assessments such as quizzes, assignments, and presentations to monitor student progress and reinforce learning. Provide constructive feedback to students to help them improve their understanding and application of photochemistry concepts.<br><br>**Discussion and Debate:** Encourage open discussions and debates on controversial topics or emerging trends in photochemistry and energy systems. This promotes critical thinking, fosters creativity, and allows students to explore different perspectives. |

| **Student Workload (SWL)**<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/w)** | 3.5 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 27 | **Unstructured SWL (h/w)** | 2 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 75 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | **Introduction to Photochemistry:**<br>Basic principles of photochemistry and its relevance to energy systems<br>Interaction of light with matter and energy transfer processes<br>Photochemical reactions and their significance in energy conversion |
| **Week 2** | **Photophysical Processes:**<br>Absorption and emission of light by molecules<br>Fluorescence and phosphorescence phenomena<br>Quantum yields and fluorescence lifetimes |
| **Week 3** | **Photochemical Reactions:**<br>Primary photochemical processes (excitation, electron transfer, energy transfer)<br>Secondary photochemical processes (radical reactions, isomerization, rearrangements)<br>Photodegradation and photochemical stability of materials |
| **Week 4** | **Principles of Solar Energy Conversion:**<br>Solar energy as a renewable energy source<br>Overview of photovoltaic and solar thermal systems<br>Role of photochemistry in solar energy conversion |
| **Week 5** | **Photovoltaic Devices:** |

| | |
|---|---|
| | Working principles of solar cells<br>Types of photovoltaic materials (organic, inorganic, hybrid)<br>Design considerations and efficiency enhancement strategies |
| **Week 6** | **Photoelectrochemical Systems:**<br>Introduction to photoelectrochemistry<br>Photoelectrochemical water splitting for hydrogen production<br>Photocatalytic systems for energy storage and conversion |
| **Week 7** | **Photocatalysis and Energy Applications:**<br>Principles of photocatalysis and its applications in energy conversion<br>Photocatalytic degradation of pollutants and wastewater treatment<br>Photocatalytic synthesis of fuels and chemicals |
| **Week 8** | **Photothermal Energy Conversion:**<br>Principles of photothermal energy conversion<br>Light-induced heat transfer and thermal energy storage<br>Photothermal materials and applications in energy systems |
| **Week 9** | **Advanced Materials for Photochemistry:**<br>Emerging materials for efficient light absorption and energy conversion<br>Nanomaterials and nanostructures for enhanced photochemical processes<br>Photonic structures and photonic crystals for energy applications |
| **Week 10** | **Thermodynamics and Kinetics in Photochemical Processes:**<br>Thermodynamic aspects of photochemical reactions and energy transfer<br>Kinetics of photochemical reactions and reaction mechanisms<br>Energy diagrams and free energy changes in photochemical systems |
| **Week 11** | **Experimental Techniques in Photochemistry:**<br>Measurement and characterization of photochemical reactions<br>Spectroscopic techniques (UV-Vis spectroscopy, fluorescence spectroscopy)<br>Photochemical reactor design and operation |
| **Week 12** | **Energy Efficiency and Sustainability in Photochemical Systems:**<br>Energy efficiency considerations in photochemical processes<br>Environmental and sustainability aspects of photochemical reactions<br>Design principles for improving energy utilization and minimizing waste |

| | |
|---|---|
| **Week 13** | **Emerging Trends in Photochemistry and Energy Systems:**<br>Advanced concepts and technologies in photochemistry for energy conversion<br>Integration of photochemistry with other energy conversion technologies<br>Future prospects and challenges in photochemical energy systems |
| **Week 14** | **Preparatory week before the final Exam** |

## Learning and Teaching Resources

مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | "Principles of Solar Cells, LEDs and Diodes: The Role of the PN Junction" by Adrian Kitai<br>"Photochemistry and Photophysics: Concepts, Research, Applications" by Virender K. Sharma<br>"Photovoltaics: Fundamentals, Technology and Practice" by Konrad Mertens<br>"Photoelectrochemical Water Splitting: Materials, Processes and Architectures" edited by Hans-Joachim Lewerenz, Laurie Peter, Ferdi Schüth<br>"Photocatalysis: Fundamentals and Perspectives" edited by Jenny Schneider, Detlef Bahnemann | No |
| **Recommended Texts** | "Photocatalytic Production of Energy-Rich Compounds" edited by Xinchen Wang, Can Li | No |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF STATICS

**University Name**: ALkarkh University of Science

**College** Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Statistic | | | **Module Delivery** | |
| **Module Type** | C | | | ☐ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | REE36035 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | | 3 | **Semester of Delivery** | | 6 |
| **Administering Department code** | | REE | **College code** | | CRE |
| **Module Leader** | Dr. Thamer Khalil Mohammed | | **e-mail** | | Thamer.197675@kus.edu.iq |
| **Module Leader's Acad. Title** | | Asst. prof. | **Module Leader's Qualification** | | PhD. |
| **Module Tutor** | None | | **e-mail** | | none |
| **Peer Reviewer Name** | | None | **e-mail** | | none |
| **Scientific Committee Approval Date** | | 20/6/2023 | **Version Number** | | No. 1 |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | -1وصف اساسيات الاحصاء<br>-2معرفة وتطبيق قوانين الاحصاء<br>-3فهم طرق الحل المتعددة<br>-4فهم الطلبة وزيادة وعيهم حول امكانية حل الجداول بانواعها<br>-5معرفة اهم الاسس العملية والنظرية لحل قوانين الاحصاء<br>-6التعرف على ان حل الجداول الاحصائية هي اهم احدى الطرق الرئيسية لحل معظم المسائل الرياضية |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | أ- الأهداف المعرفية (بعد تدريس المقرريكون الطالب قادر على )<br>أ1- يعرف الاحصاء بأنواعه<br>أ2- يعرف اهم انواعها<br>أ3- ان يكون قادر على حل جميع المشاكل الاحصائية<br>أ4- قادر على حل القيم بانواعة<br>أ5- يذكر اشكال وانواع الرسومات والبيانات<br>أ6- قادر على تحديد البياناتت المبوبة وغير المبوبة |
| **Indicative Contents**<br>المحتويات الإرشادية | ب - الأهداف المهاراتية الخاصة بالمقرر. (بعد تدريس مفردات المقرريكون الطالب قادر على )<br>ب1 – يفحص ويحلل ويختار نوع الحل<br>ب2 - يجري حل سريع شفهي لمعرفة الطريقة المناسبة<br>ب3 – ايجاد العدد من الطرق لحل مسئلة واحدة<br>ب4- احصاء اهم انواع الطرق التي تساعد الطالب في الحل |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | -الالقاء<br>2- المناقشة<br>3- تجارب العرض<br>4- التجارب الفردية<br>5- البحوث والتقارير |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | | |
| **Unstructured USWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 2 | |
| | **Assignments** | 2 | 10% (10) | 2 | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | 2 | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction of statistic |
| **Week 2** | [definitions, descriptive, inferential] |
| **Week 3** | Date [tables, diagram] |
| **Week 4** | Measure of central [tendency] |
| **Week 5** | Measure of central [Mean] |
| **Week 6** | Measure of central [Median] |
| **Week 7** | **Exam** |
| **Week 8** | Measure of central [Harmonic Mean] |
| **Week 9** | Measure of Dispersion [absolute deviation] |
| **Week 10** | The semi-interquartile |
| **Week 11** | [rang deviation] |
| **Week 12** | The semi-interquartile |
| **Week 13** | The semi-interquartile [ standard deviation] |
| **Week 14** | The semi-interquartile [ variance ] |
| **Week 15** | **Exam** |
| **Week 16** | **Preparatory week before the final Exam** |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | David M. Lane, et al. Introduction to statistic | |
| **Recommended Texts** | Introduction to mathematical statistic, Robert V.hogg , Allen T.Graig,1970 | |
| **Websites** | مبادئ الاحصاء الرياضي - امير حنا | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF

# SUSTAINABLE ENERGY UTILIZATION

**University Name**: AlKarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Sustainable Energy Utilization** | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☐ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE36036 E3** | | | | |
| **ECTS Credits** | **3** | | | | |
| **SWL (hr/sem)** | **75** | | | | |
| **Module Level** | | 3 | **Semester of Delivery** | | 2 |
| **Administering Department** | | REE | **College** | CRE | |
| **Module Leader** | Rafa Abbas Hasan | | **e-mail** | Albaldawirafa@kus.edu.iq | |
| **Module Leader's Acad. Title** | | Asst. Prof. | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | | NONE | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | | 20/6/2023 | **Version Number** | | 1 |

## Relation with other Modules

| | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | No |
| **Co-requisites module** | None | **Semester** | No |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | The course gives a broad description of different energy systems and deepened knowledge in some energy technology questions of importance, of current interest and related to research and development within the area. The course will give an understanding for and practical application of theories and models for analysis and planning of sustainable energy systems as well as development of the individual ability of the student in: written presentations, search for information, critical review of information, literature and other material. |
| **Module Learning Outcomes** | After completion of the course the student shall be able to:<br>- apply theories and models to solve energy engineering problems<br>- independently analyse and evaluate different heat to power conversion cycles from performance, economic and environmental point of view<br>- independently design, analyse and evaluate energy systems based on renewable energy with focus on solar energy and bioenergy<br>- independently and critically analyse performance and operation problems in real energy conversion processes<br>- independently and critically analyse and evaluate energy distribution systems<br>- integrate knowledge and handle complex information<br>- discuss and consider scientific, society and ethical aspects related to energy systems |
| Indicative Contents | The course consist mainly of individual analysis and calculation assignments within sustainable energy systems such as thermal engineering, power systems, solar cells and solar collectors, biofuels, transmission/distribution and more. |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | 1- Speaking 2- Discussion 3- Reports 4- Projects 5- Assignments |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 48 | **Structured SWL (h/w)** | 3 |
| **Unstructured SWL (h/sem)** | 27 | **Unstructured SWL (h/w)** | 1.8 |
| **Total SWL (h/sem)** | 75 | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| Formative assessment | Quizzes | 2 | 10% (10) | 5,10 | |
| | Assignments | 2 | 10% (10) | 2,12 | |
| | Projects / Lab. | 1 | 10% (10) | - | |
| | Report | 1 | 10% (10) | 13 | |
| Summative assessment | Midterm Exam | 2 hr | 10% (10) | 7 | |
| | Final Exam | 2hr | 50% (50) | 16 | |
| Total assessment | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

| | Material Covered |
|---|---|
| Week 1 | Historical energy transitions; definition of sustainable energy; |
| Week 2 | Introduction to energy systems; |
| Week 3 | The outlook for global energy demand under existing policies; energy balances |
| Week 4 | Climate change – science, impact and mitigation; |
| Week 5 | sources of GHG emissions; global and per-capita carbon budgets |
| Week 6 | Sustainable Development Goals and the role of energy; |
| Week 7 | energy access, poverty and affordability |
| Week 8 | Air pollution and energy links |
| Week 9 | Energy security |
| Week 10 | IEA Sustainable Development Scenario |
| Week 11 | Systems analysis of sustainability |
| Week 12 | sustainability indicators |
| Week 13 | Market development and prospects for renewable electricity, |
| Week 14 | Energy Efficiency – market and behavioural barriers to change – energy innovation |
| Week 15 | Policy instruments – carbon tax, mandates and standards. Global agreements and targets |
| Week 16 | Preparatory week before the final Exam |

| Delivery Plan (Weekly Lab. Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | / |
| **Week 2** | / |
| **Week 3** | / |
| **Week 4** | / |
| **Week 5** | / |
| **Week 6** | / |
| **Week 7** | / |

| Learning and Teaching Resources | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | 1- Bisio, Attilio, and Sharon Boots. Wiley Encyclopedia of Energy Technology and the Environment. Wiley-Interscience, 1996. ISBN: 9780471148272.<br>2- Twidell, John, and Tony Weir. Renewable Energy Resources. Taylor and Francis, 2005. ISBN: 9780419253303. | |
| **Recommended Texts** | Randolph, John, and Gilbert M. Masters. *Energy for Sustainability: Technology, Planning, Policy*. Island Press, 2008. ISBN: 9781597261036. | |
| **Websites** | McKay, David J. C. *Sustainable Energy – Without the Hot Air.* UIT Cambridge, Ltd., 2009. ISBN: 9780954452933.<br><br>Deutch, John, Ernest Moniz, et al. *The Future of Nuclear Power*. Massachusetts Institute of Technology, 2009.<br><br>Tester, Jefferson W., et al. "*The Future of Geothermal Energy: Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st Century*." (PDF - 22.6MB) Massachusetts Institute of Technology, 2006. | |

# Module Description of Waste Recycling for Saving and Production Energy

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Waste Recycling for Saving and Production Energy** | | | **Module Delivery** | |
| **Module Type** | **E** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE36036 E2** | | | | |
| **ECTS Credits** | **3** | | | | |
| **SWL (hr/sem)** | **75** | | | | |
| **Module Level** | **3** | | **Semester of Delivery** | **6** | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Hasan Mohammed Luaibi | | **e-mail** | hasan.luaibi@kus.edu.iq | |
| **Module Leader's Acad. Title** | Assistant Professor | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | None | | **e-mail** | E-mail | |
| **Peer Reviewer Name** | None | | **e-mail** | E-mail | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Objectives**<br>أهداف المادة الدراسية | The main objectives of Waste Recycling for Saving and Production Energy module that covers the basics of Waste Recycling and how do we harness it to saving and production the energy (classical and renewable) , which include:<br><br>1. Understanding the students about the introducing to the concept of waste recycling and its great importance in the specialization of our college and department, and its relationship to saving energy and reducing its cost on the one hand, and its connection to the daily life of society on the other hand.<br>2. Understanding and mention the students about the types of waste, whether solid, liquid or gaseous, and the most important sources are natural or industrial, or resulting from the daily life of society on the one hand, and methods and methods of recycling or disposal, theoretically and practically, which are commensurate with the student's academic level, and also commensurate with the objectives of the cognitive department to which the student belongs.<br>3. Understanding and mention the methods of modern waste recycling for all types of waste and their symbols.<br>4. Understanding the students how to benefit from recycling waste to save the energy.<br>5. Understanding the students how to benefit from recycling waste to production the classical energy.<br>6. Understanding the students how to benefit from recycling waste to production the renewable energy.<br>7. Understanding and mention Modern methods for the disposal of waste that is not fully utilized. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | The students will be able to:<br><br>1. How can distinguishes between the types of waste, whether solid, liquid or gaseous, and the most important sources are natural or industrial.<br>2. How can applied to the methods of modern waste recycling for all types of waste.<br>3. How can reading the symbols of the recycling wastes.<br>4. Calculate the energy quantity that can be saved from recycling waste.<br>5. Calculate the energy quantity that can be production from recycling waste.<br>6. How can identify recyclable and non-recyclable waste.<br>7. How to determine the waste that disposal (landfill or burning). |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br><br>**Theory:**<br>- Introducing to the concept of waste recycling. [3 hrs.].<br>- The types of waste recycling [3 hrs.].<br>- The methods of modern waste recycling for all types of waste and their symbols. [6hrs]<br>- The benefits from recycling waste to save the energy. [9 hrs.]<br>- The benefits from recycling waste to production the classical energy. [9hrs.]<br>- The benefits from recycling waste to production the renewable energy. [12 hrs.]<br>- The modern methods for the disposal of waste. [3 hrs.] |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | **1. Lectures:** used to introduce and explain the concepts of waste recycling and its great importance in the specialization of our college and department, and its relationship to saving energy and reducing its cost on the one hand, and its connection to the daily life of society on the other hand, benefit from recycling waste to save and production the classical and renewable energy and the disposal from the waste.<br>**2. Interactive discussions:** used to engage students in critical thinking and problem-solving questions related to methods of waste recycling in iraq through group discussions, debates, case studies, and simulations.<br>**3. Multimedia resources:** used to enhance student engagement and understanding of complex concepts related to the types of waste recycling through videos, and animations**.**<br>**4. Assessment and feedback:** used to measure student learning and provide feedback on their progress through quizzes, exams, and projects. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 3 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 27 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 1.8 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **75** | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5 and 10 | LO #1, #2 and #3, #6 |
| | **Assignments** | 2 | 10% (10) | 2 and 12 | LO #3, #4 and #5, #7 |
| | **Discussions** | 1 | 10% (10) | Continuous | All |
| | **Report** | 1 | 10% (10) | 13 | LO #2, #3 and #5 |
| **Summative assessment** | **Midterm Exam** | 1hr | 10% (10) | 7 | LO #1 - #5 |
| | **Final Exam** | 3hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

| | Material Covered |
|---|---|
| **Week 1** | Introducing to the concept of waste recycling. |
| **Week 2** | The types of waste recycling. |
| **Week 3** | The methods of modern waste recycling for all types of waste and their symbols. |
| **Week 4** | The methods of modern waste recycling for all types of waste and their symbols. |
| **Week 5** | The benefits from recycling waste to save the energy. |
| **Week 6** | The benefits from recycling waste to save the energy. |
| **Week 7** | The benefits from recycling waste to save the energy. |
| **Week 8** | Med term exam + The benefits from recycling waste to production the energy. |
| **Week 9** | The benefits from recycling waste to production the energy. |
| **Week 10** | The benefits from recycling waste to production the energy. |
| **Week 11** | The benefits from recycling waste to production the renewable energy. |
| **Week 12** | The benefits from recycling waste to production the renewable energy. |
| **Week 13** | The benefits from recycling waste to production the renewable energy. |
| **Week 14** | The benefits from recycling waste to production the renewable energy. |
| **Week 15** | The modern methods for the disposal of waste. |
| **Week 16** | **Final Exam** |

## Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

| | Material Covered |
|---|---|
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | 1) The Energy and Resources Institute, 2014, Waste to Resources: A Waste Management Handbook.<br>2) RECYCLING AND REUSE OF MATERIALS AND THEIR PRODUCTS, 2012, BOOK. | No |
| **Recommended Texts** | 1) Recycling and reuse of materials and their products, 2013, book.<br>2) Daniel Hoornweg and Perinaz Bhada-Tata , March 2012, No. 15, WHAT A WASTE A Global Review of Solid Waste Management, Urban Development Series Knowledge Paper, World Bank | No |
| **Websites** | Taken from http://www.epa.gov/epaoswer/non-hw/muncpl/reduce.htm. | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# ENERGY EFFICIENCY

**University Name**: ALkarkh University of Science

**College:** Energy and Environmental Sciences

**Department:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Energy Efficiency | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☒ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE47040 | | | | |
| **ECTS Credits** | 6 | | | | |
| **SWL (hr/sem)** | 150 | | | | |
| **Module Level** | 4 | | **Semester of Delivery** | 7 | |
| **Administering Department Code** | REE | | **College Code** | CRE | |
| **Module Leader** | Mohammad Al Dharob | | **e-mail** | Dr.m.aldharob@kus.edu.iq | |
| **Module Leader's Acad. Title** | lecture | | **Module Leader's Qualification** | PH.D | |
| **Module Tutor** | | | **e-mail** | | |
| **Peer Reviewer Name** | | | **e-mail** | | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | NONE | **Semester** | |
| **Co-requisites module** | NONE | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Study the efficiency of the electrical stations<br>2. Study the efficiency of renewable energy systems.<br>3. Calculation of energy efficiency |

| | |
|---|---|
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Evaluate the efficiency for normal and sustainable energy systems.<br>2. Compare between the efficiency of types of renewable energy<br>3. determine the parameters that effect of the efficiency of energy |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students. |

| **Student Workload (SWL)**<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 78 | **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الاسبوع | 5 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 72 | **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الاسبوع | 4.8 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 150 | | |

| **Module Evaluation**<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction: Energy efficiency |
| **Week 2** | Efficiency of fuel stations |
| **Week 3** | Efficiency of gas stations |
| **Week 4** | Efficiency of renewable energy stations |
| **Week 5** | Calculations of efficiency in stations |
| **Week 6** | Calculations of efficiency in distributions line |
| **Week 7** | Mid exam |
| **Week 8** | Calculations of efficiency in storge system |
| **Week 9** | energy efficiency policies |
| **Week 10** | Conditions effects on the energy efficiency |
| **Week 11** | |
| **Week 12** | Solar panel efficiency and solar thermal collector efficiency |
| **Week 13** | |
| **Week 14** | Solving mathematical problems related to dams |
| **Week 15** | |
| **Week 16** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | لا يوجد |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | Kreith, F. and Goswami, D.Y., Handbook of Energy Efficiency and Renewable Energy, | Not found |
| **Recommended Texts** | | Not found |
| **Websites** | | |

## 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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# ENERGY MANAGEMENT

**University Name**: ALkarkh University of Science

**College:** Energy and Environmental Sciences

**Department:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Energy management | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☒ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☒ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE47039 | | | | |
| **ECTS Credits** | 7 | | | | |
| **SWL (hr/sem)** | 175 | | | | |
| **Module Level** | | 4 | **Semester of Delivery** | | 7 |
| **Administering Department Code** | | REE | **College Code** | CRE | |
| **Module Leader** | Mohammad Al Dharob | | **e-mail** | Dr.m.aldharob@kus.edu.iq | |
| **Module Leader's Acad. Title** | | lecture | **Module Leader's Qualification** | | PH.D |
| **Module Tutor** | | | **e-mail** | | |
| **Peer Reviewer Name** | | | **e-mail** | | |
| **Scientific Committee Approval Date** | | 20/6/2023 | **Version Number** | | 1 |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | | **Semester** | |
| **Co-requisites module** | | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Understand the energy management process.<br>2. Understand the methods of energy management.<br>3. Understand the parameters of energy management. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Evaluate the cost efficiency for sustainable energy systems by applying appropriate economic methods.<br>2. understand how economic tools relate to practical aspects of energy economics and management<br>3. have acquired a clear understanding of the role of energy in the global economic system |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 78 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 5 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 97 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 6.5 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 175 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |

| | | | |
|---|---|---|---|
| **Total assessment** | 100% (100 Marks) | | |

Optimum performance of existing facilities **Delivery Plan (Weekly Syllabus)**

المنهاج الاسبوعي النظري

| | **Material Covered** |
|---|---|
| **Week 1** | Introduction: Energy and Energy Markets |
| **Week 2** | Energy resources, Energy conversion processes and devices – Energy conversion plants – Conventional - Thermal, Hydro, Nuclear fission , and Non – conventional – Solar, Wind Biomass, Fuel cells, Magneto Hydrodynamics and Nuclear fusion. Energy from waste, Energy plantation. |
| **Week 3** | Energy storage and Distribution ,. |
| **Week 4** | Energy conversion plants for Base load , Intermediate load, Peak load |
| **Week 5** | Energy Management program |
| **Week 6** | Principles, technologies of Energy conservation |
| **Week 7** | Mid exam |
| **Week 8** | power generation |
| **Week 9** | Energy strategies and energy planning |
| **Week 10** | Impact of Energy on economy, development and environment, Energy policies |
| **Week 11** | |
| **Week 12** | Energy strategy for future |
| **Week 13** | |
| **Week 14** | Solving mathematical problems related to dams |
| **Week 15** | |
| **Week 16** | **Preparatory week before the final Exam** |

**Delivery Plan (Weekly Lab. Syllabus)**

المنهاج الاسبوعي للمختبر

| | **Material Covered** |
|---|---|
| **Week 1** | لا يوجد |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Amlan Chakrabarti, Energy Engineering and Management, Prentice Hall India, 2011.<br>2. Eastop T. D. and D. R. Croft, Energy Efficiency for Engineers & Technologists, Longman, 1990.<br>3. Albert Thumann P. E. and W. J. Younger, Handbook of Energy Audits, Fairmont Press, 2008.<br>4. Doty S. and W. C. Turner, Energy Management Hand book, 7/e, Fairmont Press, 2009.<br>5. Rao S. and B. B. Parulekar, Energy Technology, Khanna Publishers, 2005. 6. Rai G. D., Non-conventional Energy Sources, Khanna Publishers, 2011. | Not found |
| **Recommended Texts** | | Not found |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF FUEL AND HYDROGEN CELLS

**University Name**: AlKarkh University of Science

**College:** Energy and Environmental Sciences

**Department:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Fuel and hydrogen cells | | | **Module Delivery** | |
| **Module Type** | **E 1** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE47042 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | 4 | | **Semester of Delivery** | 7 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Marwah Mohammed Jasim | | **e-mail** | Marwah.mohammed@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | N.A | | **e-mail** | N.A | |
| **Peer Reviewer Name** | | | **e-mail** | | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | ____ |
| **Co-requisites module** | None | **Semester** | ____ |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | 1. This course provides fundamental understanding of performance characteristics of fuel cell systems and their components.<br>2. It also outlines the design characteristics and operating issues for various fuel cells. Additionally, it discusses the design philosophy and challenges to make this system feasible.<br>3. To study various methods for production of hydrogen.<br>4. To study about safety, environmental impacts and economics of transition to hydrogen system.<br>5. To study principle, working, thermodynamics and kinetics of fuel cell process<br>6. To address the underlying concepts, methods and application of fuel cell technology.<br>7.The design and analysis emphasis will be mostly on the thermodynamics and electrochemistry.<br>8. To study about different parameters affecting the performance of fuel cell.<br>9. To study various applications and economics of fuel cell. |

| | |
|---|---|
| | 10. Fuel Cell Development Trends and Future Prospects. |
| **Module Learning Outcomes** | 1. Objective: To impart knowledge on the fuel cell technology.<br>2. Objective: To understand the Fuel cell reaction kinetics<br>3. To learn the process of hydrogen production for fuel cell operation and its related components.<br>4. The student can identify different areas of fuel cell technology.<br>5. Apply know-how of thermodynamics, electrochemistry, heat transfer, and fluid mechanics principles to design and analysis of this emerging technology.<br>6. Have thorough understanding of performance behavior, operational issues and challenges for major types of fuel cells.<br>7. Identify, formulate, and solve problems related to fuel cell technology keeping in mind economic viability and sustainability.<br>8. Use the techniques, skills, and modern engineering tools necessary for design and analysis of innovative fuel cell systems.<br>9. Understand the impact of this technology in a global and societal context.<br>10. Develop enough skills to design systems or components of fuel cells.<br>11. Can find the applications of all the areas in day to day life. |
| **Indicative Contents** | **FUEL CELLS** includes concept, key components, physical and chemical phenomena in fuel cells, advantages and disadvantages, different types of fuel cells and applications, characteristics, Nernst equation, relation of the fuel consumption versus current output.<br>**HYDROGEN ENERGY** contain introduction to hydrogen economy, production, storage and transportation systems, hydrogen from fossil fuels, electrolysis of water, thermo chemical cycles, transmission and infrastructure requirements, safety and environmental impacts, economics of transition to hydrogen systems.<br>**FUEL CELL DESIGN AND PERFORMANCE:** Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell.<br>**FUEL CELLS -APPLICATION AND ECONOMICS :** encompasses Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells. |

| **Learning and Teaching Strategies** | |
|---|---|
| **Strategies** | 1. Establish Learning Objectives: Clearly define the learning objectives aligned with the program goals and industry requirements; Identify the specific knowledge, skills, and competencies students should acquire by the end of the course.<br>2. Using the Internet to Enhance Students' Reading, Writing, and Information-Gathering Skills.<br>3. Encourage initiative: Allow students to actively participate in the learning process with class discussions and exercises that support the initiative.<br>4. Plan the Curriculum: Development a well-structured curriculum with a logical flow of topics, starting from fundamental concepts to more advanced applications.<br>5.Utilize Technology: Utilizing educational technology tools, such as interactive simulations and modeling software.<br>6. Engage Students Actively: Encouragement active learning by incorporating interactive activities, discussions, and problem-solving exercises. |

## Student Workload (SWL)

| | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الاسبوع | 3 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الاسبوع | 3.5 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 3 | 10% (10) | 4,7,11 | LO # 1,2,5,10 |
| | **Assignments** | 4 | 10% (10) | 2, 5,7,12 | LO # 4,6,9 |
| | **Projects / Lab.** | N.A | N.A | N.A | |
| | **Report** | 1 | 10% (10) | 12 | LO # 3,7,8,11 |
| **Summative assessment** | **Midterm Exam** | 2hr | 10% (10) | 8 | LO # 1-7 |
| | **Final Exam** | 2hr | 60% (60) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

| | Material Covered |
|---|---|
| **Week 1** | **1. Introduction to Fuel Cell** |
| **Week 2** | **2. fuel cell operation** |
| **Week 3** | **3. Electrochemistry of fuel cells (Electro catalysts in fuel cell)** |
| **Week 4** | **4. Fuel Cell Thermodynamics** |
| **Week 5** | **5. Fuel Cells – Green Power** |
| **Week 6** | **6. hydrogen safety** |
| **Week 7** | **7. Hydrogen Property and Production.** |
| **Week 8** | **8 review and midterm exam + Fuel cell efficiency** |
| **Week 9** | **9. hydrogen comparison to conventional fuels** |
| **Week 10** | **10 Hydrogen Distribution** |
| **Week 11** | **11 Hydrogen Storage** |
| **Week 12** | **12. Hydrogen Conversion Technology : (I) Combustion and (II) Metal Hydrides and applications** |
| **Week 13** | **13. fuel cell types** |
| **Week 14** | **14. Fuel Cells as future of clean mobility: Market expectations and challenges** |
| **Week 15** | **15 fuel cell applications** |

| Week 16 | Preparatory week before the final Exam |
|---|---|

## Learning and Teaching Resources

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | **Fuel Cell Fundamentals; 2016; by Ryan O'Hayre , Suk-Won Cha , Whitney Colella, Fritz B. Prinz; Publisher: Wiley.** | NO |
| **Recommended Texts** | **Fuel Cells: Principles, Design, and Analysis; 2014; by Shripad T. Revankar (Author), Pradip Majumdar; Publisher: CRC Press.** | NO |
| **Websites** | **https://www.twi-global.com/technical-knowledge/faqs/what-is-a-hydrogen-fuel-cell** | |

## 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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF HYBRID ENERGY

**University Name**: AlKarkh University of Science

**College** Energy and Environmental Sciences

**Department:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Hybrid Energy** | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☒ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE47037** | | | | |
| **ECTS Credits** | 6 | | | | |
| **SWL (hr/sem)** | 150 | | | | |
| **Module Level** | | 4 | **Semester of Delivery** | | 7 |
| **Administering Department code** | | REE | **College code** | | CRE |
| **Module Leader** | Firas Abdulrazzaq Hadi | | **e-mail** | | Firas.A.Hadi@kus.edu.iq |
| **Module Leader's Acad. Title** | | Asst. Prof. | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | Firas Abdulrazzaq Hadi | | **e-mail** | | Firas.A.Hadi@kus.edu.iq |
| **Peer Reviewer Name** | | | **e-mail** | | |
| **Scientific Committee Approval Date** | | 20/6/2023 | **Version Number** | | 1 |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | No | **Semester** | No |
| **Co-requisites module** | No | **Semester** | No |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | Energy services are critical for health, livelihoods, and enabling productive activities. However, more than a billion people around the world in rural areas and urban slums do not have access to modern energy. Hybrid renewable energy systems can deliver these energy services in a sustainable and cost-effectively way, but there are several challenges related to their design, and the integration of high penetration of renewables. During this course students will develop the skills and knowledge required for designing, sizing, and specifying hybrid renewable energy systems, and to develop control strategies to optimise their operation, with an emphasis on delivering designs based on understanding context, appropriate design and technology selection, implementation of models, and capacity building for sustainable projects.<br>This course uses project-based learning to develop skills and knowledge for designing and specifying hybrid renewable energy projects, by working with a real target community and local partners. In this opportunity, the activities of the course will be focus on islands in the south pacific, and the development of projects for delivering energy services to the local community. |
| **Module Learning Outcomes** | 1. Understand the technical characteristics of components in hybrid renewable energy systems, including loads, storage, and generation technologies.<br>2. Interpret a brief, present proposals for feedback and assessment in a range of written, oral, and visual formats individually and as part of a team.<br>3. Compare and prioritise energy access options according to the local context and energy service requirements.<br>4. Design, size and specify hybrid renewable energy systems using first principles and advanced simulations tools.<br>5. Optimise a hybrid renewable energy system and its control strategy using appropriate dispatchability principles and techno-economic analysis |
| **Indicative Contents** | Hybrid Energy Systems – Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind Biomass-Diesel, Micro-Hydel-PV– Classification of Hybrid Energy systems - Importance of Hybrid Energy systems – Advantages and Disadvantages – Environmental aspects of renewable energy – Impacts of renewable energy generation on the environment – Hydel Energy – Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics. |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | 1- Speaking 2- Discussion 3- Reports 4- Projects 5- Assignments |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 78 | **Structured SWL (h/w)** | 5 |
| **Unstructured SWL (h/sem)** | 72 | **Unstructured SWL (h/w)** | 4.8 |
| **Total SWL (h/sem)** | 150 | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| Formative assessment | Quizzes | 2 | 10% (10) | 5,10 | LO #1,2 and 8,9,15 |
| | Assignments | 2 | 10% (10) | 2,12 | LO # 5,6,7,10 |
| | Projects / Lab. | 1 | 10% (10) | - | |
| | Report | 1 | 10% (10) | 13 | LO #3,4,11,12,13,14 |
| Summative assessment | Midterm Exam | 2 hr | 10% (10) | 7 | LO # 1-8 |
| | Final Exam | 2hr | 50% (50) | 16 | All |
| Total assessment | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

| | Material Covered |
|---|---|
| Week 1 | Intro to Hybrid Renewable Energy Systems (HRES) |
| Week 2 | Energy & sustainable livelihoods |
| Week 3 | Electricity access to Hybrid Renewable Energy Systems |
| Week 4 | Assessing and understanding loads for HRES |
| Week 5 | Dispatchable energy for HRES |
| Week 6 | Load curve for HRES |
| Week 7 | RE resources for HRES |
| Week 8 | Project planning and Storage for HRES |
| Week 9 | Control and optimisation of HRES |
| Week 10 | Energy transmission with HRES |
| Week 11 | Energy distribution with HRES |
| Week 12 | Energy monitoring with HRES |
| Week 13 | Minigrid design |
| Week 14 | Techno-Economic optimization with HRES |
| Week 15 | Case Studies For Hybrid Renewable Energy Systems |
| Week 16 | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | / |
| **Week 2** | / |
| **Week 3** | / |
| **Week 4** | / |
| **Week 5** | / |
| **Week 6** | / |
| **Week 7** | / |

| Learning and Teaching Resources | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | *Stand Alone Power Systems, Design and Installation – GSES* | |
| **Recommended Texts** | *Solar/Diesel Minigrid Handbook – PowerWater Corportation* | |
| **Websites** | • *UNSW Library website - https://www.library.unsw.edu.au/*<br>• *Australian Bureau of Meteorology - http://www.bom.gov.au/climate/*<br>• *NASA (weather data) - https://power.larc.nasa.gov/* | |

# MODULE DESCRIPTION OF JOB ETHICS

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Job Ethics** | | | **Module Delivery** | |
| **Module Type** | **B** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | **KUS47038** | | | | |
| **ECTS Credits** | **3** | | | | |
| **SWL (hr/sem)** | **75** | | | | |
| **Module Level** | 4 | | **Semester of Delivery** | 1 | |
| **Administering Department code** | REE | | **College code** | CRE | |
| **Module Leader** | Maad Abdulla Hussein | | **e-mail** | maad@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecture | | **Module Leader's Qualification** | Ph.D. | |
| **Module Tutor** | | | **e-mail** | | |
| **Peer Reviewer Name** | | | **e-mail** | | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Objectives**<br>أهداف المادة الدراسية | 1. Application of academic programs Al-karkh University of sciences.<br>2. To understand the principles of the work ethics.<br>3. This course deals with the basic concept of job ethics.<br>4. Providing students with sound thinking methods (deductive thinking, scientific thinking, critical thinking, creative thinking, ....)<br>5. Graduating specialists in the field of different sciences with the highest efficiency to deal with job problems and decision making. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Understand and define the concepts of integrity and ethics.<br>2. Understand how to resolve ethical dilemmas.<br>3. Describe three major theoretical approaches in integrity and ethics.<br>4. Identify ethical dilemmas and apply different theoretical approaches.<br>5. Understand the concept of personal integrity in the context of this Module.<br>6. Understand how to apply social work ethics to professional decision-making. |
| **Indicative Contents**<br>المحتويات الإرشادية | Module 1: Introduction and Conceptual Framework<br>Throughout the Module, students will be introduced to concepts and thrown in at the deep end by being asked to make decisions on what they would regard as the most ethical solutions to dilemmas. Students will be guided through three major ethical theories and challenged to agree or disagree with them. Students should not be afraid to take a stance, as this will enhance their learning and enjoyment of the Module.<br>Module 2: Ethics and Universal Values<br>This Module explores the existence of universal human values, which are those things or behaviours that we believe should be privileged and promoted in the lives of all human beings.<br>Module 3: Ethics and Society<br>This Module explores the importance of ethics to society and the relationship between these two concepts.<br>Module 4: Ethical Leadership<br>We live in a world in which individuals, organizations, countries and societies are increasingly connected. Therefore, the impact of leadership - both good and bad - reverberates throughout entire political and economic systems.<br>Module 5: Ethics, Diversity and Pluralism<br>This Module explores the concepts of diversity, tolerance and pluralism. It examines ways in which the acceptance of diversity may be challenging but can be understood and accomplished by drawing on ideas and examples of ethical behavior.<br>Module 6: Challenges to Ethical Living<br>The Module seeks to help students understand some of the psychological mechanisms that can lead one towards unethical behavior in certain circumstances.<br>Module 7: Strategies for Ethical Action<br>This Module introduces practical strategies for taking ethical action in the workplace (in the public or private sectors), university, community and in life more broadly.<br>Module 8: Behavioral Ethics<br>Evidence from behavioral science research has shown that people are less consistent and less rational in their decisions than they would like to admit to themselves.<br>Module 9: Gender Dimensions of Ethics<br>This Module introduces the gender dimensions of ethics.<br>Module 10: Media Integrity and Ethics |

| | |
|---|---|
| | This Module discusses the relationship between the concepts of ethics and media. It aims to facilitate introspective reflection on the ways in which all of us, as individuals, play a part in the creation and dissemination of media.<br><br>Module 11: Business Integrity and Ethics<br>This Module introduces students to the idea that integrity and ethics are key to sustainable business success. It examines the reasons why individuals in corporate entities should act with integrity and do business ethically.<br><br>Module 12: Integrity, Ethics and Law<br>Why is it that some actions are legal but not ethical, or ethical but not legal? This Module is designed to be used by lecturers in a variety of disciplines who wish to introduce their students to the ideas of integrity, ethics and law, including what these concepts stand for and how they are different.<br><br>Module 13: Public Integrity and Ethics<br>This Module examines methods and approaches to strengthening integrity in the public sector.<br><br>Module 14: Professional Ethics<br>Should a journalist publish very private information about someone to inform the public about an issue? Should a lawyer withhold confidential client information that would save someone's life? This Module is designed to introduce students to the nature, practices and importance of professional ethics. |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | 1. Clearly distinguish between personal, theoretical and professional ethic.<br>2. Think critically about ethical issues, which are encountered first hand within a career, and apply personal, theoretical, and professional ethics to vexing moral decisions within specific professions.<br>3. Grasp the challenges posed by potential conflicts between role morality and personal morality, and consider ways of resolving those conflicts.<br>4. Understand the role of professional codes of ethics, the difference between aspirational and disciplinary codes of ethics, and how professional codes may apply in their career. |

| **Student Workload (SWL)**<br>الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 3 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 3 |

| | |
|---|---|
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **200** |

## Module Evaluation
تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 2 | 20% (10) | 5 and 10 | LO #1, #2 and #10, #11 |
| | **Assignments** | 0 | 0% (0) | 2 and 12 | LO #3, #4 and #6, #7 |
| | **Projects / Lab.** | 0 | 0% (0) | Continuous | All |
| | **Report** | 1 | 10% (10) | 13 | LO #5, #8 and #10 |
| **Summative assessment** | **Midterm Exam** | 2hr | 20% (10) | 7 | LO #1 - #7 |
| | **Final Exam** | 3hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

| | **Material Covered** |
|---|---|
| **Week 1** | Module 1: Introduction and Conceptual Framework |
| **Week 2** | Module 2: Ethics and Universal Values |
| **Week 3** | Module 3: Ethics and Society |
| **Week 4** | Module 4: Ethical Leadership |
| **Week 5** | Module 5: Ethics, Diversity and Pluralism |
| **Week 6** | Module 6: Challenges to Ethical Living |
| **Week 7** | Module 7: Strategies for Ethical Action |
| **Week 8** | Module 8: Behavioural Ethics |
| **Week 9** | Module 9: Gender Dimensions of Ethics |
| **Week 10** | Module 10: Media Integrity and Ethics |
| **Week 11** | Module 11: Business Integrity and Ethics |
| **Week 12** | Module 12: Integrity, Ethics and Law |
| **Week 13** | Module 13: Public Integrity and Ethics |
| **Week 14** | Module 14: Professional Ethics |
| **Week 15** | **Preparatory week before the final Exam** |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Business Ethics Activity Book<br>by Dr. Marlene Caroselli<br>Released September 2003<br>Publisher(s): AMACOM<br>ISBN: 9780814413203 | No |
| **Recommended Texts** | The Work Ethic: Working Values and Values That Work | No |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF SUSTAINABLE BUILDINGS

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Sustainable Buildings** | | | **Module Delivery** | |
| **Module Type** | E 3 | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE47042 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | 4 | | **Semester of Delivery** | 7 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Sura Thamir Nasir | | **e-mail** | Sura.thamir91@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecture | | **Module Leader's Qualification** | Ms.C. | |
| **Module Tutor** | None | | **e-mail** | E-mail | |
| **Peer Reviewer Name** | None | | **e-mail** | E-mail | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Objectives**<br>أهداف المادة الدراسية | The main objectives of a Sustainable Buildings module that covers the basics of Sustainable Buildings and unwanted environmental impacts and limiting these impacts could include:<br><br>1. Understanding the basic principles of Sustainable Buildings: This objective would cover the fundamental principles of Sustainable Buildings, including site selection, materials and resources, energy use and air pollution, water use and quality, and indoor air quality.<br>2. Understanding Site Selection. In addition to the impacts housing developments have on the environment, project location can have an even greater impact if it is too distant from community services and infrastructure.<br>3. Understanding the Materials and Resources. Negative environmental impacts can be minimized through responsible and intentional use and application of green materials Products that contain a high percentage of rapidly renewable |

| | |
|---|---|
| | resources have a much lighter environmental footprint Materials that are locally mined, harvested and manufactured.<br>4. Understanding the Green building and more energy-efficient planning and zoning regulations can result in significant reductions in energy use and atmospheric pollution Energy costs continue to soar and climate change effects are becoming more widespread, so creating stable and predictable operating costs for low- and moderate-income (LMI) homeowners and renters makes good economic sense and preserves long-term housing affordability.<br>5. Examining Water Use and Quality Buildings also significantly impact water usage and affect water quality through runoff and wastewater contamination Showers, sinks, dishwashers, washing machines and toilets all consume significant amounts of water The per capita water consumption in the Intermountain The region averages about 250 gallons per day.<br>6. Evaluating the Indoor Air Quality: This objective would cover Many modern building materials that contain dangerous chemicals that off-gas into the atmosphere. Green building addresses this serious health concerns by using materials fewer less chemical content andoff-gassingg potential Green building also incorporates proper home ventilation to provide an adequate supply of fresh outside air and monitoring for contaminants, such as radon and carbon monoxide. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | 1. Understand the fundamental principles of Sustainable Buildings, including site selection, materials and resources, energy use and air pollution, water use and quality, and indoor air quality.<br>2. Identify the Sustainable Buildings, including site selection, materials and resources, energy use and air pollution, water use and quality, and indoor air quality. Green Building Benefits the Environment.<br>3. Describe the process of Reducing Material Impacts, Increasing Energy Efficiency and Comfort.<br>4. Explain the Greenhouse Gas Emissions and Indoor Air Pollution.<br>5. Evaluate the advantages and disadvantages of Sustainable Buildings.<br>6. Understand the role that Sustainable Buildings may play in meeting future energy needs and reducing greenhouse gas emissions.<br>7. Apply critical thinking and problem-solving skills to evaluate complex issues related to Sustainable Buildings.<br>8. Communicate effectively about Sustainable Buildings concepts and issues with others. |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br><br>**<u>Theory:</u>**<br>Green Building Basics<br>- Introduction<br>- Green Building Benefits the Environment<br>-Getting Started with Green Building [6 hrs]<br>The Most Important Element:<br>- The Efficient Use of Energy [6 hrs]<br>The Reality of the Built Environment:<br>- The Problem of Existing Buildings [6 hrs] |

| | |
|---|---|
| | Impacts of Conventional Buildings That Green Buildings Seek to Rectify<br>- Energy Use in Buildings [6 hrs]<br>- Greenhouse Gas Emissions and Indoor Air Pollution [6 hrs]<br>- Building Water Use [6 hrs]<br>Land Use and Consumption<br>- Construction Materials<br>- Construction, Operation, and Demolition Waste [6 hrs] |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | 1. **Lectures:** used to introduce and explain key concepts related to Green Building.<br>2. **Interactive discussions:** used to engage students in critical thinking and problem-solving related to Green Building through group discussions, debates, case studies, and simulations.<br>3. **Multimedia resources:** used to enhance student engagement and understanding of complex concepts related to Green Building through videos, animations, and simulations.<br>4. **Assessment and feedback:** used to measure student learning and provide feedback on their progress through quizzes, exams, and projects. |

| **Student Workload (SWL)**<br>الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 3 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 3.5 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **100** | | |

| **Module Evaluation**<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5 and 10 | LO #1, #2 and #3, #6 |
| | **Assignments** | 2 | 10% (10) | 2 and 12 | LO #3, #4 and #5, #7 |
| | **Projects / Lab.** | 1 | 10% (10) | Continuous | All |
| | **Report** | 1 | 10% (10) | 13 | LO #2, #3 and #5 |
| **Summative assessment** | **Midterm Exam** | 2hr | 10% (10) | 7 | LO #1 - #5 |
| | **Final Exam** | 3hr | 50% (50) | 16 | All |

| | | | |
|---|---|---|---|
| **Total assessment** | 100% (100 Marks) | | |

| **Delivery Plan (Weekly Syllabus)**<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Green Building Benefits the Environment |
| **Week 2** | Design Integration, Site Location and Selection, Realizing No Cost Measures Through Building Design |
| **Week 3** | Reducing Material Impacts, Increasing Energy Efficiency and Comfort,<br>Material Resource Efficiency |
| **Week 4** | Building Systems that Reduce Material and Energy Impacts:<br>Green Foundations,<br>Autoclaved Aerated Concrete (Sidebar) |
| **Week 5** | Green Floor Framing Systems,<br>Green Wall Systems (Standard Framing Alternatives), Natural Building (Sidebar) |
| **Week 6** | Green Roofing Systems, Raised Heel Truss (Sidebar),<br>Green Roofs (Sidebar) |
| **Week 7** | Reducing Energy Use and Increasing Comfort:<br>Insulation,<br>Windows and Doors |
| **Week 8** | Super Performance Windows (Sidebar), Space and Water Heating,<br>Affordable Radiant Heating Systems (Sidebar) |
| **Week 9** | The ENERGY STAR Program — Green Appliances and Lighting,<br>Green Plumbing,<br>Renewable Energy,<br>Building Integrated Photovoltaic (BIPV) Shingles (Sidebar) |
| **Week 10** | Water Conservation,<br>Greywater Systems (Sidebar),<br>Improving Indoor Air Quality |
| **Week 11** | Recycled, Salvaged Materials and Waste Management |
| **Week 12** | Green Building Resources: Energy Efficiency, Building Systems, Foundation Systems |
| **Week 13** | Wall Systems, Windows, Composite Decking Materials |
| **Week 14** | Green Building Material Sourcing |
| **Week 15** | Recycling and Reuse, Renewable Energy |
| **Week 16** | **Final Exam** |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | 1- " GREEN BUILDING GUIDE Design Techniques, Construction Practices & Materials for Affordable Housing" by Craig Nielson, LEED AP.<br>2- " Overview of Green Buildings" by J. Cullen Howe. | No |
| **Recommended Texts** | | No |
| **Websites** | None | |

## 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 |
| | | | | |

**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.

# MODULE DESCRIPTION 0F TIDAL ENERGY

**University Name**: AlKarkh University of Science

**College**: Energy and Environmental Science

**Dept.:** Renewable energy

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Tidal Energy | | | **Module Delivery** | |
| **Module Type** | **E 2** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE47042 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | **4** | | **Semester of Delivery** | 7 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Amani Ibrahim | | **e-mail** | | |
| **Module Leader's Acad. Title** | Assist. Prof. | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | | | **e-mail** | | |
| **Peer Reviewer Name** | | | **e-mail** | | |
| **Scientific Committee Approval Date** | | | **Version Number** | | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | | **Semester** | |
| **Co-requisites module** | | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Knowledge of the concept of Tidal Energy<br>2. Knowledge the physical principle of Tidal Energy<br>3.<br>4. Knowledge of the reality of renewable energy in Iraq<br>5. Knowledge of the principle of designing environmentally friendly sustainable cities |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | Knowledge other forms of ocean energy, such as mechanical energy from waves, currents and tides, and chemical energy from salinity gradients. |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الاسبوع | 3 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الاسبوع | 3.5 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects / Lab.** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 1hr | 10% (10) | | |
| | **Final Exam** | 3hr | 50% (50) | | |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Energy from Currents |
| **Week 2** | Horizontal Forces, Anchoring Systems |
| **Week 3** | Corrosion and Biological Fouling |
| **Week 4** | Cavitation, Large Torque |
| **Week 5** | Maintenance, Power Transmission |
| **Week 6** | Turbine Farms |
| **Week 7** | Review & exam |
| **Week 8** | Ecology |
| **Week 9** | Wave Energy |
| **Week 10** | Wave-Energy Converters |
| **Week 11** | Offshore Wave-Energy Converters |
| **Week 12** | The Velocity of Ocean Waves |
| **Week 13** | Wave Height |
| **Week 14** | Energy and Power |
| **Week 15** | **Wavegen System (OWC)** |
| **Week 16** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | Fundamentals of Renewable Energy Processes | |
| **Recommended Texts** | Handbook on renewable energy source | |
| **Websites** | | |

## 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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# Conductive polymers

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Conductive polymers | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☒ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | REE47038 | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 150 | | | | |
| **Module Level** | **4** | | **Semester of Delivery** | **8** | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Dr. Al-Hamza Dhia Hameed | | **e-mail** | AHamza@gmail.com | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Develop a comprehensive understanding of conductive polymers and their significance in the energy sector.<br>2. Familiarize students with the properties, characteristics, and applications of conductive polymers.<br>3. Equip students with knowledge and skills in the synthesis and characterization of conductive polymers.<br>4. Explore the electrical conductivity mechanisms in conductive polymers and their relationship to molecular structure and processing conditions.<br>5. Provide insights into the design, fabrication, and optimization of conductive polymer composites.<br>6. Develop an understanding of energy storage applications using conductive polymers, including batteries and supercapacitors.<br>7. Investigate energy conversion applications of conductive polymers, such as solar cells and thermoelectric devices.<br>8. Explore emerging applications and future trends in the field of conductive polymers.<br>9. Provide hands-on laboratory experience in the synthesis, characterization, and fabrication of conductive polymers and their devices.<br>10. Foster industry collaborations and provide case studies to showcase real-world applications of conductive polymers.<br>11. Examine the environmental impact and sustainability aspects of conductive polymers, including life cycle assessment and recycling strategies.<br>12. Discuss career opportunities, future prospects, and research directions in the field of conductive polymers. |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Demonstrate a comprehensive understanding of conductive polymers, their properties, and their significance in the energy sector.<br>2. Apply knowledge of synthesis techniques to fabricate conductive polymers with desired characteristics.<br>3. Employ various characterization methods to analyze the structural and electrical properties of conductive polymers.<br>4. Explain the electrical conductivity mechanisms in conductive polymers and understand the relationship between molecular structure and conductivity.<br>5. Design and optimize conductive polymer composites by selecting appropriate fillers, adjusting loading levels, and controlling distribution.<br>6. Evaluate the performance and efficiency of energy storage devices, such as batteries and supercapacitors, based on conductive polymers.<br>7. Analyze and improve the performance of conductive polymer-based energy conversion devices, including solar cells and thermoelectric devices.<br>8. Identify emerging applications and future trends in the field of conductive polymers and assess their potential impact in the energy sector.<br>9. Utilize laboratory skills to synthesize, characterize, and fabricate conductive polymers and their devices.<br>10. Collaborate with industry partners to develop and implement practical applications of conductive polymers. |

| | |
|---|---|
| | 11. Assess the environmental impact of conductive polymers and propose sustainable practices for their synthesis, use, and disposal.<br>12. Identify career opportunities and research directions in the field of conductive polymers within the energy sector.<br>13. Communicate effectively about conductive polymers, including their properties, applications, and potential impact, both orally and in writing.<br>14. Demonstrate critical thinking skills by analyzing and solving problems related to conductive polymers in the energy domain.<br>15. Exhibit ethical and professional behavior in conducting research, handling data, and interacting with peers and industry professionals in the field of conductive polymers. |
| **Indicative Contents**<br>المحتويات الإرشادية | **1. Introduction to Conductive Polymers**<br>Definition and characteristics of conductive polymers<br>Significance of conductive polymers in the energy sector<br>Overview of applications in energy technologies<br>Historical development and key milestones in the field<br>**2. Synthesis and Characterization of Conductive Polymers**<br>Synthetic routes and polymerization techniques<br>Characterization methods for structural and electrical properties<br>Analysis of polymer morphology and microstructure<br>**Module 3: Electrical Conductivity Mechanisms in Conductive Polymers**<br>Theory of charge transport in polymers<br>Intrinsic and extrinsic doping methods<br>Molecular structure and its impact on conductivity<br>Processing conditions and their influence on electrical properties<br>**Module 4: Conductive Polymer Composites**<br>Introduction to conductive polymer composites<br>Types of conductive fillers and their dispersion in polymer matrices<br>Impact of filler loading and distribution on electrical properties<br>Fabrication techniques and challenges in composite production<br>**Module 5: Energy Storage Applications**<br>Conductive polymer-based batteries<br>Electrode materials and designs<br>Electrochemical properties and performance metrics<br>Strategies for enhancing energy density and cycling stability<br>Conductive polymer-based supercapacitors<br>Working principles and energy storage mechanisms<br>Electrode materials and architectures<br>Approaches to improving capacitance and power density<br>**Module 6: Energy Conversion Applications**<br>Conductive polymer-based solar cells<br>Photovoltaic principles and device architectures |

| | |
|---|---|
| | Polymer donor and acceptor materials<br>Techniques for improving efficiency and stability<br>Conductive polymer-based thermoelectric devices<br>Thermoelectric principles and figure of merit<br>Polymer selection for optimal thermoelectric performance<br>Strategies to enhance thermoelectric efficiency<br>**Module 7: Emerging Applications and Future Trends**<br>Conductive polymers in flexible and stretchable electronics<br>Conductive polymers for energy-efficient lighting and displays<br>Conductive polymers in sensors and actuators<br>Recent advances and ongoing research in the field<br>Future prospects and potential applications<br>**Module 8: Manufacturing and Scale-up of Conductive Polymers**<br>Scale-up considerations and challenges<br>Manufacturing processes for conductive polymer-based devices<br>Quality control and characterization techniques for large-scale production<br>Economic and sustainability aspects of conductive polymer manufacturing<br>**Module 9: Environmental Impact and Sustainability**<br>Life cycle assessment of conductive polymers<br>Environmental considerations in material selection and synthesis<br>Recycling and waste management strategies for conductive polymers<br>Eco-friendly alternatives and sustainable practices<br>**Module 10: Industry Engagement and Case Studies**<br>Collaborations between academia and industry in conductive polymers<br>Case studies showcasing successful applications and commercialization<br>Industry perspectives on challenges and opportunities in the field<br>Career paths and opportunities in the conductive polymer industry |

| **Learning and Teaching Strategies**<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | **Lectures**: Traditional lectures can be used to deliver foundational knowledge on conductive polymers, their properties, and applications. Lectures can also include discussions on historical developments and key concepts.<br>**Case Studies**: Case studies can be used to explore real-world applications of conductive polymers. Students can analyze and discuss the challenges, opportunities, and outcomes of specific projects or industry collaborations, allowing them to gain insights into practical applications.<br>**Group Discussions and Debates**: Group discussions encourage active participation and critical thinking. Students can engage in debates on topics such as the future of conductive polymers, ethical considerations, or emerging applications. This promotes collaborative learning and develops communication skills. |

| | |
|---|---|
| | **Problem-Based Learning**: Students can be presented with open-ended problems or scenarios related to conductive polymers. They can work in groups to analyze the problem, propose solutions, and present their findings. This fosters analytical thinking and problem-solving skills.<br>**Research Projects**: Assigning research projects to students allows them to explore specific aspects of conductive polymers in depth. They can conduct literature reviews, design experiments, and analyze data, contributing to the advancement of knowledge in the field.<br>**Online Resources and Virtual Tools**: Utilizing online resources, digital simulations, and virtual tools can enhance learning. These resources can provide interactive demonstrations, virtual experiments, and supplementary materials for self-paced learning.<br>**Presentations and Poster Sessions**: Assigning presentations or poster sessions allows students to communicate their research findings or assigned topics effectively. This develops their presentation skills, promotes peer learning, and encourages critical evaluation of information.<br>**Formative and Summative Assessments**: Regular formative assessments, such as quizzes or group projects, can help monitor students' progress. Summative assessments, such as examinations or research reports, evaluate students' understanding and mastery of the curriculum. |

## Student Workload (SWL)
الحمل الدراسي للطالب

| | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 63 | **Structured SWL (h/w)** | 4.5 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 62 | **Unstructured SWL (h/w)** | 4.5 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 125 | | |

## Module Evaluation
تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | | |
| | **Assignments** | 2 | 10% (10) | | |
| | **Projects** | 1 | 10% (10) | | |
| | **Report** | 1 | 10% (10) | | |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | | |
| | **Final Exam** | 2hr | 50% (50) | | |

| | | | |
|---|---|---|---|
| **Total assessment** | 100% (100 Marks) | | |

| **Delivery Plan (Weekly Syllabus)**<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | **Introduction to Conductive Polymers**<br>Overview of conductive polymers and their; significance in the energy sector; Conductive polymer properties and characteristics; Applications of conductive polymers in energy technologies; and Historical development and milestones in the field |
| **Week 2** | **Synthesis and Characterization of Conductive Polymers**<br>Synthetic routes for conductive polymers<br>Polymerization techniques and methods<br>Characterization techniques for structural and electrical properties<br>Analysis of polymer morphology and microstructure |
| **Week 3** | **Electrical Conductivity Mechanisms in Conductive Polymers**<br>Theory of charge transport in polymers<br>Intrinsic and extrinsic doping of polymers<br>Influence of molecular structure on electrical conductivity<br>Relationship between processing conditions and conductivity |
| **Week 4** | **Conductive Polymer Composites: Part1**<br>Introduction to conductive polymer composites<br>Types of conductive fillers and their dispersion in polymer matrices |
| **Week 5** | **Conductive Polymer Composites: Part 2**<br>Influence of filler loading and distribution on electrical properties<br>Processing techniques and challenges in composite fabrication |
| **Week 6** | **Energy Storage Applications: Part 1**<br>Conductive polymer-based batteries<br>Electrode materials and designs<br>Electrochemical properties and performance metrics<br>Strategies for enhancing energy density and cycling stability |
| **Week 7** | **Energy Storage Applications: Part 2**<br>Conductive polymer-based supercapacitors<br>Working principles and energy storage mechanisms |

| | |
|---|---|
| | Electrode materials and architectures<br>Approaches to improving capacitance and power density |
| **Week 8** | **Energy Conversion Applications: Part 1**<br>Conductive polymer-based solar cells<br>Photovoltaic principles and device architectures<br>Polymer donor and acceptor materials<br>Techniques for improving efficiency and stability |
| **Week 9** | **Energy Conversion Applications: Part 2**<br>Conductive polymer-based thermoelectric devices<br>Thermoelectric principles and figure of merit<br>Polymer selection for optimal thermoelectric performance<br>Strategies to enhance thermoelectric efficiency |
| **Week 10** | **Emerging Applications and Future Trends**<br>Conductive polymers in flexible and stretchable electronics<br>Conductive polymers for energy-efficient lighting and displays<br>Conductive polymers in sensors and actuators<br>Overview of recent advances and ongoing research<br>Future prospects and potential applications. |
| **Week 11** | **Seminars for students Applications of conductive polymers** |
| **Week 12** | **Manufacturing and Scale-up of Conductive Polymers**<br>Scale-up considerations and challenges<br>Manufacturing processes for conductive polymer-based devices<br>Quality control and characterization techniques for large-scale production<br>Economic and sustainability aspects of conductive polymer manufacturing. |
| **Week 13** | **Environmental Impact and Sustainability**<br>Life cycle assessment of conductive polymers<br>Environmental considerations in material selection and synthesis<br>Recycling and disposal strategies for conductive polymers<br>Eco-friendly alternatives and sustainable practices |
| **Week 14** | **Industry Engagement and Case Studies**<br>Collaborations between academia and industry in conductive polymers<br>Case studies highlighting successful applications and commercialization |

| | |
|---|---|
| | Industry perspectives on challenges and opportunities in the field<br>Career paths and opportunities in the conductive polymer industry |
| **Week 15** | **Seminars for students on recent developments in conductive polymers** |
| **Week 16** | **Preparatory week before the final Exam** |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | Skotheim, T. A., Reynolds, J. R., & Handbook of Conducting Polymers. 3rd Ed. CRC Press, 2007<br>Roncali, J. (Ed.). Molecular Materials: Preparation, Characterization, and Applications. Wiley-VCH, 2010. | No |
| **Recommended Texts** | Bhadra, S., Khastgir, D., Singha, N. K., & Lee, J. H. (Eds.). Polymer Nanocomposites in the Energy Sector: Preparation, Properties, and Applications. CRC Press, 2017. | No |
| **Websites** | | |

## 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 |
| | | | | |

# MODULE DESCRIPTION OF NANOTECHNOLOGY

**University Name**: AlKarkh University of Sciences

**College:** Energy and Environmental Sciences

**Department:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Nanotechnology | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | REE48046 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | 4 | | **Semester of Delivery** | 8 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Marwah Mohammed Jasim | | **e-mail** | Marwah.mohammed@kus.edu.iq | |
| **Module Leader's Acad. Title** | Lecturer | | **Module Leader's Qualification** | Ph.D | |
| **Module Tutor** | N.A | | **e-mail** | N.A | |
| **Peer Reviewer Name** | | | **e-mail** | | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | ____ |
| **Co-requisites module** | None | **Semester** | ____ |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | 1. The main objective of this course is to introduce and to brief the student about diverse aspects on Nanotechnology. In particular, this course will provide better insights about certain important theories, growth process of nanoparticles and their property with respect to their size effects.<br>2. provide a foundation semester in the general area of science of nanoscience and nanotechnology.<br>3. Use the fundamental science and engineering principles relevant to materials that include the relationships between nano/microstructure, characterization, properties, processing, performance and design of materials.<br>4. the objective of this course is to make the students familiar with the properties behavior and applications and implementation of nanotechnology. This will motivate the students to apply the concepts of Nanoscience and nanotechnology in various fields. The objective of the course is to make the students acquainted with the applications of nanotechnology in various fields such as nanoelectronics, industrial, biomedical and aerospace. |
| **Module Learning Outcomes** | Students who complete the course will have demonstrated the following:<br>1. Apply the students the essential role of Nanotechnology and Nanoscience.<br>2. Understand the classification nanostructured materials.<br>3. Understood the principles and Characterization Techniques.<br>4. Understand various Mechanical, chemical and physical methods for the synthesis of diverse types of nanomaterials (0D, 1D and 2D).<br>5. Decipher information on the specific details of both bottom up and top-down synthesis.<br>6. Understand the tools used for nanomaterials characterization, and nanomaterials applications.<br>7. End of this course, students will be able to hone their creative thinking and problem-solving skills, build synergistic teamwork and enhance their communication skills. |
| **Indicative Contents** | Nanomaterials science: Types of Nanomaterials, definition of nanoscale, surfaces and particle size, surface energy and surface tension and relation to size, phase transformation in nanomaterials, specific heat and heat capacity of nanomaterials, mechanical properties of nanomaterials, optical properties of nanomaterials, electrical and magnetic properties of nanomaterials.<br>Synthesis Methods of Nanomaterials : Top down : Milling; Bottom up approaches – Synthesis of zero dimensional metal, metal oxides, semiconductor nanoparticles by different routes – Colloidal method, Sol-gel, Electrodeposition; Kinetically Confined Synthesis of Nanoparticles - Aerosol synthesis, Micellar growth, Spray pyrolysis, Template-based synthesis; Synthesis of one dimensional nanosystems by different routes.<br>Properties of Nanomaterials : includes Electronic Properties, Magnetic and Dielectric properties, Optical Properties, Mechanical Properties.<br>Nanomaterials for Energy System includes the fundamental concepts in energy systems, Nanomaterials for energy conversion systems and nanomaterials for photovoltaic solar energy conversion systems.<br>Advanced Nanomaterials for Nanotechnology: includes Nanostructured Magnetism:Effect Bulk nanostructuring of magnetic property, Giant and colossal magnetic resistance, Nanomagnetic materials, Paramagnetism in metallic nanoparticles, Semiconduction quantum dots. Thermoelectric Materials: Concept of phonon, Thermal conductivity specific heat, exothermic and endothermic processes, Different types of thermoelectric materials.<br>Applications of Nanomaterials : The applications of nanomaterials in environmental improvement are different from one another depending on the type of devices used, for example, solar cells for producing clean energy, nanotechnologies in coatings for building exterior surfaces, and sonochemical decolorization of dyes by the effect of nanocomposite, etc. (11 hrs) |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | 1. Encourage initiative: Allow students to actively participate in the learning process with class discussions and exercises that support the initiative.<br>2. Using the Internet to Enhance Students' Reading, Writing, and Information-Gathering Skills.<br>3. Establish Learning Objectives: Clearly define the learning objectives aligned with the program goals and industry requirements; Identify the specific knowledge, skills, and competencies students should acquire by the end of the course.<br>4. Plan the Curriculum: Development a well-structured curriculum with a logical flow of topics, starting from fundamental concepts to more advanced applications.<br>5. Engage Students Actively: Encouragement active learning by incorporating interactive activities, discussions, and problem-solving exercises.<br>6. Utilize Technology: Utilizing educational technology tools, such as interactive simulations and modeling software. |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 63 | **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الأسبوع | 4 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 37 | **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الاسبوع | 2.5 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

| Module Evaluation | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 3 | 10% (10) | 4,7,11 | LO # 1,2,5,10 |
| | **Assignments** | 4 | 10% (10) | 2, 5,7,12 | LO # 4,6,9 |
| | **Projects / Lab.** | 1 | N.A. | N.A | N.A |
| | **Report** | 1 | 10% (10) | 12 | LO # 3,7,8,11 |
| **Summative assessment** | **Midterm Exam** | 1 hr | 10% (10) | 8 | LO # 1-8 |
| | **Final Exam** | 3hr | 60% (60) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introduction to Nanotechnology |
| **Week 2** | Nanoscience and Nanotechnology |
| **Week 3** | Classification of Nanomaterials |
| **Week 4** | Types of Nanoparticles (NPs) |
| **Week 5** | nanocomposite and nanomaterials |
| **Week 6** | Sources of nanoparticles in the environment |
| **Week 7** | Design and Synthesis of Nanomaterials |
| **Week 8** | Midterm exam + Review |
| **Week 9** | Carbon-Based Nanomaterials. |
| **Week 10** | Properties Nanomaterials |
| **Week 11** | Nanomaterials for Energy System |
| **Week 12** | Computational Nanotechnology |
| **Week 13** | Characterization Techniques of Nanomaterials |
| **Week 14** | Advanced Nanomaterials for Nanotechnology |
| **Week 15** | Applications of nanotechnology in renewable energies |
| **Week 16** | **Preparatory week before the final Exam** |

| Learning and Teaching Resources | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | 1. Advances in Nanotechnology and the Environment, Juyoung Kim, CRC Press, Taylor and Francis Group. ).<br>2. Ghuzang G.Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004.<br>3. C. C. Koch, ―Nanostructured Materials: Processing, Properties and Applications‖, 2nd Edition, Ed.: 2007<br>4. G. Cao, Nanostructures and Nanomaterials – Synthesis, Properties and Applications, Imperial College Press 2006 | NO |
| **Recommended Texts** | 1. Nanomaterials – An introduction to synthesis, properties and applications, D. Vollath, Wiley-VCH, Second Edition.<br>2. Processing & properties of structural naonmaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005 | NO |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FORت

# Nuclear energy

**University Name**: ALkarkh University of Science

**College:** Renewable Energy and Environmental Sciences

**Dept:** renewable energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Nuclear Energy | | | **Module Delivery** | |
| **Module Type** | **Elective** | | | ☒ **Theory**<br>☒ **Lecture**<br>☐ **Lab**<br>☐ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | REE480 E2 | | | | |
| **ECTS Credits** | 4 | | | | |
| **SWL (hr/sem)** | 100 | | | | |
| **Module Level** | | 4 | **Semester of Delivery** | | 1 |
| **Administering Department** | | REE | **College** | | CRE |
| **Module Leader** | Luma jamal abbas | | **e-mail** | | Luma.jamal@kus.edu.iq |
| **Module Leader's Acad. Title** | | Lecturer | **Module Leader's Qualification** | | Ph.D |
| **Module Tutor** | NONE | | **e-mail** | | NONE |
| **Peer Reviewer Name** | | NONE | **e-mail** | | NONE |
| **Scientific Committee Approval Date** | | 20/6/2023 | **Version Number** | | 1 |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. To have knowledge about nuclear technologies.<br>2. To have knowledge about radiation, radiation units, usage areas.<br>3. To have knowledge about radiation safety.<br>4. To have knowledge about nuclear energy production<br>5. To be familiar with the terminology of nuclear technologies.<br>6. To have basic knowledge about energy production by nuclear fission.<br>7. To know the formation and results of nuclear reactions |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | Fundamentals of Nuclear Power is a course in which the main topics of nuclear energy education such as reactor physics, reactor technology, reactor safety, health physics, radiation physics and technology are all considered as parts of a whole and aims to provide students with a general nuclear engineering formation. |
| **Indicative Contents**<br>المحتويات الإرشادية | 1. Reactor physics and theory and technology of nuclear power plant. Topics<br>● Reactor Physics. Introduction to Nuclear Power<br>● Nuclear stability and radioactive decay<br>● Nuclear reactions<br>● Nuclear fission, fission products<br>● Nuclear reactor fuels<br>● Different types of nuclear reactors by: fuel and coolants<br>● Thermal reactors: PWR, BWR<br>● Nuclear PP major Components for Thermal reactors<br>● Components of the reactor vessel<br>● Core, Shield<br>● Heat Exchanger<br>● Condenser<br>● Coolant, moderator<br>● Control materials: Control Rods, Liquid materials, Installed poisons<br>● Creating Electricity |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The lectures will consist of interactive power point presentations, videos, handouts, and other educational materials. Students are responsible for the material covered in the course materials. The knowledge will be evaluated via homework assignments, short quizzes and take-home exams.. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 102 | الحمل الدراسي المنتظم للطالب اسبوعيا | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 98 | الحمل الدراسي غير المنتظم للطالب اسبوعيا | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 100 | | |

| Module Evaluation<br>تقييم المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| | | **Time/Number** | **Weight (Marks)** | **Week Due** | **Relevant Learning Outcome** |
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5,10 | 1-5 |
| | **Assignments** | 2 | 10% (10) | 2,12 | 5-10 |
| | **Projects / Lab.** | 1 | 10% (10) | continuous | |
| | **Report** | 1 | 10% (10) | 13 | 10-12 |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 17 | 13-15 |
| | **Final Exam** | 2hr | 50% (50) | 16 | 16 |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Nuclear properties |
| **Week 2** | Mass of nucleus |
| **Week 3** | Charge of nucleus |
| **Week 4** | Nuclear density |
| **Week 5** | Binding energy |
| **Week 6** | Spin and parity of the nucleus |

| | |
|---|---|
| **Week 7** | energy, work, and power of the body |
| **Week 8** | Statics<br>Energy seperatio |
| **Week 9** | Nuclear decay<br>Nuclear fuel |
| **Week 10** | Gamma decay<br>Alpha decay<br>Nuclear fusion |
| **Week 11** | Beta decay<br>Nuclear fission |
| **Week 12** | Interaction radiation with matter |
| **Week 13** | Interaction of photons |
| **Week 14** | Elastic scattering and inelastic scattering |
| **Week 15** | Compound nucleus |
| **Week 16** | **Preparatory week before the final Exam** |

| **Delivery Plan (Weekly Lab. Syllabus)**<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| **Learning and Teaching Resources**<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Basic properties of nucleus, Springer,2003.<br>NUCLEAR FISSION AND FUSION, Welter Class publishing. | |

| | | |
|---|---|---|
| | | |
| **Recommended Texts** | NUCLEAR PHYSICS, of the European Physical Society<br>October 2016 | |
| **Websites** | https://www-nds.iaea.org/ | |

| **Grading Scheme**<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION FOR

# Solar thermal energy systems

**University Name**: ALkarkh University of Science

**College:** Energy and Environmental Science

**Dept:** Renewable Energies

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Solar thermal energy systems | | | **Module Delivery** | |
| **Module Type** | | | | ☒ **Theory**<br>☒ **Lecture**<br>x **Lab**<br>**x Tutorial**<br>☐ **Practical**<br>**x Seminar** | |
| **Module Code** | REE48144 | | | | |
| **ECTS Credits** | 7 | | | | |
| **SWL (hr/sem)** | 175 | | | | |
| **Module Level** | 4 | | **Semester of Delivery** | 8 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Dr. Mohammad AL dharob | | **e-mail** | Dr.m.aldharob@kus.edu.iq | |
| **Module Leader's Acad. Title** | LECTURER | | **Module Leader's Qualification** | PHD | |
| **Module Tutor** | NONE | | **e-mail** | NONE | |
| **Peer Reviewer Name** | NONE | | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | 20/6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | REE35027 | **Semester** | 5 |
| **Co-requisites module** | | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Study solar radiation its (principles and characteristics)<br>2. Study heat transfer of solar energy system radiation<br>3. Study the solar heat collectors |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Calculate the solar heat radiation<br>2. Known the best design of solar heat system<br>3. Understand the principle of work of solar thermal system.<br>4. Understand of principle work of the solar heat collectors<br>5. |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students. |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 94 | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 81 | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | 175 | | |

| Module Evaluation<br>تقييم المادة الدراسية |
|---|

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| Formative assessment | Quizzes | 2 | 10% (10) | | |
| | Assignments | 2 | 10% (10) | | |
| | Projects / Lab. | 1 | 10% (10) | | |
| | Report | 1 | 10% (10) | | |
| Summative assessment | Midterm Exam | 2 hr | 10% (10) | | |
| | Final Exam | 2hr | 50% (50) | | |
| Total assessment | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

| | Material Covered |
|---|---|
| Week 1 | Introduction of solar thermal energy |
| Week 2 | solar radiation |
| Week 3 | Solar radiation and energy conservation |
| Week 4 | Angles of solar rotation |
| Week 5 | Heat transfer of solar thermal energy |
| Week 6 | Solar thermal power economies |
| Week 7 | Solar thermal energy kinds |
| Week 8 | Mid exam |
| Week 9 | Solar thermal energy parts |
| Week 10 | Solar thermal collectors (1) |
| Week 11 | |
| Week 12 | Solar thermal collectors (2) |
| Week 13 | |
| Week 14 | Active and passive solar heating system |
| Week 15 | |
| Week 16 | **Preparatory week before the final Exam** |

## Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

| | Material Covered |
|---|---|
| **Week 1** | Coating color effect of collectors of solar thermal energy |
| **Week 2** | |
| **Week 3** | Measuring of fluid properties for solar thermal energy |
| **Week 4** | |
| **Week 5** | The effect of direction and slope of solar thermal energy system |
| **Week 6** | |
| **Week 7** | Comparation between collector types efficiency |

## Learning and Teaching Resources
مصادر التعلم والتدريس

| | Text | Available in the Library? |
|---|---|---|
| **Required Texts** | Principle of solar engineering<br>D.yogi Goswami | Not found |
| **Recommended Texts** | | Not found |
| **Websites** | | |

## 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 |
| | | | | |

**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.

# MODULE DESCRIPTION FORM

# نموذج وصف المادة الدراسية

**University Name**: ALkarkh University of Sciences

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information<br>معلومات المادة الدراسية | | | | | |
|---|---|---|---|---|---|
| **Module Title** | Wind energy | | | **Module Delivery** | |
| **Module Type** | C | | | ☒ Theory<br>☐ Lecture<br>☒ Lab<br>☐ Tutorial<br>☐ Practical<br>☒ Seminar | |
| **Module Code** | REE48043 | | | | |
| **ECTS Credits** | 6 | | | | |
| **SWL (hr/sem)** | 150 | | | | |
| **Module Level** | 4 | | **Semester of Delivery** | 8 | |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Amani Ibrahim Mohamed | | **e-mail** | dr.amani_altmimi@kus.edu.iq | |
| **Module Leader's Acad. Title** | Assist. Prof | | **Module Leader's Qualification** | PhD | |
| **Module Tutor** | None | | **e-mail** | None | |
| **Peer Reviewer Name** | None | | **e-mail** | None | |
| **Scientific Committee Approval Date** | 20/ 6/2023 | | **Version Number** | 1 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Aims**<br>أهداف المادة الدراسية | 1. Describe the basics, principles and concepts of wind energy<br>2. 1- Describe the basics, principles and concepts of wind energy<br>3. Calculation of wind energy density<br>4. Selection of promising areas<br>5. Design Wind farm<br>6. Calculation the Efficiency |
| **Module Learning Outcomes**<br><br>مخرجات التعلم للمادة الدراسية | 1. Evaluation of wind energy sources<br>2. Wind farm design<br>3. Calculate the total productivity of a wind farm<br>4. Using computer programs for wind energy |
| **Indicative Contents**<br>المحتويات الإرشادية | |

| Learning and Teaching Strategies<br>استراتيجيات التعلم والتعليم | |
|---|---|
| **Strategies** | |

| Student Workload (SWL)<br>الحمل الدراسي للطالب | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | | | |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | | | |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | | | |

## Module Evaluation

تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| Formative assessment | Quizzes | 2 | 10% (10) | | |
| | Assignments | 2 | 10% (10) | | |
| | Projects / Lab. | 1 | 10% (10) | | |
| | Report | 1 | 10% (10) | | |
| Summative assessment | Midterm Exam | 2 hr | 10% (10) | | |
| | Final Exam | 2hr | 50% (50) | | |
| Total assessment | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

| | Material Covered |
|---|---|
| Week 1 | Introduction to the concept of renewable energy sources |
| Week 2 | Wind (definition, composition, acting forces) |
| Week 3 | The physical principle of wind power (derivatives) |
| Week 4 | Statistical distributions applied to wind energy (definition and importance) |
| Week 5 | Review & Exam |
| Week 6 | Wind Energy and Weibull Distribution (Defining & Importance) |
| Week 7 | Wind power density and Weibull distribution |
| Week 8 | Wind turbines and power curve |
| Week 9 | Energy efficiency |
| Week 10 | Review & Exam |
| Week 11 | Wind farm |
| Week 12 | Wind farm design |
| Week 13 | WAsP (WIND ATLAS ANALYSIS PROGRAME) |
| Week 14 | |
| Week 15 | |
| Week 16 | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | Wind rose |
| **Week 2** | contour lines of wind speed |
| **Week 3** | Persistence of wind direction |
| **Week 4** | Basic of Wasp software |
| **Week 5** | Basic of sigmaplot software |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | • WIND RESOURCE ASSESSMENT HANDBOOK<br>• WIND ENERGY METEOROLOGY | |
| **Recommended Texts** | Fundamentals of renewable energy processes<br>ALDO V.DA ROSA | |
| **Websites** | | |

| Grading Scheme<br>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 |
| | | | | |

**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.

# MODULE DESCRIPTION OF

# ECONOMICS OF ENERGY

**University Name**: ALkarkh University of Science

**College:** Renewable Energy and Environmental Sciences

**Dept:** Renewable Energy Sciences

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Economics of energy** | | | **Module Delivery** | |
| **Module Type** | **C** | | | ☒ **Theory**<br>☒ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☒ **Seminar** | |
| **Module Code** | **REE48147** | | | | |
| **ECTS Credits** | 5 | | | | |
| **SWL (hr/sem)** | 125 | | | | |
| **Module Level** | | 4 | **Semester of Delivery** | | 8 |
| **Administering Department** | | REE | **College** | CRE | |
| **Module Leader** | Firas Abdulrazzaq Hadi | | **e-mail** | Firas.A.Hadi@kus.edu.iq | |
| **Module Leader's Acad. Title** | | Asst. Prof. | **Module Leader's Qualification** | | Ph.D. |
| **Module Tutor** | Firas Abdulrazzaq Hadi | | **e-mail** | NONE | |
| **Peer Reviewer Name** | | NONE | **e-mail** | NONE | |
| **Scientific Committee Approval Date** | | 20/6/2023 | **Version Number** | | 1 |

| Relation with other Modules | | | |
|---|---|---|---|
| **Prerequisite module** | REE47039 | **Semester** | 7 |
| **Co-requisites module** | No | **Semester** | No |

| Module Aims, Learning Outcomes and Indicative Contents | |
|---|---|
| **Module Aims** | This course aims to familiarize students with the economics of energy markets and the associated environmental policies. It will help students in developing the tools to examine the energy markets and to assess the effectiveness of environmental regulations. |
| **Module Learning Outcomes** | Professional Development: Graduates will embody a general awareness of issues in agricultural and natural resource management and their implications in a larger societal context. Students will begin to develop a network of personal and professional connections which will foster an understanding of the culture surrounding professional expectations and conduct. Communication Skills: Graduates will demonstrate proficiency in oral and written communication in terms of substance, organization, mechanics, documentation, and synthesis. Proficient students will have the ability to clearly communicate findings, critically and analytically, at a professional level within their chosen career. |
| **Indicative Contents** | This course examines energy and environment issues from an economics perspective. The course begins by discussing fundamental concepts in energy economics. We examine the structures of oil, natural gas and electricity markets, and and policies regarding renewables, transportation, and climate change. We also cover the topics of pollution and sustainable economic growth. We discuss the effectiveness of environmental policies such as mandated technologies, taxes, subsidies and pollution permit trading. This course incorporates the issue of climate change in the economic analysis, as it is now acknowledged as an important constraint and policies are aimed at decarbonizing the economy |

| Learning and Teaching Strategies | |
|---|---|
| **Strategies** | 1- Speaking 2- Discussion 3- Reports 4- Projects 5- Assignments |

| Student Workload (SWL) | | | |
|---|---|---|---|
| **Structured SWL (h/sem)** | 63 | **Structured SWL (h/w)** | 4 |
| **Unstructured SWL (h/sem)** | 62 | **Unstructured SWL (h/w)** | 4.1 |
| **Total SWL (h/sem)** | 125 | | |

## Module Evaluation

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5,10 | LO #1,2 and 8,9,15 |
| | **Assignments** | 2 | 10% (10) | 2,12 | LO # 5,6,7,10 |
| | **Projects / Lab.** | 1 | 10% (10) | - | |
| | **Report** | 1 | 10% (10) | 13 | LO #3,4,11,12,13,14 |
| **Summative assessment** | **Midterm Exam** | 2 hr | 10% (10) | 7 | LO # 1-8 |
| | **Final Exam** | 2hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

## Delivery Plan (Weekly Syllabus)

| | **Material Covered** |
|---|---|
| **Week 1** | Overview of Energy Economics, Energy Statistics, Energy |
| **Week 2** | Economic Foundations of Energy Demand |
| **Week 3** | Empirical Analysis of Energy Demand |
| **Week 4** | Energy Demand Management |
| **Week 5** | Energy Efficiency |
| **Week 6** | Economics of Non-renewable Energy Supply |
| **Week 7** | Economics of Renewable Energy Supply |
| **Week 8** | Energy Markets |
| **Week 9** | History of Oil Industry and the International Oil Market |
| **Week 10** | Economics of Environment Protection |
| **Week 11** | Environmental Protection and Pollution |
| **Week 12** | Climate Change Economics |
| **Week 13** | Environmental Effects |
| **Week 14** | Economics of RE |
| **Week 15** | Economics of Non-RE |
| **Week 16** | **Preparatory week before the final Exam** |

| Delivery Plan (Weekly Lab. Syllabus) | |
|---|---|
| | **Material Covered** |
| **Week 1** | / |
| **Week 2** | / |
| **Week 3** | / |
| **Week 4** | / |
| **Week 5** | / |
| **Week 6** | / |
| **Week 7** | / |

| Learning and Teaching Resources | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | Handbook of Global Energy Policy by Andreas Goldthau | |
| **Recommended Texts** | 1- Energy Trading and Risk Management by Iris Mack<br>2- There is no textbook for this course. However, we will be assigning a few sections from Pindyck, R., and D. Rubinfeld (2005) primarily for review purposes: | |
| **Websites** | https://economics.colostate.edu/wp-content/uploads/sites/7/2018/03/ECON-444.001-Syllabus-SP18-Burkhardt.pdf | |

# Module Description of Impact production energy on the environment

| Module Information | | | | | |
|---|---|---|---|---|---|
| **Module Title** | **Impact production energy on the environment** | | | **Module Delivery** | |
| **Module Type** | **E** | | | ☒ **Theory**<br>☐ **Lecture**<br>☐ **Lab**<br>☒ **Tutorial**<br>☐ **Practical**<br>☐ **Seminar** | |
| **Module Code** | **REE48048 E2** | | | | |
| **ECTS Credits** | **4** | | | | |
| **SWL (hr/sem)** | **100** | | | | |
| **Module Level** | **4** | | **Semester of Delivery** | | **8** |
| **Administering Department** | REE | | **College** | CRE | |
| **Module Leader** | Hasan Mohammed Luaibi | | **e-mail** | hasan.luaibi@kus.edu.iq | |
| **Module Leader's Acad. Title** | Assistant Professor | | **Module Leader's Qualification** | | Ph.D |
| **Module Tutor** | None | | **e-mail** | E-mail | |
| **Peer Reviewer Name** | None | | **e-mail** | E-mail | |
| **Scientific Committee Approval Date** | 20/06/2023 | | **Version Number** | 1.0 | |

| Relation with other Modules<br>العلاقة مع المواد الدراسية الأخرى | | | |
|---|---|---|---|
| **Prerequisite module** | None | **Semester** | |
| **Co-requisites module** | None | **Semester** | |

| Module Aims, Learning Outcomes and Indicative Contents<br>أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية | |
|---|---|
| **Module Objectives**<br>أهداف المادة الدراسية | The main objectives of impact production energy on the environment module that covers the basics of production energy and how it effects on the environment , which include:<br><br>1. Understanding the students to the concept of the effects of production of energy on the environment and the laws and legislation that have been developed to reduce them and its great importance in the specialization of our college and our department and its relationship to providing alternative, clean and renewable energy instead of energy production that leads to environmental pollution and its significant effects on climate change and community health.<br>2. Understanding the students to the difference between non-renewable energy types and their sources and renewable energy types and their sources, which are commensurate with the student's academic level, and also commensurate with the cognitive objectives of the department to which the student belongs.<br>3. Understanding the students to most important international and local laws and regulations to reduce environmental pollution resulting from the production of non-renewable energy. |
| **Module Learning Outcomes**<br>مخرجات التعلم للمادة الدراسية | The students will be able to:<br><br>1. How can discover the effects of production of energy on the environment.<br>2. How can to distinguish between non-renewable energy types and their sources and renewable energy types and their sources.<br>3. How can reading important international and local laws and regulations to reduce environmental pollution resulting from the production of non-renewable energy. |
| **Indicative Contents**<br>المحتويات الإرشادية | Indicative content includes the following.<br><br>**<u>Theory:</u>**<br>- Introducing to the concept of the effects of production of energy on the environment. [6 hrs.].<br>- The types of production the non-renewable energy. [3 hrs.].<br>- The sources of the non-renewable energy. [3hrs]<br>- The types of production the renewable energy. [6 hrs.]<br>- The sources of the non-renewable energy. [3hrs.]<br>- Environmental reality in the world as a result of conventional energy production [9 hrs.]<br>- Global warming phenomena. [3 hrs.]<br>- Using the renewable energy as alternative of the non-renewable energy. [9 hrs.]<br>- The important international and local laws and regulations to reduce environmental pollution resulting from the production of conventional energy. [3 hrs.] |

## Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

| | |
|---|---|
| **Strategies** | **1. Lectures:** used to introduce and explain the concepts of the effects of production of energy on the environment and the laws and legislation that have been developed to reduce them and its great importance in the specialization of our college and our department and its relationship to providing alternative, clean and renewable energy instead of energy production that leads to environmental pollution and its significant effects on climate change and community health, and what the difference between non-renewable energy types and their sources and renewable energy types and their sources, which are commensurate with the student's academic level, and also commensurate with the cognitive objectives of the department to which the student belongs, in addition to most important international and local laws and regulations to reduce environmental pollution resulting from the production of non-renewable energy.<br>**2. Interactive discussions:** used to engage students in critical thinking and problem-solving questions related to using the renewable energy as alternative of the conventional energy in iraq through group discussions, debates, case studies, and simulations.<br>**3. Multimedia resources:** used to enhance student engagement and understanding of complex concepts related to the effects of production of energy on the environment through videos, and animations**.**<br>**4. Assessment and feedback:** used to measure student learning and provide feedback on their progress through quizzes, exams, and projects. |

## Student Workload (SWL)
الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا

| | | | |
|---|---|---|---|
| **Structured SWL (h/sem)**<br>الحمل الدراسي المنتظم للطالب خلال الفصل | 48 | **Structured SWL (h/w)**<br>الحمل الدراسي المنتظم للطالب أسبوعيا | 3 |
| **Unstructured SWL (h/sem)**<br>الحمل الدراسي غير المنتظم للطالب خلال الفصل | 52 | **Unstructured SWL (h/w)**<br>الحمل الدراسي غير المنتظم للطالب أسبوعيا | 3.5 |
| **Total SWL (h/sem)**<br>الحمل الدراسي الكلي للطالب خلال الفصل | **100** | | |

## Module Evaluation
تقييم المادة الدراسية

| | | Time/Number | Weight (Marks) | Week Due | Relevant Learning Outcome |
|---|---|---|---|---|---|
| **Formative assessment** | **Quizzes** | 2 | 10% (10) | 5 and 10 | LO #1, #2 and #3, #6 |
| | **Assignments** | 2 | 10% (10) | 2 and 12 | LO #3, #4 and #5, #7 |
| | **Discussions** | 1 | 10% (10) | Continuous | All |
| | **Report** | 1 | 10% (10) | 13 | LO #2, #3 and #5 |
| **Summative assessment** | **Midterm Exam** | 1hr | 10% (10) | 7 | LO #1 - #5 |
| | **Final Exam** | 3hr | 50% (50) | 16 | All |
| **Total assessment** | | | 100% (100 Marks) | | |

| Delivery Plan (Weekly Syllabus)<br>المنهاج الاسبوعي النظري | |
|---|---|
| | **Material Covered** |
| **Week 1** | Introducing to the concept of the effects of production of energy on the environment. |
| **Week 2** | Introducing to the concept of the effects of production of energy on the environment. |
| **Week 3** | The types of production the non-renewable energy. |
| **Week 4** | The sources of the non-renewable energy. |
| **Week 5** | The types of production the renewable energy. |
| **Week 6** | The types of production the renewable energy. |
| **Week 7** | The sources of the non-renewable energy. |
| **Week 8** | Med term exam + Environmental reality in the world as a result of conventional energy production |
| **Week 9** | Environmental reality in the world as a result of conventional energy production |
| **Week 10** | Environmental reality in the world as a result of conventional energy production |
| **Week 11** | Global warming phenomena. |
| **Week 12** | Using the renewable energy as alternative of the non-renewable energy. |
| **Week 13** | Using the renewable energy as alternative of the non-renewable energy. |
| **Week 14** | Using the renewable energy as alternative of the non-renewable energy. |
| **Week 15** | The important international and local laws and regulations to reduce environmental pollution resulting from the production of conventional energy. |
| **Week 16** | **Final Exam** |

| Delivery Plan (Weekly Lab. Syllabus)<br>المنهاج الاسبوعي للمختبر | |
|---|---|
| | **Material Covered** |
| **Week 1** | |
| **Week 2** | |
| **Week 3** | |
| **Week 4** | |
| **Week 5** | |
| **Week 6** | |
| **Week 7** | |

| Learning and Teaching Resources<br>مصادر التعلم والتدريس | | |
|---|---|---|
| | **Text** | **Available in the Library?** |
| **Required Texts** | 1) John P. Holdren and Kirk R. Smith, energy the environment and health, chapter three, 2015.<br>2) The Energy and Resources Institute, 2014, Waste to Resources: A Waste Management Handbook. | No |
| **Recommended Texts** | 1) Most federal environmental laws and regulatory agencies weakened since 2000. | No |
| **Websites** | 1) NATO's Smart Energy Team (SENT) final report, (2015) http://www.natolibguides.info/ld.php?content_id=18110194.<br>2) Taken from http://www.epa.gov/epaoswer/non-hw/muncpl/reduce.htm. | |

| Grading Scheme<br>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 |
| | | | | |

**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.