**COURSE SPECIFICATION**

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| This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification. |

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| Baghdad University | 1. Teaching Institution |
| Faculty of Engineering / Department of Energy | 2. University Department/Centre |
| ENRE 415/ hydrogen energy, fuel cell | 3. Course title/code |
| B.Sc | 4. Programme(s) to which it contributes |
| Weekly | 5. Modes of Attendance offered |
| Yearly | 6. Semester/Year |
| 120 hours | 7. Number of hours tuition (total) |
| 22/5/2015 | 8. Date of production/revision of this specification |
| 9. Aims of the Course | |
| Fuel cells cleanly and efficiently convert chemical energy from hydrogen-rich fuels into electrical power and usable high quality heat in an electrochemical process that is virtually absent of pollutants. Similar to a battery. Each individual cell contains an anode, a cathode and a electrolyte layer. | |
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| 10· Learning Outcomes, Teaching ,Learning and Assessment Method |
| 1. Knowledge and Understanding   A1-Electrochemical cell.  A2-Fuel cell reaction.  A3-Thermodynamics of fuel.  A4 -Chemical production of hydrogen.  A5-elctrolytic hydrogen.  A6- hydrogen storage. |
| B. Subject-specific skills  B 1 Calculation concentrations to find models weight.  B 2 - Write chemical equations.  B 3 - Application of thermal and kinetic laws of chemical reactions.  B4- learn to write the equation. |
| Teaching and Learning Methods |
| . The method of lecturing.1  . discussion with the students.2  . Give examples solved by students groups.3  . Follow-up students in solving possible problems.4 |
| Assessment methods |
| . a daily and monthly tests.1  . practical and theoretical tests in the laboratory.2 |
| C. Thinking Skills  C1. A1-research sources.  C 2-learning scientific terms.  C 3-hold discussions with the students and the professor.  C 4- throw seminars between the students and the professor. |

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| D. General and Transferable Skills (other skills relevant to employability and personal development)  D1-education students to engineering knowledge.  D2-read the periodic table of the elements and nuclear scientifically incorrect.  D3-linking practical experience with theoretical ideas. |

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| 11. Course Structure | | | | | |
| Assessment Method | Teaching  Method | Unit/Module or Topic Title | ILOs | Hours | Week |
| Discussions | Lectures | Hydrogen isotopes | History of hydrogen | 3 | 1 |
| Discussions | Lectures | Kinetics and thermo. | Hydrogen energy | 3 | 2 |
| Discussions | Lectures | Properties of hydrogen elements | Physical and chemical properties | 3 | 3 |
| Discussions | Lectures | Hydrogen fuel | Advantages and disadvantages | 3 | 4 |
| Discussions | Lectures | Methods of production | Preparing of hydrogen gas | 3 | 5 |
| Discussions | Lectures | Hydrogen manufacturing | Uses of hydrogen gas | 3 | 6 |
| Discussions | Lectures | Potential | Safety and handling | 3 | 7 |
| Discussions | Lectures | Hydrogen handling | Hydrogen storage | 3 | 8 |
| Discussions | Lectures | Production of hydrogen | Synthetic of Hydrogen | 3 | 9 |
| Discussions | Lectures | Fact of hydrogen | Hydrogen delivery | 3 | 10 |
| Discussions | Lectures | Fuel cell –basics | Fuel cell | 3 | 11 |
| Discussions | Lectures | Types of cells | Hydrogen fuel cell | 3 | 12 |
| Discussions | Lectures | Direct fuel cell | Methanol fuel cell | 3 | 13 |
| Discussions | Lectures | PH cell | Alkaline fuel cell | 3 | 14 |
| Discussions | Lectures | Acid cell | Phosphoric acid fuel cell | 3 | 15 |
| Discussions | Lectures | Combined heat and power | Fuel cell system | 3 | 16 |
| Discussions | Lectures | Fuel cell work | Heat recovery system | 3 | 17 |
| Discussions | Lectures | Busies , boats | Application of fuel cells | 3 | 18 |
| Discussions | Lectures | Markets and economics | Fuelling station | 3 | 19 |
| Discussions | Lectures | Environmental effects | Health effects of hydrogen | 3 | 20 |
| Discussions | Lectures | Balancing equations | Redox reactions | 3 | 21 |
| Discussions | Lectures | Standard potentials | Calvanic cell | 3 | 22 |
| Discussions | Lectures | Cell EMF | Effects of concentration | 3 | 23 |
| Discussions | Lectures | Types | Batteries | 3 | 24 |
| Discussions | Lectures | Alkaline battery | Dry cell battery | 3 | 25 |
| Discussions | Lectures | Acidic battery | Lead storage battery | 3 | 26 |
| Discussions | Lectures | Of water | Electrolysis | 3 | 27 |
| Discussions | Lectures | Quamtititative | Aspects of electrolysis | 3 | 28 |
| Discussions | Lectures | Standard EMF | Calculations | 3 | 29 |
| Discussions | Lectures | Equations | Half reaction electrode | 3 | 30 |
| Discussions | Lectures | Calvanic cell | Danial cell | 3 | 31 |
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| 12. Infrastructure | |
| 1. Chemical Engineering. 2. Quantitative Analysis. | Required reading:  · CORE TEXTS  · COURSE MATERIALS  · OTHER |
| Conduct experiments in chemistry lab and learn at their own experiences and scientific programs. | Special requirements (include for example workshops, periodicals, IT software, websites) |
| Practical training for students in the laboratories of the Ministry of Science and Technology / Renewable Energy Department, as well as lecturing. | Community-based facilities  (include for example, guest  Lectures , internship , field studies) |

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| 13. Admissions | |
| 25 | Pre-requisites |
| 10 | Minimum number of students |
| 30 | Maximum number of students |