**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 skillsB 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 | TeachingMethod | 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, guestLectures , internship , field studies) |

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