# Academic Programs Booklet

## College of Science

## 2017



Prepared By: VP For Academic Programs and Graduate Studies Office

# College of Science

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# College of Science

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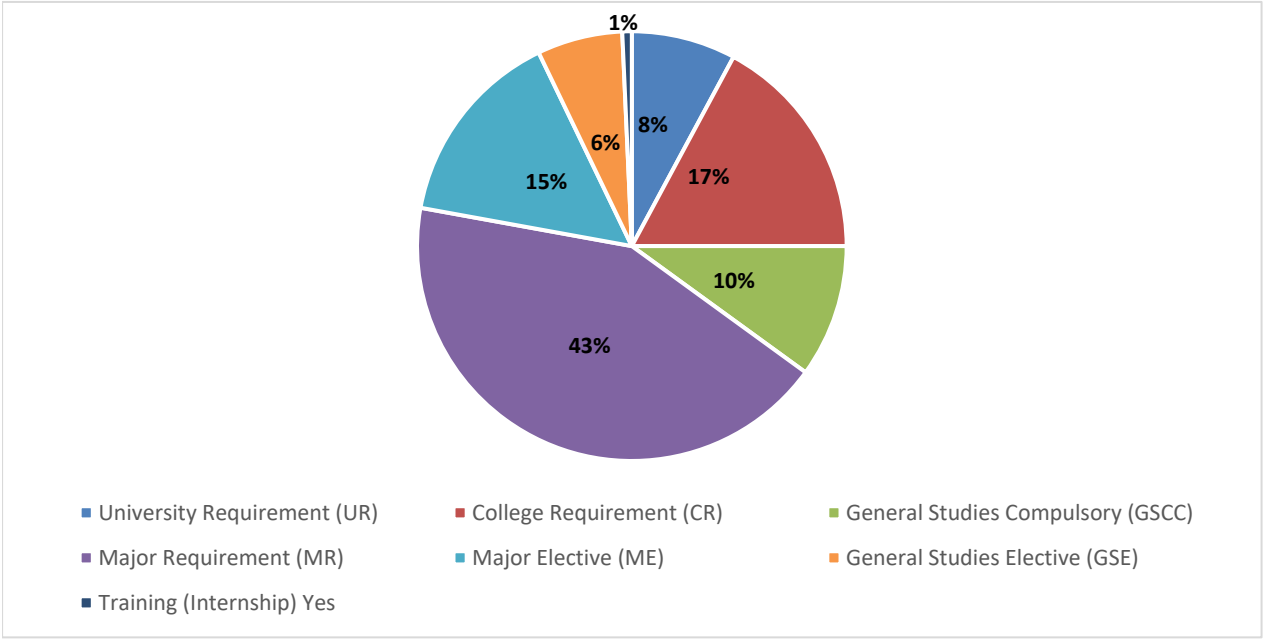
## List of College Requirement Courses

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite |
|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | |
| CHEMY 101 | Geneal Chemistry I | 3 | 3 | 4 | CR | ----- |
| BIOLS 102 | General Biology I | 3 | 3 | 4 | CR | ----- |
| PHYCS 101 | General Physics I | 3 | 3 | 4 | CR | ----- |
| MATHS 121 | Calculus and Analytic Geometry I | 3 | 0 | 3 | CR | ----- |
| TCS 113 | Computer Programming I | 3 | 2 | 3 | CR | ----- |
| ENGL 125 | English for Science I | 3 | 0 | 3 | CR | ----- |
| NGL 126 | English for Science II | 3 | 0 | 3 | CR | ----- |

# Bachelor of Science in Chemistry (Single Track) 2017

## Program Components




| | |
|---|---|
| **University Requirement (UR)** | **11** |
| **College Requirement (CR)** | **24** |
| **General Studies Compulsory (GSCC)** | **14** |
| **Major Requirement (MR)** | **60** |
| **Major Elective (ME)1** | **9** |
| **General Studies Elective (GSE)2** | **9** |
| **Training (Internship) Yes** | **1** |
| **Total Credit (CRD)** | **128** |

## Teaching Language: English

[1] Student must select **Seven** (3XX & 4XX) courses from Major Elective (ME) List.

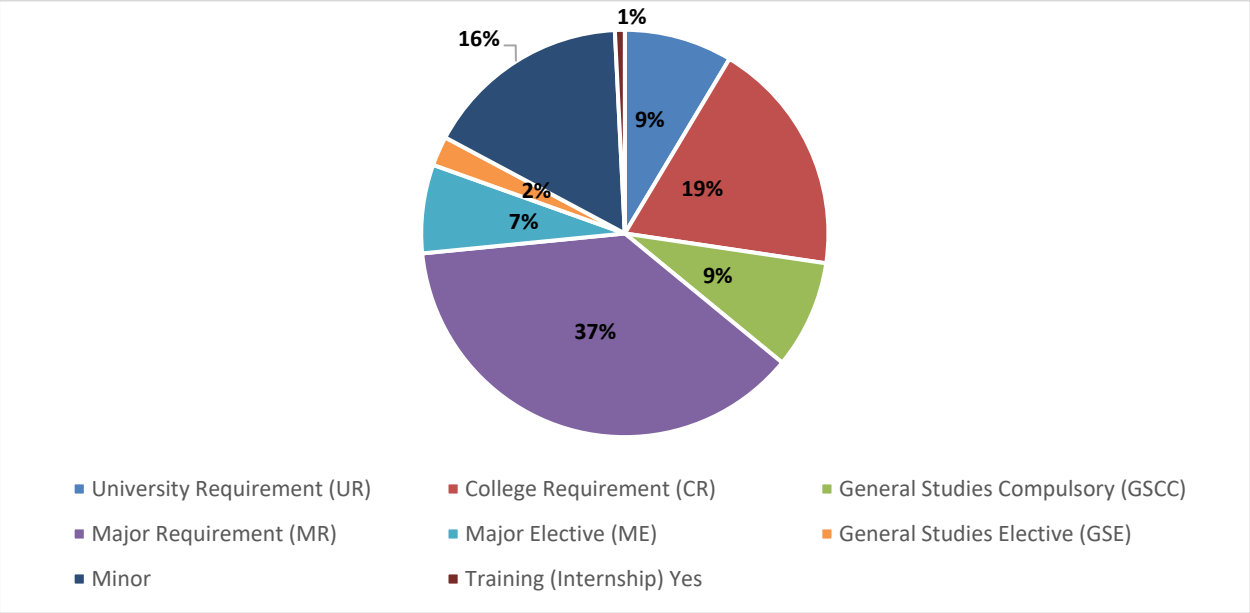
[2] Student must select **three** General Studies Electives, one of them must be from Humanities and Social Science.
Note:

- Free Elective Courses: any UOB course excluding: (1) courses offered for special students, (2) courses covered in the B.Sc. curriculum, (3) courses equivalent or lower than those already taken in the curriculum and should not be a science course prepared by College of Science for other colleges.

- HU/SS Courses - Humanities and Social Science Component: Any course from the following:
  Humanities: Fine Arts, History, American Studies, Classics, Communications, English, (Foreign Language) French, Music, Philosophy, Theatre, Literature (Arabic), Religion (comparative).
  Social Science: Anthropology, Economics, Education, Geography, History, Psychology, Sociology, Women's Studies, Political Science.

# Bachelor of Science in Chemistry (Major Chemistry) 2017

## Program Components




| | |
|---|---|
| **University Requirement (UR)** | **11** |
| **College Requirement (CR)** | **24** |
| **General Studies Compulsory (GSCC)** | **11** |
| **Major Requirement (MR)** | **48** |
| **Major Elective (ME)[1]** | **9** |
| **General Studies Elective (GSE)[2]** | **3** |
| **Minor[3]** | **21** |
| **Training (Internship) Yes** | **1** |
| **Total Credit (CRD)** | **128** |

## Teaching Language: English

[1] Student should select **four** major elective courses from Major Elective List.

[2] Student should select **one** Elective course from Humanities and Social Science.

Note:

- HU/SS Courses - Humanities and Social Science Component: Any course from the following:
  Humanities: Fine Arts, History, American Studies, Classics, Communications, Foreign Language, Music, Philosophy, Theatre, Literature (Arabic), and Religion (comparative).
  Social Science: Anthropology, Economics, Education, Geography, History, Psychology, Sociology, Women's Studies, and Political Science.

[3] Student should take 7 courses as Minor track from one of the following specializations: Astronomy, Biology Computer Science, Mathematics, Physics, or Statistics according to the requirements of the department offering the minor.

**Important Note: Overlapping Courses**

If any of the listed courses in the minor requirements tables below is covered as part of the major degree requirements, then the student must replace them with an equal number of courses from the minor field, which are at the same level or higher. The total number of minor courses must be seven for all fields, with a minimum of 21 credit hours.

## Detailed Study Plan (Single Track) 2017

### Year 1 - Semester 1

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| ARAB 110 | Arabic Language Skills | 3 | 0 | 3 | UR | ----- | No |
| ITCS 113 | Computer Programming I | 3 | 2 | 3 | CR | ----- | No |
| ENGL 125 | English for Science I | 3 | 0 | 3 | CR | ----- | No |
| MATHS 121 | Calculus and Analytic Geometry I | 3 | 0 | 3 | CR | ----- | No |
| CHEMY 101 | General Chemistry I | 3 | 3 | 4 | CR | ----- | Yes |

### Year 1 - Semester 2

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| PHYCS 101 | General Physics I | 3 | 3 | 4 | CR | ----- | Yes |
| HIST 122 | Modern History of Bahrain and Citizenship | 3 | 0 | 3 | UR | ----- | No |
| MATHS 122 | Calculus and Analytic Geometry II | 4 | 0 | 4 | MSR | MATHS 121 | No |
| CHEMY 102 | General Chemistry II | 3 | 3 | 4 | MR | CHEMY 101 | Yes |
| ENGL 126 | English for Science II | 3 | 0 | 3 | CR | ENGL 125 | No |

### Year 2 - Semester 3

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| BIOLS 102 | General Biology I | 3 | 3 | 4 | CR | ----- | No |
| CHEMY 103 | Safety and Hazardous Chemicals | 2 | 0 | 2 | MR | ----- | Yes |
| CHEMY 231 | Physical Chemistry I | 3 | 2 | 3 | MR | CHEMY 102 | Yes |
| CHEMY 241 | Inorganic Chemistry I | 3 | 2 | 3 | MR | CHEMY 102 | Yes |
| PHYCS 102 | General Physics II | 3 | 3 | 4 | MSR | PHYCS 101 | No |

## Year 2 - Semester 4

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 211 | Analytical Chemistry I | 3 | 2 | 3 | MR | CHEMY 102 | Yes |
| CHEMY 221 | Organic Chemistry I | 3 | 2 | 3 | MR | CHEMY 102 | Yes |
| CHEMY 331 | Physical Chemistry II | 3 | 0 | 3 | MR | CHEMY 231 | Yes |
| CHEMY 341 | Inorganic Chemistry II | 3 | 0 | 3 | MR | CHEMY 241 | Yes |
| ISLM 101 | Islamic Culture | 3 | 0 | 3 | UR | ----- | No |

## Year 3 - Semester 5

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| BIOLS 315 | Biochemistry | 2 | 3 | 3 | MSR | CHEMY 221 & BIOLS 102 | No |
| CHEMY 311 | Analytical Chemistry II | 3 | 0 | 3 | MR | CHEMY 211 | Yes |
| CHEMY 321 | Organic Chemistry II | 3 | 0 | 3 | MR | CHEMY 221 | Yes |
| CHEMY 332 | Practical Physical Chemistry | 0 | 6 | 3 | MR | CHEMY 331 | Yes |
| GSE XXX | Humanities / Social Science | X | X | 3 | GSE | ----- | No |
| MATHS 205 | Differential Equations | 3 | 0 | 3 | MSR | MATHS 122 | No |

## Year 3 - Semester 6

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 322 | Practical Organic Chemistry | 0 | 6 | 3 | MR | CHEMY 321 | Yes |
| CHEMY 3/4XX | Major Elective 1 | X | X | 3 | ME | As Per ME list | Yes |
| CHEMY 421 | Organic Chemistry III | 3 | 0 | 3 | MR | CHEMY 321 | Yes |
| GSE XXX | Free Elective Course 1 | X | X | 3 | GSE | ----- | No |
| CHEMY 411 | Analytical Chemistry III | 3 | 0 | 3 | MR | CHEMY 311 | Yes |

**Training Requirement**

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 398 | Internship | 0 | 0 | 1 | MR-Training | Completion of 75 credits | No |

## Year 4 - Semester 7

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 323 | Organic Spectroscopy | 3 | 0 | 3 | MR | CHEMY 321 | Yes |
| CHEMY 342 | Practical Inorganic Chemistry | 0 | 6 | 3 | MR | CHEMY 341 | Yes |
| CHEMY 441 | Application of Group Theory of Inorganic Chemistry | 3 | 0 | 3 | MR | CHEMY 341 | Yes |
| CHEMY 432 | Physical Chemistry III | 3 | 0 | 3 | MR | CHEMY 331 | Yes |
| CHEMY 499 | Senior Research Project | 0 | 9 | 3 | MR | Department Approval | Yes |

## Year 4 - Semester 8

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 312 | Practical Analytical Chemistry | 0 | 6 | 3 | MR | CHEMY 311 | Yes |
| HIST 122 | Modern History of Bahrain and Citizenship | 3 | 0 | 3 | UR | ----- | No |
| CHEMY 4XX | Major Elective 2 | X | X | 3 | ME | As per ME list | Yes |
| CHEMY 4XX | Major Elective 3 | X | X | 3 | ME | As per ME list | Yes |
| GSE XXX | Free Elective Course 2 | X | X | 3 | GSE | ----- | No |

## Detailed Study Plan (Major Chemistry ) 2017

### Year 1 - Semester 1

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| ARAB 110 | Arabic Language Skills | 3 | 0 | 3 | UR | ----- | No |
| ITCS 113 | Computer Programming I | 3 | 2 | 3 | CR | ----- | No |
| ENGL 125 | English for Science I | 3 | 0 | 3 | CR | ----- | No |
| MATHS 121 | Calculus and Analytic Geometry I | 3 | 0 | 3 | CR | ----- | No |
| CHEMY 101 | General Chemistry I | 3 | 3 | 4 | CR | ----- | Yes |

### Year 1 - Semester 2

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| PHYCS 101 | General Physics I | 3 | 3 | 4 | CR | ----- | No |
| ENGL 126 | English for Science II | 3 | 0 | 3 | CR | ENGL 125 | No |
| CHEMY 102 | General Chemistry II | 3 | 3 | 4 | MR | CHEMY 101 | Yes |
| MATHS 122 | Calculus and Analytic Geometry II | 4 | 0 | 4 | MSR | MATHS 121 | No |
| HRLC 107 | Human Rights | 2 | 0 | 2 | UR | ----- | No |

### Year 2 - Semester 3

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| BIOLS 102 | General Biology I | 3 | 3 | 4 | CR | ----- | No |
| CHEMY 103 | Safety and Hazardous Chemicals | 2 | 0 | 2 | MR | ----- | Yes |
| CHEMY 231 | Physical Chemistry I | 3 | 2 | 3 | MR | CHEMY 102 | Yes |
| CHEMY 241 | Inorganic Chemistry I | 3 | 2 | 3 | MR | CHEMY 102 | Yes |
| PHYCS 102 | General Physics II | 3 | 3 | 4 | MSR | PHYCS 101 | No |

## Year 2 - Semester 4

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 211 | Analytical Chemistry I | 3 | 2 | 3 | MR | CHEMY 102 | Yes |
| CHEMY 221 | Organic Chemistry I | 3 | 2 | 3 | MR | CHEMY 102 | Yes |
| CHEMY 331 | Physical Chemistry II | 3 | 0 | 3 | MR | CHEMY 231 | Yes |
| CHEMY 341 | Inorganic Chemistry II | 3 | 0 | 3 | MR | CHEMY 241 | Yes |
| ISLM 101 | Islamic Culture | 3 | 0 | 3 | UR | ----- | No |

## Year 3 - Semester 5

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| HRLC 107 | Human Rights | 2 | 0 | 2 | UR | ----- | No |
| CHEMY 311 | Analytical Chemistry II | 3 | 0 | 3 | MR | CHEMY 211 | Yes |
| CHEMY 321 | Organic Chemistry II | 3 | 0 | 3 | MR | CHEMY 221 | Yes |
| CHEMY 332 | Practical Physical Chemistry | 0 | 6 | 3 | MR | CHEMY 331 | Yes |
| GSE XXX | Humanities / Social Science | X | X | 3 | GSE | ----- | No |
| Minor | Course 1 | X | X | 3 | Minor | As per Minor | No |

## Year 3 - Semester 6

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| PHYCS 324 | Atomic and Molecular Physics | 3 | 2 | 3 | MR | PHYCS 222 | Yes |
| CHEMY 322 | Practical Organic Chemistry | 0 | 6 | 3 | MR | CHEMY 321 | Yes |
| CHEMY 3/4XX | Major Elective 1 | X | X | 3 | ME | As per ME list | Yes |
| CHEMY 421 | Organic Chemistry III | 3 | 0 | 3 | MR | CHEMY 321 | Yes |
| Minor | Course 2 | X | X | 3 | Minor | As per Minor | No |
| HIST 122 | Modern History of Bahrain and Citizenship | 3 | 0 | 3 | UR | ----- | No |

**Training Requirement**

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 398 | Internship | 0 | 0 | 1 | MR-Training | Completion of 75 credits | No |

## Year 4 - Semester 7

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 323 | Organic Spectroscopy | 3 | 0 | 3 | MR | CHEMY 321 | Yes |
| CHEMY 342 | Practical Inorganic Chemistry | 0 | 6 | 3 | MR | CHEMY 341 | Yes |
| CHEMY 3/4XX | Major Elective 2 | X | X | 3 | ME | As per ME list | Yes |
| Minor | Course 3 | X | X | 3 | Minor | As per Minor | No |
| Minor | Course 4 | X | X | 3 | Minor | As per Minor | No |
| MATHS 205 | Differential Equations | 3 | 0 | 3 | MSR | MATH 122 | No |

## Year 4 - Semester 8

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 312 | Practical Analytical Chemistry | 0 | 6 | 3 | MR | CHEMY 311 | Yes |
| CHEMY 4XX | Major Elective 3 | X | X | 3 | ME | As per ME list | Yes |
| Minor | Course 5 | X | X | 3 | Minor | As per Minor | No |
| Minor | Course 6 | X | X | 3 | Minor | As per Minor | No |
| Minor | Course 7 | X | X | 3 | Minor | As per Minor | No |

## Major Elective Courses List

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| CHEMY 300 | Professional and Transferable Skills for Chemists | 3 | 0 | 3 | ME | CHEMY 102 | Yes |
| CHEMY 333 | Quantum Chemistry | 3 | 0 | 3 | ME | CHEMY 201 or MATHS 122 | Yes |
| CHEMY 348 | Industrial Inorganic Chemistry | 3 | 0 | 3 | ME | CHEMY 241 | Yes |
| CHEMY 351 | Principles and applications of Green Chemistry | 3 | 0 | 3 | ME | CHEMY 211 & CHEMY 221 | Yes |
| CHEMY 422 | Physical Organic Chemistry | 3 | 0 | 3 | ME | CHEMY 321 | Yes |
| CHEMY 423 | Selected Topics in Heterocyclic Chemistry | 3 | 0 | 3 | ME | CHEMY 321 | Yes |
| CHEMY 424 | Natural Products | 2 | 3 | 3 | ME | CHEMY 321 | Yes |
| CHEMY 425 | Mechanism in organic Chemistry | 3 | 0 | 3 | ME | CHEMY 321 | Yes |
| CHEMY 426 | Food Chemistry | 2 | 3 | 3 | ME | CHEMY 321 | Yes |
| CHEMY 428 | Industrial Organic Chemistry | 3 | 0 | 3 | ME | CHEMY 321 | Yes |
| CHEMY 431 | Chemical Dynamics: Catalyst and Surface Chemistry | 3 | 0 | 3 | ME | CHEMY 331 | Yes |
| CHEMY 434 | Polymer Chemistry | 2 | 3 | 3 | ME | CHEMY 321 | Yes |
| CHEMY 435 | Advance Thermodynamics | 3 | 0 | 3 | ME | CHEMY 331 | Yes |
| CHEMY 438 | Electrochemistry | 3 | 0 | 3 | ME | CHEMY 331 | Yes |
| CHEMY 442 | Bio-inorganic Chemistry | 2 | 3 | 3 | ME | CHEMY 341 | Yes |
| CHEMY 443 | Inorganic Reaction Mechanisms | 3 | 0 | 3 | ME | CHEMY 341 | Yes |
| CHEMY 452 | Environmental Chemistry | 2 | 3 | 3 | ME | CHEMY 312 | Yes |
| CHEMY 453 | Organic Environmental Chemistry | 2 | 3 | 3 | ME | CHEMY 322 | Yes |
| CHEMY 441 | Application of Group Theory of Inorganic Chemistry | 3 | 0 | 3 | ME | CHEMY 341 | Yes |
| CHEMY 411 | Analytical Chemistry III | 3 | 0 | 3 | ME | CHEMY 311 | Yes |
| CHEMY 432 | Physical Chemistry III | 3 | 0 | 3 | ME | CHEMY 331 | Yes |
| CHEMY 499 | Senior Research Project | 0 | 9 | 3 | ME | Department Approval | Yes |

## General Studies Elective Courses List

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite |
|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | |
| ARAB 141 | Modern Arabic Lit. | 3 | 0 | 3 | GSE | ------ |
| ARAB 242 | Arabic Poetry In The Renaissance Period | 3 | 0 | 3 | GSE | ------ |
| ART 133 | Fundamentals of Music and Its Appreciation | 3 | 0 | 3 | GSE | ------ |
| ART 141 | Drawing and Painting | 2 | 1 | 3 | GSE | ------ |
| ART 221 | Traditional Music of Bahrain and Its Application | 3 | 0 | 3 | GSE | ------ |
| CHL 101 | Introduction to Chinese Language | 3 | 0 | 3 | GSE | ------ |
| CHL 102 | Basic Chinese Language | 3 | 0 | 3 | GSE | CHL 101 |
| EDAR 126 | Playing on Piano and Org 1 | 3 | 0 | 3 | GSE | ------ |
| EDPS 144 | Psychology of Learning and Memory | 3 | 0 | 3 | GSE | ------ |
| EDTC 100 | Teaching and Learning Technology | 3 | 0 | 3 | GSE | ------ |
| ENGL 130 | Introduction to Literature | 3 | 0 | 3 | GSE | ------ |
| | | | | | | |
| FREN 141 | French I | 3 | 0 | 3 | GSE | ------ |
| FREN 142 | French II | 3 | 0 | 3 | GSE | FREN 141 |
| GERM 101 | Introduction to German | 3 | 0 | 3 | GSE | ------ |
| HISTO 212 | Contemporary History of The Arab World | 3 | 0 | 3 | GSE | ------ |
| HISTO 281 | Landmarks of Islamic Civilisation | 3 | 0 | 3 | GSE | ------ |
| ISLM 114 | Quranic Sciences | 3 | 0 | 3 | GSE | ------ |
| ISLM 136 | Biography of The Prophet | 3 | 0 | 3 | GSE | ------ |
| ISLM 141 | Introduction to Shari'A | 3 | 0 | 3 | GSE | ------ |
| ISLM 252 | Islamic Doctrine | 3 | 0 | 3 | GSE | ------ |
| JAPN 101 | Japanese Level I | 3 | 0 | 3 | GSE | ------ |
| JAPN 102 | Japanese Level II | 3 | 0 | 3 | GSE | JAPN 101 |
| KL 101 | Korean Language I | 3 | 0 | 3 | GSE | ------ |
| KL 102 | Korean Language II | 3 | 0 | 3 | GSE | KL 101 |
| LAW 101 | Introduction to Legal Studies | 3 | 0 | 3 | GSE | ------ |
| LAW 102 | History of Law | 3 | 0 | 3 | GSE | ------ |
| LAW 106 | Constitutional Law I | 3 | 0 | 3 | GSE | ------ |
| PHEDE 214 | Principles of Educational Statistics | 3 | 0 | 3 | GSE | ------ |
| PSYC 103 | Introduction to Psychology | 3 | 0 | 3 | GSE | ------ |
| PSYC 120 | Psychology of Marriage | 3 | 0 | 3 | GSE | ------ |
| PSYC 211 | Educational Psychology | 3 | 0 | 3 | GSE | ------ |
| PSYC 281 | Thinking Skills | 3 | 0 | 3 | GSE | PSYC 103 or EDPS 241 |
| SOCIO 161 | Introduction to Sociology | 3 | 0 | 3 | GSE | ------ |
| SOCIO 181 | Introduction to Anthropology | 3 | 0 | 3 | GSE | ------ |
| SOCIO 191 | Citizenship, Identity and Globalization | 3 | 0 | 3 | GSE | ------ |
| SOCIO 224 | Sociology of Health | 3 | 0 | 3 | GSE | ------ |
| SOCIO 226 | Sociology of Arabian Gulf | 3 | 0 | 3 | GSE | ------ |
| TL 101 | Turkish Language | 3 | 0 | 3 | GSE | ------ |
| GSE XXX | Other electives | X | X | 3 | GSE | Department Approval |

## Course Description

**Course Code:** CHEMY 102 **Course Title:** General Chemistry II
Gaseous equilibrium (equilibrium constant, Kc and Kp); acids and bases (water dissociation, pH, weak acids and bases, salts); acid-base and precipitation equilibria (buffers, indicators, titrations, pH curves);thermochemistry (calorimetry, enthalpy, thermochemical equations, heats of formation, first law of thermodynamics); rate of reaction, rate and concentration, concentration and time, activation energy, rate and temperature, catalysis, mechanisms; electrochemistry; voltaic cells; cell voltages. Organic Chemistry (alkanes, alkenes, alkynes, isomerism, nomenclature, arenes, functional groups, reaction). Related practical work.

**Course Code:** CHEMY 103 **Course Title:** Safety and Hazardous Chemicals
General laboratory safety practices; laboratory safety equipment; first aid and emergency procedures; hazardous chemicals and health; flammable, carcinogenic; mutagenic and tetratogenic chemicals; information and training; COSHH regulations.

**Course Code:** CHEMY 201 **Course Title:** Mathematical Techniques for Chemistry
Graphs and functions; statistical treatment of chemical data; least-squares methods applied to experimental results in chemistry; complex numbers; determinants and matrices; differentiation and applications; indefinite integrals; infinite series; partial differentiation; common differential equations used in chemistry. **(Open as GSE to Chemistry students only).**

**Course Code:** CHEMY 211 **Course Title:** Analytical Chemistry I
Evaluation of analytical data; gravimetric and volumetric methods of analysis; precipitation titrimetery; complex formation titration; analytical electrochemistry and introduction to spectroscopy.

**Course Code:** CHEMY 221 **Course Title:** Organic Chemistry I
Fundamental concepts and technique in organic chemistry: The nature of organic compounds, alkanes and cycloalkanes; stereo chemistry of alkanes and overview of organic reactions; alkenes; structure and reactivity; alkenes; reactions and synthesis; alkynes; stereochemistry; alkyl halides and reactions of alkyl halides; nucleophilic substitution and elimination reactions. Related practical work.

**Course Code:** CHEMY 223 **Course Title:** Organic Chemistry for Biological Sciences
Topics in organic chemistry that are essential for biology majors. Structure and bonding, the nature of organic compounds, alkanes, alkenes, alkynes, aromatic compounds, stereochemistry, alkyl halide, alcohols, ethers, phenols, aldehydes, ketones, nucleophilic addition reactions, carboxylic acids, amines, bimolecular carbohydrates, amino acids, peptides, proteins and lipids.

**Course Code:**CHEMY 231 **Course Title:** Physical Chemistry I
Concepts and techniques in physical and theoretical chemistry including thermochemistry; the laws of thermodynamics; properties of gases; solution chemistry and colligative properties; phase equilibria; electrolytes and ionic equilibria; free energy and equilibrium.

**Course Code:** CHEMY 241 **Course Title:** Inorganic Chemistry I
A comparative and systematic study of the physical and chemical properties of representative metals and non- metals: Occurrence, abundances, extraction, uses, periodic trends, solubility, hydrolysis; common compounds of metals and non-metals; valence octet limitation and inert-pair effect; multicenter bond; catenation in chemistry of non-metals. Molecular structure and bonding: energytic of covalent and ionic bond formation. Structure of simple solids: energytic of ionic bond formation and Born-Haber cycle. Acids and bases: characteristics, reactions, and properties (HSAB). Oxidation and reduction: variation of oxidation states. Inorganic thermodynamics. Related practical work.

**Course Code:** CHEMY 300 **Course Title:** Professional and Transferable skills for Chemists
The course includes general study skills, communication skills (written and oral), critical thinking, ethics, group and project work, project management, time management, chemical information retrieval, experience in using IT packages for chemistry and chemistry computational programs. The course will be delivered by chemistry faculty through a combination of interactive learning workshops, group work, presentations and hand-on sessions in the computer laboratory.

**Course Code:** CHEMY 311 **Course Title:** Analytical Chemistry II
Methods of Analysis, Spectroscopic methods of analysis; properties of electromagnetic radiation; absorption spectroscopy; fluorescence and phosphorescence; optical spectroscopic instruments; applications of absorption spectroscopy to qualitative and quantitative analysis; atomic spectrometric methods; analytical separation and chromatography.

**Course Code:** CHEMY 312 **Course Title:** Practical Analytical Chemistry
Fundamental basis of instrumental analysis; detection limits; sampling methods; processing of experimental data; applications of chromatographic; electrochemical, spectral and thermal methods in quantitative and qualitative chemical analyses.

**Course Code:** CHEMY 321 **Course Title:** Organic Chemistry II
Conjugated dienes; benzene and aromaticity; electrophilic aromatic substitution reactions; alcohols, phenols and thiols; ethers, expoxides and sulfides, aldehydes and ketones; carboxylic acids and carboxylic acid derivatives aliphatic, aromatic derivatives, aliphatic and aromatic amines.

**Course Code:** CHEMY 322 **Course Title:** Practical Organic Chemistry
Advanced preparations of some multistep synthesis using important synthetic reagents and reactions of the following types: substitution, elimination, addition, rearrangement, cyclization, oxidation, reduction and alkylation.

**Course Code:** CHEMY 323 **Course Title:** Organic Spectroscopy
Electromagnetic radiation; infrared and ultraviolet-visible spectrum; interpretation of IR and UV spectra; nuclear magnetic resonance; chemical shift; counting of protons; spin-spin coupling; splitting patterns; spin-spin splitting; 1H-NMR and 13C-NMR; basic principles of mass spectroscopy; the use of molecular spectroscopy for the identification and elucidation of organic structures.

**Course Code:** CHEMY 331 **Course Title:** Physical Chemistry II
Solution of electrolytes; transport numbers; thermodynamics of ion; ionic equilibrium; the Donan equilibrium; electrochemical cells; thermodynamics of electro - chemical cells; reaction kinetics; reactions in solutions; composite reaction mechanism; chain reaction; catalysis; photochemical reactions; surface chemistry and colloids.

**Course Code:** CHEMY 332 **Course Title:** Practical Physical Chemistry
Techniques in physical measurement and quantitative studies, illustrated through experiments on thermodynamics, electrochemistry, transport phenomena, reaction kinetics, surface chemistry and colloids.

**Course Code:** CHEMY 333 **Course Title:** Quantum Chemistry
Fundamental concepts in theoretical chemistry, including quantum mechanics of some simple systems; atomic structure and spectra, and molecular orbital theory for some diatomic and simple polyatomic molecules.

**Course Code:** CHEMY 341 **Course Title:** Inorganic Chemistry II
Broad based topics in coordination chemistry. The development of coordination chemistry; Werener's theory; types of Lewis acid and base ligands and hard and soft acids and bases; preparation and stability of complex compounds; bonding; valence bond treatments; crystal field; ligand field and molecular orbital theories; electronic spectra, magnetic properties; stereochemistry of coordination compounds, mechanism of complex-ion reactions.

**Course Code:** CHEMY 342 **Course Title:** Practical Inorganic Chemistry
Investigation of chemical problems through a wide variety of techniques including preparation, separation, and instrumental, gravimetric and volumetric analysis of transition coordination compounds.

**Course Code:** CHEMY 348 **Course Title:** Industrial Inorganic Chemistry
Manufacture and application of: Primary inorganic materials, - mineral fertilizers, metal fertilizers, metal and their compounds, silicones and inorganic solids, nuclear fuel cycle.

**Course Code:** CHEMY 351 **Course Title:** Principles and Applications of Green Chemistry
Introduction to green chemistry principles; solving some environmental problems regarding industrial waste generation; the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances; controlling environmental pollution in atmosphere from management point of view and Life Cycle Assessment (LCA) and its application will also be dealt with as a case study.

**Course Code:** CHEMY 398 **Course Title:** Internship
The Internship course is designed to provide an opportunity to gain work experience related to the student's specified field of science, in a supervised workplace environment for a period of 8 consecutive weeks. The student shall submit a report upon completion.

**Course Code:** CHEMY 411 **Course Title:** Analytical Chemistry III
Electro analytical methods (polarography, voltammetry, coulometry); solvent extraction distribution coefficient, per cent of extraction, solvent extraction of metals; separation methods including the theory and application of gas- liquid chromatography, high performance liquid chromatography and electrophoresis; mass spectrometry (principles, instrumentation and applications); X-ray spectrometry (absorption, fluorescence and diffraction methods); nuclear magnetic resonance.

**Course Code:** CHEMY 421 **Course Title:** Organic Chemistry III
Carbonyl Alpha - Substitution reactions, carbonyl condensation reactions; heterocycles and nucleic acids; orbitals and organic chemistry; pericyclic reactions; carbohydrates; lipids; amino acids, peptides and proteins.

**Course Code:** CHEMY 422 **Course Title:** Physical Organic Chemistry
Orbital symmetry; LCOA model forpi a1 pi* orbitals of benzene; aromaticity and antiaromaticity; electrocyclic reactions (conrotatory and disrotatory); Huckel and Mobius bonding patterns; sigmatropic reactions; synthetic reactions; synthetic applications of Diels-Alder and Cope reaction.

**Course Code:** CHEMY 423 **Course Title:** Selected Topics in Heterocyclic Chemistry
Introduction to heterocyclic chemistry; aromaticity of heterocyclic compounds; heterocyclic analogues of cyclopentadiene with one heteroatom or more (pyrrole, furan, thiophence, pyrazole etc.); heterocyclic analogues of benzene with one or more heteroatom (pyridine, pyrimidine, pyrazines etc.); fused ring systems involving five membered ring (indole, benzofuran), heterocyclic analogues of naphthalene (quinoline, isoquinoline etc.); some compounds with more than two heteroatoms Purines, triazines etc.); chemical properties and synthetic methods; natural occurrence and biological importance.

**Course Code:** CHEMY 424 **Course Title:** Natural Products
Classification of natural products; natural products of biological importance; marine plants and pigments; and natural products in the flora of Bahrain. Experiments include isolation and identification of major classes of natural products with special reference to local plants.

**Course Code:** CHEMY 425 **Course Title:** Mechanism in Organic Chemistry
The strength of acids and bases, Nucleophilic substitution at a saturated carbon atom, Carbocations, electron-deficient N and O atoms and their reactions, Electrophilic and nucleophilic substitution in aromatic systems, Electrophilic and nucleophilic addition to C=C, Nucleophilic addition to C=O, Elimination reactions, Carbanions and their reactions, Radicals and their reactions.

**Course Code:** CHEMY 426 **Course Title:** Food Chemistry
This food chemistry course deals with the chemical composition and chemical changes that are related to food palatability, food appearance, odor, flavor, nutritional value, storage and foods spoilage. Chemistry offers solutions with regard to these pertinent issues of food quality, food additives and contaminants, food processing, food preservation, food adulteration as well as the issues of health, dietetic needs and food quality control. This course addresses these aspects of food chemistry and will be delivered through a combination of interactive learning lecture and laboratory work, discussion groups and research assignments activity.

**Course Code:** CHEMY 428 **Course Title:** Industrial Organic Chemistry
Raw materials used in organic chemical manufacture. Chemical manufacture processes. Products of organic chemical manufacture. Petroleum refinery processes and gasoline manufacture processes. Petrochemical production processes and their feed-stocks. Petroleum cracking processes and reforming, isomerization and alkylation processes. Petrochemical processes used in the Gulf e.g. for production of polyethylene, polyvinyl chloride and synthetic fibers. Drug, soaps (detergents), perfumes, food additives, pesticides and fertilizer industries.

**Course Code:** CHEMY 431 **Course Title:** Chemical Dynamics: Catalyst and Surface Chemistry
Chain reactions; fast reaction studies; photochemistry; reaction rate theories; homogeneous catalysis; heterogeneous catalysis; adsorption at liquid interface; colloids.

**Course Code:** CHEMY 432 **Course Title:** Chemical Dynamics: Catalysis and Surface Chemistry
Quantum mechanics: principles, techniques and applications; atomic structure and atomic spectra; molecular structure; molecular symmetry; molecular spectroscopy: rotational, vibrational and electronic spectra, magnetic spectroscopy; statistical mechanics.

**Course Code:** CHEMY 434 **Course Title:** Polymer Chemistry
Concepts and definitions, synthesis of some copolymers and complexes; different techniques for the determination of the rate of polymerization; molecular weight determination by different techniques (viscosity, dialometry, osmometry, and spectroscopy; etc.); determination of tacticity of polymers by spectroscopy NMR; IR) rubber like elasticity.

**Course Code:** CHEMY 435 **Course Title:** Advance Thermodynamics
The concepts and machinery of statistical mechanics and thermodynamics; thermodynamics of solutions; three component systems; activities and Huckle theory; activated complex theory; electrolyte processes.

**Course Code:** CHEMY 438 **Course Title:** Electrochemistry
Ionic interactions, Electrolytic conductance, Electrochemical Potentials, The electrified interface, Voltammetry of Reversible systems, Electro analytical Methods, Electrode Kinetics, Electrolysis, Industrial applications.

**Course Code:** CHEMY 441 **Course Title:** Application of Group Theory to Inorganic Chemistry
A semi-mathematical approach to group theory is developed through the stages of recognition of symmetry elements and operations, evaluation of binary products; properties of groups and group elements; systematic determination of point-group symmetries; generation of reducible and irreducible representations; and the construction and uses of point group character tables. Group theoretical treatment is applied to the symmetry of atomic orbitals; fundamental vibration stretching frequencies; hybridization schemes for atomic orbitals; crystal field splitting patterns, symmetry allowed electronic transitions, and molecular orbitals in transition metal complexes.

**Course Code:** CHEMY 442 **Course Title:** Bio-Inorganic Chemistry
The basic principles of bio-inorganic chemistry; the study of metalloprotein and other metal containing biological molecules; metal enzymes and other metal-activated enzymes in hydrolysis and group-transfer reaction,) the transition metals in biological redox reactions; nitrogen fixation and nitrogen cycle; oxygen carriers; the storage and transport of iron; the alkali metal and alkaline earth metal cations in biology; metal ions and chelating agents in medicine.

**Course Code:** CHEMY 443 **Course Title:** Inorganic Reaction Mechanisms
Determination of mechanism, classification of reactions, substitutions, reactions-general considerations, tetrahedral substitution, substitution at four - coordinate planar reaction centres, substitution in five - coordinate systems, substitution at six-coordinate reaction centres. Stereo chemical change, oxidation and reduction redox addition, elimination and substitution. Catalysis and conclusions.

**Course Code:** CHEMY 452 **Course Title:** Environmental Chemistry
Characteristics and chemical aspects of the atmosphere; hydrosphere and lithosphere; thermodynamic treatment of elemental stability in aqueous solutions; chemical speciation; chemical oceanography; biosphere; environmental effects of human activities, with emphasis on air pollution; case studies.

**Course Code:** CHEMY 453 **Course Title:** Organic Environmental Chemistry
Organic chemistry, organic functional group and classes of organic compounds, synthetic polymers. Biological chemistry. Organic air pollutants. The nature, sources and environmental chemistry of hazardous substances. Reduction, treatment and disposal of hazardous waste. Toxicology chemistry.

**Course Code:** CHEMY 499 **Course Title:** Senior Research Project
Undergraduate research project in experimental or theoretical chemistry under the supervision of a departmental staff member. Introduction to chemical literature, use of Chemical Abstracts and literature search procedure. An oral exam with a submission of a written report are compulsory.

## Minor in Astronomy for Physics Major

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| PHYCS 282 | The Cosmic Perspective | 3 | 0 | 3 | Minor | PHYCS 102 | Yes |
| PHYCS 283 | Planets and the Solar System | 3 | 0 | 3 | Minor | PHYCS 282 | Yes |
| PHYCS 381 | Stellar Astrophysics | 3 | 0 | 3 | Minor | PHYCS 283 | Yes |
| PHYCS 384 | Galaxies and the Universe | 3 | 0 | 3 | Minor | PHYCS 381 | Yes |
| PHYCS 385 | Observational Astronomy | 3 | 2 | 3 | Minor | PHYCS 381 | Yes |
| PHYCS 3/4XX* | (see the list below) | 3 | 0 | 3 | Minor | See the list below | Yes |
| PHYCS 3/4XX* | (see the list below) | 3 | 0 | 3 | Minor | See the list below | Yes |

***Students should select electives 3/4XX from the following list:**

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| PHYCS 383 | Space Science and Technology | 3 | 0 | 3 | Minor | PHYCS 102 | Yes |
| PHYCS 481 | Solar System Dynamics | 3 | 0 | 3 | Minor | PHYCS 283 | Yes |
| PHYCS 482 | High-Energy Astrophysics | 3 | 0 | 3 | Minor | PHYCS 384 | Yes |
| PHYCS 483 | Extragalactic Astrophysics and Cosmology | 3 | 0 | 3 | Minor | PHYCS 384 | Yes |
| PHYCS 485 | Astronomical Data Analysis | 3 | 2 | 3 | ME | PHYCS 385 | Yes |

## Minor in Biology for Chemistry Major

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Minor GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| BIOLS 103 | General Biology II | 3 | 3 | 4 | Minor | BIOLS 102 | Yes |
| BIOLS 250 | Microbiology | 2 | 3 | 3 | Minor | BIOLS 103 | Yes |
| BIOLS 222 | Plant Morphology | 2 | 3 | 3 | Minor | BIOLS 103 | Yes |
| BIOLS 234 | Chordate Zoology | 2 | 3 | 3 | Minor | BIOLS 103 | Yes |
| BIOLS 300 | Cell Biology | 2 | 3 | 3 | Minor | BIOLS 102 | Yes |
| BIOLS 340 | General Ecology | 2 | 3 | 3 | Minor | BIOLS 103 | Yes |
| BIOLS 4XX* | (see the list below) | 2 | 3 | 3 | Minor | See the list below | Yes |

### * List of Electives for Minor Biology

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Minor GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| BIOLS 441 | Environmental Impact Assessment | 2 | 3 | 3 | Minor | BIOLS 340 | Yes |
| BIOLS 442 | Conservation Biology | 2 | 3 | 3 | Minor | BIOLS 340 | Yes |
| BIOLS 451 | Immunology | 2 | 3 | 3 | Minor | BIOLS 250 | Yes |
| BIOLS 452 | Biology of Prokaryotes | 2 | 3 | 3 | Minor | BIOLS 250 | Yes |
| BIOLS 481 | Fish and Fisheries | 2 | 3 | 3 | Minor | BIOLS 234 | Yes |

## Minor in Computer Science for Chemistry Major

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| ITCS 114 | Computer Programming II | 3 | 2 | 3 | Minor | ITCS 113 | Yes |
| ITCS 214 | Data Structures | 3 | 2 | 3 | Minor | ITCS 114 | Yes |
| ITCS 285 | Database Management Systems | 3 | 2 | 3 | Minor | ITCS 214 | Yes |
| ITCS 316 | Human-Computer Interaction | 3 | 2 | 3 | Minor | ITCS 214 | Yes |
| ITCS 389 | Software Engineering I | 3 | 2 | 3 | Minor | ITCS 285 | Yes |
| ITCS* 3/4XX | (see the list below) | 3 | 2 | 3 | Minor | See the list below | Yes |
| ITCS* 3/4XX | (see the list below) | 3 | 2 | 3 | Minor | See the list below | Yes |

### List of Electives for Minor Computer Science

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| ITCS 333 | Internet Software Development | 3 | 2 | 3 | Minor | ITCS 285 | Yes |
| ITCS 444 | Mobile Application Development | 3 | 2 | 3 | Minor | ITCS 333 | Yes |
| ITCS 453 | Multimedia and Hypermedia Systems | 3 | 2 | 3 | Minor | ITCS 214 | Yes |
| ITCS 489 | Software Engineering II | 3 | 2 | 3 | Minor | ITCS 389 | Yes |
| ITCS 494 | Selected Topics in Computer Science | 3 | 2 | 3 | Minor | Department Approval | Yes |
| ITCS 496 | Physical Implementation of DBMS | 3 | 2 | 3 | Minor | ITCS 285 | Yes |

## Minor in Mathematics for Chemistry Major

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| MATHS 204 | Calculus and Analytic Geometry III | 3 | 0 | 3 | Minor | MATHS 122 | Yes |
| MATHS 205 | Calculus and Analytic Geometry III OR Differential Equations | 3 | 0 | 3 | Minor | MATHS 122 | Yes |
| MATHS 211 | Linear Algebra | 3 | 0 | 3 | Minor | MATHS 121 | Yes |
| MATHS 3/4XX | Minor 4 to be taken from Mathematics: Major Requirements or Major Electives | 3 | 0 | 3 | Minor | See the list below | Yes |
| MATHS 3/4XX | Minor 5 to be taken from Mathematics: Major Requirements or Major Electives | 3 | 0 | 3 | Minor | See the list below | Yes |
| MATHS 3/4XX | Minor 6 to be taken from Mathematics: Major Requirements or Major Electives | 3 | 0 | 3 | Minor | See the list below | Yes |
| MATHS 3/4XX | Minor 7 to be taken from Mathematics: Major Requirements or Major Electives | 3 | 0 | 3 | Minor | See the list below | Yes |

### List of Electives for Minor Mathematics

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| MATHS 303 | Analysis I | 3 | 0 | 3 | Minor | MATHS 204 | Yes |
| MATHS 304 | Analysis II | 3 | 0 | 3 | Minor | MATHS 303 | Yes |
| MATHS 305 | History of Mathematics | 3 | 0 | 3 | Minor | ----- | Yes |
| MATHS 307 | Introduction to Lie Group for Differential Equations | 3 | 0 | 3 | Minor | MATHS 204 & MATHS 205 | Yes |
| MATHS 311 | Abstract Algebra I | 3 | 0 | 3 | Minor | MATHS 211 | Yes |
| MATHS 312 | Abstract Algebra II | 3 | 0 | 3 | Minor | MATHS 311 | Yes |
| MATHS 331 | Numerical Analysis I | 3 | 0 | 3 | Minor | MATHS 122 & (ITCS 114 or ITCS 102) | Yes |
| MATHS 332 | Numerical Analysis II | 3 | 0 | 3 | Minor | MATHS 331 | Yes |
| MATHS 341 | Complex Analysis I | 3 | 0 | 3 | Minor | MATHS 204 | Yes |
| MATHS 352 | Number Theory | 3 | 0 | 3 | Minor | MATHS 121 | Yes |
| MATHS 381 | Methods of Applied Mathematics | 3 | 0 | 3 | Minor | MATHS 204 & MATHS 205 | Yes |

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| MATHS 385 | Analytical Mechanics | 3 | 0 | 3 | Minor | MATHS 204 & MATHS 205 | Yes |
| MATHS 387 | Fluid Mechanics | 3 | 0 | 3 | Minor | MATHS 385 | Yes |
| MATHS 388 | Vector Analysis and Tensor Analysis | 3 | 0 | 3 | Minor | MATHS 204 | Yes |
| MATHS 395 | Problem Solving in Mathematics | 3 | 0 | 3 | Minor | MATHS 381 | Yes |
| MATHS 401 | Applied Mathematics I | 3 | 0 | 3 | Minor | MATHS 381 | Yes |
| MATHS 402 | Applied Mathematics II | 3 | 0 | 3 | Minor | MATHS 401 | Yes |
| MATHS 405 | Theory of Differential Equations | 3 | 0 | 3 | Minor | MATHS 205 | Yes |
| MATHS 411 | Commutative Algebra | 3 | 0 | 3 | Minor | MATHS 312 | Yes |
| MATHS 415 | Topology I | 3 | 0 | 3 | Minor | MATHS 253 & MATHS 303 | Yes |
| MATHS 416 | Topology II | 3 | 0 | 3 | Minor | MATHS 415 | Yes |
| MATHS 417 | Functional Analysis | 3 | 0 | 3 | Minor | MATHS 211 & MATHS 303 | Yes |
| MATHS 441 | Complex Analysis II | 3 | 0 | 3 | Minor | MATHS 341 | Yes |
| MATHS 451 | Topics in Geometry | 3 | 0 | 3 | Minor | MATHS 253 | Yes |
| MATHS 452 | Differential Geometry | 3 | 0 | 3 | Minor | MATHS 204 | Yes |
| MATHS 461 | Elementary Partial Differential Equation | 3 | 0 | 3 | Minor | MATHS 204 & MATHS 205 | Yes |

## Minor in Physics for Chemistry Major

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| PHYCS 209 | Bulk Properties of Matter | 3 | 2 | 3 | Minor | PHYCS 101 | Yes |
| PHYCS 221 | Methods of Mathematical Physics I | 3 | 0 | 3 | Minor | PHYCS 102 & MATHS 122 | Yes |
| PHYCS 222 | Modern Physics | 3 | 2 | 3 | Minor | PHYCS 102 | Yes |
| PHYCS 324 | Atomic and Molecular Physics | 3 | 2 | 3 | Minor | PHYCS 222 | Yes |
| PHYCS 3XX* | Any course from List 1 | X | X | 3 | Minor | See the list 1 below | Yes |
| PHYCS 3/4XX** | Any course from the list 2 | X | X | 3 | Minor | See the list 2 below | Yes |
| PHYCS 3/4XX** | Any course from the list 2 | X | X | 3 | Minor | See the list 2 below | Yes |

**List 1: Electives for Minor Physics**

**Students should select one course from the following courses**

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| PHYCS 314 | Classical Mechanics | 3 | 2 | 3 | Minor | PHYCS 221 or MATHS 205 | Yes |
| PHYCS 326 | Quantum Mechanics I | 3 | 2 | 3 | Minor | PHYCS 222 | Yes |
| PHYCS 348 | Electromagnetic Theory | 3 | 2 | 3 | Minor | PHYCS 221 or MATHS 205 | Yes |
| PHYCS 365 | Thermal Physics | 3 | 2 | 3 | Minor | PHYCS 209 | Yes |

**List 2: Electives for Minor Physics**

**Students should select two courses 3/4XX from the following courses**

**If Student did not register PHYCS 102 as major support course, then he/she has to register it as minor.**

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| PHYCS 102 | General Physics II | 3 | 3 | 4 | Minor | PHYCS 101 | Yes |
| PHYCS 314 | Classical Mechanics | 3 | 2 | 3 | Minor | PHYCS 221 or MATHS 205 | Yes |
| PHYCS 331 | Physical Optics | 3 | 2 | 3 | Minor | PHYCS 102 | Yes |
| PHYCS 348 | Electromagnetic Theory | 3 | 2 | 3 | Minor | PHYCS 221 or MATHS 205 | Yes |
| PHYCS 365 | Thermal Physics | 3 | 2 | 3 | Minor | PHYCS 209 | Yes |
| PHYCS 351 | Solid State Physics I | 3 | 2 | 3 | Minor | PHYCS 222 | Yes |
| PHYCS 425 | Computational Physics | 3 | 2 | 3 | Minor | PHYCS 221 or MATHS 205 | Yes |
| PHYCS 471 | Nuclear Physics | 3 | 2 | 3 | Minor | PHYCS 326 | Yes |
| PHYCS 333 | Oscillations and Waves | 3 | 2 | 3 | Minor | PHYCS 221 | Yes |
| PHYCS 344 | Plasma Physics | 3 | 0 | 3 | Minor | PHYCS 348 | Yes |
| PHYCS 353 | Physics of Materials | 3 | 2 | 3 | Minor | PHYCS 209 | Yes |
| PHYCS 364 | Meteorology | 3 | 2 | 3 | Minor | PHYCS 209 | Yes |
| PHYCS 366 | Environmental Physics | 3 | 2 | 3 | Minor | PHYCS 209 | Yes |
| PHYCS 382 | Astronomy | 3 | 0 | 3 | Minor | PHYCS 102 | Yes |
| PHYCS 383 | Space Science and Technology | 3 | 0 | 3 | Minor | PHYCS 102 | Yes |
| PHYCS 408 | Medical Physics | 3 | 2 | 3 | Minor | PHYCS 209 | Yes |
| PHYCS 421 | Mathematical Physics | 3 | 0 | 3 | Minor | PHYCS 221 | Yes |
| PHYCS 422 | Particle Physics | 3 | 0 | 3 | Minor | PHYCS 326 | Yes |
| PHYCS 427 | Quantum Mechanics II | 3 | 0 | 3 | Minor | PHYCS 326 | Yes |
| PHYCS 428 | Space and Time | 3 | 0 | 3 | Minor | PHYCS 222 & PHYCS 314 | Yes |
| PHYCS 444 | Electrodynamics | 3 | 0 | 3 | Minor | PHYCS 348 | Yes |
| PHYCS 462 | Statistical Physics | 3 | 0 | 3 | Minor | PHYCS 365 | Yes |
| PHYCS 465 | Solar Energy | 3 | 2 | 3 | Minor | PHYCS 365 | Yes |
| PHYCS 492 | Selected Topics in Modern Physics | 3 | 0 | 3 | Minor | Department Approval | Yes |

## Minor in Statistics for Chemistry Major

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| MATHS 211 | Linear Algebra | 3 | 0 | 3 | Minor | MATHS 121 | Yes |
| STAT 271 | Introduction to Probability | 3 | 0 | 3 | Minor | MATHS 121 | Yes |
| STAT 371 | Probability and Statistics I | 3 | 0 | 3 | Minor | MATHS 122 & STAT 271 | Yes |
| STAT 372 | Probability and Statistics II | 3 | 0 | 3 | Minor | STAT 371 | Yes |
| STAT 373 | Statistical Packages and Simulation | 3 | 0 | 3 | Minor | STAT 271 | Yes |
| STAT 3/4XX | Minor 6 to be taken from Statistics: Major Requirements or Major Electives courses List | 3 | 0 | 3 | Minor | See the list below | Yes |
| STAT 3/4XX | Minor 7 to be taken from Statistics: Major Requirements or Major Electives courses List | 3 | 0 | 3 | Minor | See the list below | Yes |

### List of Electives for Minor Statistics

| Course Code | Course Title | Course Hours | | | Course Type | Pre requisite | Major GPA |
|---|---|---|---|---|---|---|---|
| | | LEC | PRAC | CRD | | | |
| STAT 374 | Regression Analysis | 3 | 0 | 3 | Minor | MATHS 211 & STAT 372 | Yes |
| STAT 378 | Surveys and Sampling | 3 | 0 | 3 | Minor | STAT 371 | Yes |
| STAT 381 | Time Series Analysis | 3 | 0 | 3 | Minor | STAT 372 | Yes |
| STAT 382 | Biostatistics and Epidemiology | 3 | 0 | 3 | Minor | MATHS 121 | Yes |
| STAT 383 | Demography and Population Studies | 3 | 0 | 3 | Minor | MATHS 121 | Yes |
| STAT 384 | Bayesian Inference | 3 | 0 | 3 | Minor | STAT 371 | Yes |
| STAT 385 | Econometrics | 3 | 0 | 3 | Minor | ECON140 & STAT 271 | Yes |
| STAT 391 | Non-Parametric Statistics | 3 | 0 | 3 | Minor | STAT 271 | Yes |
| STAT 392 | Operational Research I | 3 | 0 | 3 | Minor | MATHS 211 | Yes |
| STAT 393 | Operational Research II | 3 | 0 | 3 | Minor | STAT 392 | Yes |
| STAT 394 | Linear programming | 3 | 0 | 3 | Minor | MATHS 122 & STAT 271 | Yes |
| STAT 471 | Decision Theory | 3 | 0 | 3 | Minor | STAT 372 | Yes |
| STAT 472 | Analysis and Design of Experiments | 3 | 0 | 3 | Minor | STAT 372 | Yes |
| STAT 473 | Introduction to Multivariate Analysis | 3 | 0 | 3 | Minor | MATHS 211 & STAT 372 | Yes |
| STAT 474 | Statistical Modelling | 3 | 0 | 3 | Minor | STAT 372 | Yes |
| STAT 476 | Queuing systems | 3 | 0 | 3 | Minor | STAT 372 | Yes |
| STAT 478 | Introduction to Stochastic Processes | 3 | 0 | 3 | Minor | STAT 372 | Yes |
| STAT 479 | Reliability | 3 | 0 | 3 | Minor | STAT 372 | Yes |

# Major Support Requirements Courses Descriptions

**Course Code:** MATHS 122 **Course Title:** Calculus and Analytic Geometry II
Methods of integration. Applications to areas; arc length; volumes; etc. Parametric equations. Polar coordinates. Infinite series. Taylors' theorem and power series.

**Course Code:** MATHS 205 **Course Title:** Differential Equations
Differential equations of first order and their solution. Separable and exact equations. Equations convertible to separable type. Higher order linear equations with constant coefficients (homogeneous and non-homogeneous). Power series method for second order linear equations. Variation of parameters. Laplace transform technique. Applications of differential equations.

**Course Code:** BIOLS 315 **Course Title**: Biochemistry
Principles of biological chemistry; the chemistry of water, acids and bases, and buffer control of pH. Protein structure and function; principles of enzymology, and carbohydrate, lipid, and nucleic acid structure and function. Basic intermediate metabolism including: protein, carbohydrate and lipid synthesis and breakdown; Kreb's cycle and oxidative phosphorylation; pentose phosphate pathway and the process of photosynthesis.

**Course Code:** PHYCS 102 **Course Title:** General Physics II
Electric charges and fields; Coulomb's and Gauss's laws; electric potential; capacitors and dielectrics; direct current circuits; Kirchoff's rules; magnetic field and flux; ampere's law; induced emf; Lenz's law; mutual and self-inductance; AC circuits; RLC circuit.

# University Requirements Courses Descriptions

**Course Code:** ARAB 110 **Course Title:** Arabic Language Skills
This course focuses on basic Arabic skills including form, function, and meaning. It also helps the student to appreciate and understand structures and approach them from a critical point of view, through various genres in literature.

**Course Code:** HIST 122 **Course Title:** Modern History of Bahrain and Citizenship
Spatial identity of Bahrain: Brief history of Bahrain until the 18th century; the historical roots of the formation of the national identity of Bahrain since the 18th century; the modern state and evolution of constitutional life in Bahrain; the Arabic and Islamic dimensions of the identity of Bahrain; the core values of Bahrain's society and citizenship rights (legal, political, civil and economic); duties; responsibilities and community participation; economic change and development in Bahrain; Bahrain's Gulf, Arab and international relations.

**Course Code:** HRLC 107 **Course Title:** Human Rights Principles
This course deals with the principles of human rights in terms of the definition of human rights, scope, sources with a focus on the International Bill of Human Rights; The Charter of the United Nations; Universal Declaration of Human Rights; The International Covenant on Economics, Social and Culture rights; Convention against Torture and other Cruel, Inhuman or Degrading Treatment or Punishment; Mechanics and the Constitutional Protection of Rights and Public Freedoms in Kingdom of Bahrain.

**Course Code:** ISLM 101 **Course Title:** Islamic Culture
An introduction to the general outline and principles of Islamic culture, its general characteristics, its relationships with other cultures, general principles of Islam in beliefs, worship, legislation and ethics.

# College Requirement Courses Descriptions

**Course Code:** CHEMY 101 **Course Title:** General Chemistry I
Significant figures, chemical formulas and equations; mass relations, limiting reactants and theoretical yield; Physical behaviour of gases; electronic structure, periodic table, covalent bonding; Lewis structures, Molecular structures, hybridization; molecular orbitals, solutions; colligative properties. Related practical work.

**Course Code:** BIOLS 102 **Course Title:** General Biology I
Properties of life; atoms, molecules and chemical bonds; biomolecules; cell structure and function; bioenergetics (intermediary metabolism); cell reproduction; Mendelian genetics; structure of DNA; RNA and protein synthesis; molecular genetics.

**Course Code**: PHYCS 101 **Course Title:** General Physics I
Units and measurements; brief review of vectors; Newton's laws of motion; projectile motion; work and energy; impulse and momentum; rotational dynamics; equilibrium of a rigid body; periodic motion.

**Course Code:** MATHS 121 **Course Title:** Calculus and Analytic Geometry I
Limits and continuity. Derivatives and integrals. Applications of derivatives which include mean value theorem, extrema of functions and optimization. Definite integrals and the Fundamental Theorem of Calculus. Derivatives and integrals of exponential, logarithmic and inverse Trigonometric functions.

**Course Code**: ITCS 113 **Course Title:** Computer Programming I
This course introduces problem solving and fundamental programming concepts and techniques implemented by a high-level programming language. Topics include primitive and compound data types, syntax, semantics, expressions, assignment, input, output, conditional and iterative control structures, functions.

**Course Code:** ENGL 125 **Course Title:** English for Science I
This is the first of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing. The course includes an extensive reading programme via a self-access lab.

**Course Code:** ENGL 126 **Course Title:** English for Science II
English for Science is the second of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing.