|  |  |
| --- | --- |
| **Course Title:**  | **Igneous and Metamorphic Petrology** |
| **Course Code:** | **GEO 323** |
| **Program:** | **Geology program** |
| **Department:**  | **Geology and Geophysics Department** |
| **College:** | **College of Science** |
| **Institution:** | **King Saud University**  |

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# A. Course Identification

|  |  |
| --- | --- |
| **1. Credit hours:** | **3** |
| **2. Course type** |
| **a.** | University |  | College |  | Department | **√** | Others |  |  |
| **b.** | Required | **√** | Elective |  |  |
| **3. Level/year at which this course is offered:** | 5th level |
| **4. Pre-requisites for this course** (if any)**:** GEO 221 |
| **5. Co-requisites for this course** (if any)**:** none |
|  |

## 6. Mode of Instruction (mark all that apply)

| **No** | **Mode of Instruction** | **Contact Hours** | **Percentage**  |
| --- | --- | --- | --- |
| **1** | **Traditional classroom** | **✓** | 75% |
| **2** | **Blended**  | **✓** | 10% |
| **3** | **E-learning** | **✓** | 10% |
| **4** | **Correspondence** | **✓** | 5% |
| **5** | **Other**  | **✓** | 75% |

**7. Actual Learning Hours** (based on academic semester)

|  |  |  |
| --- | --- | --- |
| **No** | **Activity** | **Learning Hours** |
| **Contact Hours** |
| **1** | **Lecture** | 2 |
| **2** | **Laboratory/Studio** | 2 |
| **3** | **Tutorial**  |  |
| **4** | **Others** (specify) |  |
|  | **Total** | 4 |
| **Other Learning Hours\*** |
| **1** | **Study**  | 2 |
| **2** | **Assignments** | 2 |
| **3** | **Library** |  |
| **4** | **Projects/Research Essays/Theses**  | 2 |
| **5** | **Others** (specify) |  |
|  | **Total** | 6 |

**\*** The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

# B. Course Objectives and Learning Outcomes

|  |
| --- |
| 1. Course Description **Mineral composition of magmatic rocks- Classification of magmatic rocks- Origin and composition of magma- magmatic differentiation- volcanism and its products- emplacement mechanisms of plutonic rocks- geochemistry of igneous rocks and its relationship to their tectonic settings- Isotopes and radiometric dating- Introduction to metamorphism: its processes and categories- The phase rule and composition-assemblage diagrams- Metamorphic facies / Thermobarometry and P-T-t paths- Contact metamorphism / Dynamic metamorphism- Metamorphism in subduction zones / Ocean-floor metamorphism** |
|  |
| 2. Course Main Objective |
|  |

## 3. Course Learning Outcomes

| **CLOs** | **Aligned****PLOs** |
| --- | --- |
| 1 | **Knowledge:** |  |
| 1.1 | -To provide the student with an overall knowledge of the processes of metamorphism and their products-Develop the ability to make detailed maps in areas of igneous/metamorphic terrains. | Apply the concepts of plate tectonics and allochthonous terranes to recognize the regional metamorphic belts. |
| **2** | **Skills :** |  |
| 2.1 | -To enable the student to distinguish metamorphic lithologies and features in the field and under the polarizing microscope.-Calculate the radiometric ages of rock and minerals using isotopic data | Estimate the P-T condition of metamorphism on the basis of mineral chemistry |
| **3** | **Competence:** |  |
| 3.1 | -The student should eventually be capable of mapping metamorphic terrains and deciphering their tectonic milieu.-Team work is promoted by allocating the mapping of certain field areas to 3-4 student group | The student will learn how to conduct a proper field excursion and rely on himself in such situations. |

# C. Course Content

|  |  |  |
| --- | --- | --- |
| **No** | **List of Topics** | **Contact Hours** |
| 1 | **Mineral composition of magmatic rocks** | 3 |
| 2 | **Classification of magmatic rocks** | 2 |
| 3 | **Origin and composition of magma** | 2 |
| 4 | **magmatic differentiation** | 3 |
| 5 | **volcanism and its products** | 2 |
| 6 | **emplacement mechanisms of plutonic rocks** | 2 |
| 7 | **geochemistry of igneous rocks and its relationship to their tectonic settings** | 3 |
| 8 | **Isotopes and radiometric dating** | 2 |
| 9 | **Introduction to metamorphism: its processes and categories**  | 3 |
| 10 | **The phase rule and composition-assemblage diagrams** | 2 |
| 11 | **Metamorphic facies / Thermobarometry and P-T-t paths** | 2 |
| 12 | **Contact metamorphism / Dynamic metamorphism** | 2 |
| 13 | **Metamorphism in subduction zones / Ocean-floor metamorphism** | 2 |
| **Total** | 30 |

# D. Teaching and Assessment

## 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| **Code** | **Course Learning Outcomes** | **Teaching Strategies** | **Assessment Methods** |
| --- | --- | --- | --- |
| **1.0** | **Knowledge** |
| 1.1 | To provide the student with an overall knowledge of the processes of metamorphism and their products | -weekly lectures-Usages of different Arabic and English references, Internet articles, Term papers | **quizzes and exams** |
| **2.0** | **Skills** |
| 2.1 | To enable the student to distinguish metamorphic lithologies and features in the field and under the polarizing microscope. | Homework assignments and reports. | **Practical exams** |
| **3.0** | **Competence** |
| 3.1 | The student should eventually be capable of mapping metamorphic terrains and deciphering their tectonic milieu. | Lectures are supported by illustration, handouts and sometimes with presentation. Lectures are followed by numerous examples, some of which are practical in nature, to illustrate the application and use. | **Assignments and field reports** |

## 2. Assessment Tasks for Students

| **#** | **Assessment task\***  | **Week Due** | **Percentage of Total Assessment Score** |
| --- | --- | --- | --- |
| **1** | Assignment  | Bi-weekly | 15 % |
| **2** | First Test | weekly | 6 % |
| **3** | Mid-term exam | After the 10th week | 15% |
| **4** | 1st lab exam | After the 6th week | 12% |
| **5** | 2nd lab exam | Last week | 12% |
| **6** | Final exam | As per university schedule | 40 % |

**\*Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

# E. Student Academic Counseling and Support

|  |
| --- |
| **Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :** |
| Office hours allocated for students of this course are on average 3-4 hours per week, with more time available in the period just before the final exams |

# F. Learning Resources and Facilities

## 1.Learning Resources

|  |  |
| --- | --- |
| **Required Textbooks** | * Winter, J.D., 2002, An Introduction to Igneous and Metamorphic Petrology, Prentice Hall, 697 p.
* MacKenzie W.S. & Adams A.E., 1994, A Color Atlas of Rocks and Minerals in Thin Section, John Wiley & Sons, 192 p.
* Best, M.G., 2003, Igneous and Metamorphic Petrology, 2nd ed, Blackwell Science, 729 p
 |
| **Essential References Materials** | * Hall A. 1996. Igneous petrology, 2nd ed. Harlow, UK, Longman.
* Wilson M. Igneous petrogenesis: 1989. A global tectonic approach. Boston, Unwin Hyman.
* Mason R. (1990). Petrology of the Metamorphic Rocks, 2nd ed. Unwin Hyman, London.
* Barker A.J. (1998). Introduction to Metamorphic Textures and Microstructures. 2nd ed., Stanley Thornes, Cheltenham.
* Kornprobst, J. (2002). Metamorphic Rocks and Their Geodynamic Significance: A Petrological Handbook. Petrology and Structural Geology Series Vol. 12. Kluwer, Dordrecht.
* Yardley, B. W. D. (1989) An Introduction to Metamorphic Petrology, Longman, Harlow.
 |
| **Electronic Materials** | * Geochemistry of igneous rocks
* Teaching Phase Equilibria
* John Winter home page
* Atlas of Igneous and metamorphic rocks, minerals, and textures
* Journal of Metamorphic Geology
* THERMOCALC program and data set.
* MetPetDB: A database for metamorphic petrology.
 |
| **Other Learning Materials** | * Basic Geochemistry: Origin and Distribution of the Elements
* Basic Petrography
* Crystallography
* Ocean Crust and Ophiolites
* Arc Magmatism
* Phase Diagrams in Igneous Systems
* Petrogenesis of Granitic Rocks
* Radiogenic Isotopes in Geological Sciences
 |

## 2. Facilities Required

| **Item** | **Resources** |
| --- | --- |
| **Accommodation**(Classrooms, laboratories, demonstration rooms/labs, etc.) | * Lecture room equipped with a blackboard, overhead projector, computer and internet connection.
* The laboratory will have a blackboard, overhead projector with computer connection and seating arrangement for the students.
 |
| **Technology Resources** (AV, data show, Smart Board, software, etc.) | * An easily accessible computer lab.
 |
| **Other Resources** (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | * Printer – Scanner – data show
 |

# G. Course Quality Evaluation

| **Evaluation****Areas/Issues**  | **Evaluators**  | **Evaluation Methods** |
| --- | --- | --- |
| * Student questionnaire for evaluation of the conclusion of the course.
* Meeting and discussion between faculty and students.
 | * Faculty assessment of the course and effectiveness of teaching delivery.
* Periodic self- assessment of the program.
 | * Graduate Committee will review deficiencies based on the student evaluation, faculty input, course file, and program assessment.
* Feedback from employers and alumni surveys and graduating students’ input are used to identify any deficiencies in students’ ability in applying knowledge of properties and the use of structural materials.
* Organize workshop on effective teaching methods to enable instructors to improve their teaching skill.
 |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

**Assessment Methods** (Direct, Indirect)

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# H. Specification Approval Data

|  |  |
| --- | --- |
| **Council / Committee** | College of Science / Department of Geology and Geophysics |
| **Reference No.** |  |
| **Date** | 20th Oct 2020 |