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

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# A. Course Identification

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1. Credit hours:** | | | | **3(2+0+1)** | | | | | | | | | | | | |
| **2. Course type** | | | | | | | | | | | | | | | | |
| **a.** | University | |  | | College | | |  | Department | | | | **X** | Others |  |  |
| **b.** | | Required | | | | **X** | Elective | | |  |  | | | | | |
| **3. Level/year at which this course is offered:** | | | | | | | | | | | | **5 /1441 - 1442** | | | | |
| **4. Pre-requisites for this course** (if any)**:**  Nil | | | | | | | | | | | | | | | | |
| **5. Co-requisites for this course** (if any)**:** | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |

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

| **No** | **Mode of Instruction** | **Contact Hours** | **Percentage** |
| --- | --- | --- | --- |
| **1** | **Traditional classroom** | 75 | 100% |
| **2** | **Blended** | 0 | 0 |
| **3** | **E-learning** | 0 | 0 |
| **4** | **Correspondence** | 0 | 0 |
| **5** | **Other** | 0 | 0 |

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

|  |  |  |
| --- | --- | --- |
| **No** | **Activity** | **Learning Hours** |
| **Contact Hours** | | |
| **1** | **Lecture** | 45 |
| **2** | **Laboratory/Studio** | 30 |
| **3** | **Tutorial** | - |
| **4** | **Others** (specify) | - |
|  | **Total** | 75 |
| **Other Learning Hours\*** | | |
| **1** | **Study** | 30 |
| **2** | **Assignments** | 10 |
| **3** | **Library** | 10 |
| **4** | **Projects/Research Essays/Theses** | 20 |
| **5** | **Others** (specify) small projects presentation | - |
|  | **Total** | 70 |

**\*** 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 The course content includes the description, classification, composition, occurrence, distribution, nature and origin of igneous- and metamorphic rocks. It is designed to provide the basic principles and fundamental concepts of petrology, in light of recent advances on the subject, via lectures and laboratory investigations. The latter include systematic identification of the various rock groups using both hand samples, and thin sections under the polarizing microscope. Weekly laboratory assignments involving detailed and systematic description of lithologic & petrographic varieties are given. A field report containing observation, analysis and interpretation of geological features introduced during the petrology field trip is required.. |
|  |
| 2. Course Main Objective |
| * Describe all basic concepts of modern igneous and metamorphic petrology including   magma types, classification and distribution of igneous & metamorphic rocks.   * Develop an understanding of petrogenetic processes involved in the formation of magmas. * Describe factors controlling the process of metamorphism. * Determine metamorphic zones and facies based on mineral assemblages and interpret the P/T conditions of metamorphism. * Interpret the origin and evolutionary trends of igneous and metamorphic rocks based on chemical and mineralogical data. * Identify, using hand samples, the various rocks within the plutonic/volcanic groups, and identify the various types of thermal and regional metamorphic rocks. * Use the polarizing microscope to identify igneous and metamorphic rocks and their   Textures’, then describe and write scientific petrographic reports. |

## 3. Course Learning Outcomes

| **CLOs** | | **Aligned****PLOs** |
| --- | --- | --- |
| 1 | **Knowledge:** |  |
| 1.1 | Define, record, arrange, identify, relate, tabulate the basic geological concept of different rock’s types and related to their eveolution via tectictonic environmental processes, and their rock-forming minerals in both hand specimen and in thin-section., | Gain knowledge about origin of different and different types of rocks and minerals |
| 1.2 | Recall, listing, Reccall the different rock’s types (Structural, textural, mineralogical…ect.), and relate them to their environment and in the lab (minerology content under polarized microscope and hand specimen). |
| 1.3 | Stating, writing, describe, and memorized the the Evolution of principal of geological features of these rocks (Igneous & metamorphic), tectonics processes and evolution, structures, forming and development of various rocks types |
| 1... |  |  |
| 2 | Skills : |  |
| 2.1 | Compare, state between magmas influences in forming different igneous rocks’ types (the eruptive, plutonic and metamorphic) style and types of various igneous that will form  *(magma types, magma formation, magma compositions, magma heat generation, as well as in* metamorphic formation rocks in a region and metamorphic rocks’ types | Acquire skills about geologic of igneous and metamorphic rocks types and features in their environmental conditions | |
| 2.2 | Recognize, contrast, explainthe various observations of igneous and metamorphic rock and their mineral identification in hand specimen and in thin-section using a transmitted light microscope. the igneous & metamorphic rocks classification tables that accompany this section are arranged on the basis of igneous textures first, and further broken down on the basis of igneous and metamorphic rocks’ composition |
| 2.3 | Clarify, and summarise the igneous composition and metamorphic minerals content and assemblage on the basis of color: light = felsic composition, medium = intermediate composition, and dark = mafic composition, as well as on the metamorphism agents as working individually in a team. … . |
| 2... |  |  | |
| 3 | Competence: |  | |
| 3.1 | Demonstrate and modify igneous composition and metamorphic minerals content and assemblage on the basis of color: light = felsic composition, medium = intermediate composition, and dark = mafic composition, as well as on the metamorphism agents and tectonic environment status via scientific writing. | Communicate, in verbally and in written individual, as well as in a team-work or groups. | |
| 3.2 | Illustrate and write igneous composition and metamorphic minerals content and assemblage on the basis of color: light = felsic composition, medium = intermediate composition, and dark = mafic composition, as well as on the metamorphism agents as working in a teamwork |
| 3.3 | Communicating the results via Interpret, distinguish, demonstrate the formation and evolution to their phase diagrams relevant to igneous systems and petrogenic grids relevant to metamorphic systems of the rocks on the basis of mineral assemblages recorded in reference to their geological emplacement with others. |
| 3... |  |  | |

# C. Course Content

|  |  |  |
| --- | --- | --- |
| **No** | **List of Topics** | **Contact Hours** |
| 1 | Introduction to igneous and metamorphic | 2 |
| 2 | Mineral composition and Classification of magmatic rocks | 4 |
| 3 | Origin and composition of magma | 4 |
| 4 | magmatic differentiation | 2 |
| 5 | volcanism and its products | 3 |
| 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 | 3 |
| 9 | Introduction to metamorphism: its processes and categories | 4 |
| 10 | The phase rule and composition-assemblage diagrams | 4 |
| 11 | Metamorphic facies / Thermobarometry and P-T-t paths | 3 |
| 12 | Contact metamorphism / Dynamic metamorphism | 3 |
| 13 | Metamorphism in subduction zones / Ocean-floor metamorphism | 2 |
| 14 | Metamorphism in collision zones | 3 |
| 15 | Metamorphic and tectonic evolution of the Arabian Shield | 3 |
| **Total** | | 45 |

# 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 | **Defining, describing, record, outlines, the origin of the different rock’s types related to plate tectonic boundaries definition, geological setting of various rocks evolved vai or related to the Arabian shield microplate tectonics as principal terranes.** | **In class lecturing** | * **Quizzes,** * **Monthly majors and final exams.** |
| 1.2 | **Outlines how different rocks’ types, Evolution and creation processes, anf their minerals; contents, as well as their textures.** | **Lab work preparation and training.** | Evaluation of lab reports |
| 1.3 | **Describe, recall, and memorized the principal of geological features of the rocks and their minerals and types as well their evolutions processes.** | * ***Cooperative Learning.*** * ***Students groups discussion.*** * ***lectures*** * ***Laboratory efforts* and works reports.** | * **Quizzes,** * **Monthly majors and final exams** |
| **2.0** | **Skills** | | |
| 2.1 | Compare between various rocks types and their geologic initiation features and their initiation processes | * **Lectures and homework assignments.** | * **Oral exams** * **Quizzes** |
| 2.2 | **Explain and interpreting the various rocks types natural development processes and their occurrence.** | Problem solving in the tutorial | Checking the problems solved in the homework assignments |
| 2.3 | Work independently and as part of a team | Writing group reports | Assessment of the laboratory reports |
| 2.4 | Communicate results of work to others | Solving problems in groups as working in a group, and brain storming | Grading homework assignments, and lab reports |
| **3.0** | **Competence** | | |
| 3.1 | Scientific writing | Writing laboratory reports | Evaluating the laboratory written reports |
| 3.2 | Working in teams | Incorporating the use and utilization of computer in the course requirements | Evaluating the laboratory written reports |

## 

## 2. Assessment Tasks for Students

| **#** | **Assessment task\*** | **Week Due** | **Percentage of Total Assessment Score** |
| --- | --- | --- | --- |
| **1** | **Attendance, Homeworks (Questions, research on topics or a literature reviews ), and assignments** (class quizzes, scientific reports, field trip) | ***weekly*** | ***5%*** |
| **2** | **First Assessment Exam** | **6** | **10%** |
| **3** | **Presentation of Projects** | **8** | **5%** |
| **4** | **Lab and Quizes** | **4 – 8 - 12** | **30%** |
| **5** | **Second Assessment Exam** | **13** | **10%** |
| **6** | **Final Exam** | **15** | **40%** |
| **7** | **Total** |  | 100 |
| **8** |  |  |  |

**\*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 :** |
| * ***The faculty member by role and college regulation has to allocate a six consultation office hours per week.*** * ***These consultation office hours should be scheduled, timed and to be put or hanged on front of the faculty member’s office door for seeking the students’ attention.*** |

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# F. Learning Resources and Facilities

## 1.Learning Resources

|  |  |
| --- | --- |
| **Required Textbooks** | * ***Ronald, F. B., and Carol D. F. (2014). Essential of igneous and Metamorphic Petrology, Cambridge University Press, Neyork, USA.*** * ***Hadler, S. K. and Josp Tisljar. (2014). Introduction to mineralogy and petrology, Radarweg Amesterdam the Netherland.*** * Textbook: Petrology: Igneous, Sedimentary, Metamorphic (2012; by Raymond) is required. |
| **Essential References Materials** | * ***Gautom S. (2014). Petrology: principals and practice, Springer Heidleberg Newyork Dordrechi London.****.* |
| **Electronic Materials** | <https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html>  <http://www.tulane.edu/~sanelson/eens212/> |
| **Other Learning Materials** |  |

## 2. Facilities Required

| **Item** | **Resources** |
| --- | --- |
| **Accommodation**  (Classrooms, laboratories, demonstration rooms/labs, etc.) | * ***The faculty member by role and college regulation has to allocate a six consultation office hours per week.*** * ***These consultation office hours should be scheduled, timed and to be put or hanged on front of the faculty member’s office door for seeking the students’ attention.*** |
| **Technology Resources**  (AV, data show, Smart Board, software, etc.) | * ***Computer Lab should be equipped with at least 15 hardware, assisted with suitable software, one data show, and one smart board. at least 15 systems.*** |
| **Other Resources**  (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | * ***Availability of chemicals, glassware and equipment relevant to the course material.*** * ***Safety facilitie.*** |

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# G. Course Quality Evaluation

| **Evaluation**  **Areas/Issues** | **Evaluators** | **Evaluation Methods** |
| --- | --- | --- |
| Student course evaluation | Students | Direct |
| peer review | Faculty member | Direct |
| Periodic self- assessment of the program | Program coordinator | Direct |
| Faculty assessment of the course and effectiveness of teaching delivery | Instructor | Direct |
|  |  |  |
|  |  |  |
|  |  |  |

**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)

# H. Specification Approval Data

|  |  |
| --- | --- |
| **Council / Committee** | **Geology and Geophysics Department** |
| **Reference No.** |  |
| **Date** | **19/8/2019** |