King Saud University

College of Sciences

Geology and geophysics Department

جامعة الملك سعود
كلية العلوم
الجيولوجيا قسم
والجيوفيزياء

Kingdom of Saudi Arabia

The National Commission for Academic Accreditation & Assessment

COURSE SPECIFICATION

Of

Metamorphic Rocks

322 Geo

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1431- 1432 (2010/2011)

Course Specification

For Guidance on the completion of this template, please refer to Handbook 2 of Internal Quality Assurance Arrangements

Institution	**King Saud University**
College/Department	**College of Science / Geology Department**

A) Course Identification and General Information:

1. Course title and code: **Metamorphic Petrology (322 Geo)**
2. Credit hours : **3(2+0+1)**
3. Program(s) in which the course is offered. (If general elective available in many programs indicate this rather than list programs) **(Geology Program Of Bachelor Degree)**
4. Name of faculty member responsible for the course **Dr. Bassam Abdulmutti Abu Amarah**
5. Level/year at which this course is offered : 5^{th} level/ **3^{rd} year**
6. Pre-requisites for this course (if any) **Optical Mineralogy (224 Geo)**
7. Co-requisites for this course (if any) **Field Geology**
8. Location if not on main campus King Saud University Campus in Ad-Dariyah

B Objectives

1. Summary of the main learning outcomes for students enrolled in the course.

- The Course intends to investigate the metamorphic rock , the metamorphism processes, and its facies and rock-forming minerals , using the devices and instrumentations (Polarized microscope (P.M.), Microprobe (mineral Chemistry of the rock-forming minerals, ... etc. .

- This Course will develop student's knowledge of the metamorphic rocks and its metamorphism agents , and the principles behind it. Hence, the learning outcomes will be summarized as follows:

1) Provide the students with knowledge of the Metamorphic Petrology .
2) Initiating cognitive skill to generate the abilities of identifying the physical properties of metamorphic rocks, facies, and minerals.
3) Skilfulness in dealing with optics characteristics to identify, interpret the mineral- bearing of the rocks, and analyzing its genesis.
4) Skilfulness in communication with others to generate the strategically scientific thinking. Of imeplementation
5) Skilfulness in operating the computer with different types of software programs concerning metamorphic petrology for the seek of its implementation.

2. Briefly describe any plans for developing and improving the course that are being implemented. (eg increased use of IT or web based reference material, changes in content as a result of new research in the field)

1) The course content will be periodically reviewed by the instructor and the courses planning committee as and when necessary.
2) By using the internet in locating the recent books, articles, and periodicals related to igneous petrology.
3) Chasing all the comments and suggestions issued by the improvement and development study plan committees in geology program to run all procedures in changing and modifying the course content periodically.
4) Applying and using all the results of postgraduate scientific studies to develop 322 Geo course program.
5) Increased use of visual displays using PowerPoint and Flash software in some lectures and lab sessions.
6) Course contents, and assignments will be posted soon on the instructor’s web page.
7) More emphasis will be given to the applications of the EPMA on mineral chemistry and thermobarometer as soon as this device becomes available in the university.

C. Course Description (Note: General description in the form to be used for the Bulletin or Handbook should be attached)

1) Topics to be Covered		
Topics	No. of Weeks	Contact hours
Introduction to metamorphism: its processes and categories	**1**	**2**
Review of the mineralogy of metamorphic rocks	**1**	**2**
Classification schemes and metamorphic textures	**1**	**2**
Radiometric dating of metamorphic rocks	**1**	**2**
The phase rule and composition-assemblage diagrams	**1**	**2**
Metamorphic facies	**1**	**2**
Micro-analytical techniques and recalculation of mineral analysis	**1**	**2**
Thermobarometry and P-T-t paths	**1**	**2**
Contact metamorphism	**1**	**2**
Dynamic metamorphism	**1**	**2**
Metamorphism in subduction zones	**1**	**2**
Ocean-floor metamorphism	**1**	**2**
Metamorphism in collision zones	**1**	**2**
Metamorphic and tectonic evolution of the Arabian Shield	**1**	**2**
Meteorite impacts and shock metamorphism	**1**	**2**
Total	**15**	**30**
Field trips for full three days at weekends =30 hours (10 hours /day) at selected weekends	3 Days	3 Days
Labs and practical work	15	15

2 Course components (total contact hours per semester):			
Lecture: **30 Contacted hours.**	Tutorial: **Hypothetical (lectures).**	Practical/Fieldwork/Internship: **15 (practical) + 3days (fieldwork)**	Other: Nil

3. Additional private study/learning hours expected for students per week. (This should be an average for the semester not a specific requirement in each week)

30 hours Lectures, and 15 hours lab work, (2 hours to lecture /week, one hour for practical/week, and many hours, and evaluation parameter have been addressed for assignments and field and lab reports.

4. Development of Learning Outcomes in Domains of Learning

For each of the domains of learning shown below indicate:

- A brief summary of the knowledge or skill the course is intended to develop;

  - The course gives a basic knowledge on metamorphic petrology.

- A description of the teaching strategies to be used in the course to develop that knowledge or skill; : Teaching is conducted through lectures , practical sessions and fieldwork.

- The methods of student assessment to be used in the course to evaluate learning outcomes in the domain concerned.

  - Methods include quizes , homeworks , tests and examinations.

- The course is briefed and designed to eradicate and to develop all students , understanding, achievement , and applying skills.

- Describing the teaching strategies used for improving the students knowledge and skilfulness.

- Demonstrate the course evaluating methods to meet learning outcome of the academic program.

a. Knowledge

(i) Description of the knowledge to be acquired

1) The student is expected to acquire knowledge in methods and procedures to identify different metamorphic rocks .
2) Acquaintance the characteristics of mineral's optics to assure the difference between metamorphic rocks.
3) The student is expected to have knowledge in silicate minerals and their relationships to the rock's facies and genesis (petro genesis).
4) Acquaintance of student enrollment in the course to evaluate his performance indicators.
5) Acquaintance of the student enrolment in the course to apply its knowledge in the field .
6) Develop the ability to make detailed maps in areas of metamorphic terrains.
7) Apply the concepts of plate tectonics and allochthonous terranes to the study of regional metamorphic belts.

(ii) Teaching strategies to be used to develop that knowledge

1) Teaching will be conducted through a continuous and a regular lectures , practical sessions and fieldwork.

2) Encouraging the students to read all the related articles and to the other different learning resources. .

3) Brainstorming to be run in classroom between the students and the coarse directors.

4) To be acquaint with latest internet information.

5) To run homework's, and assignments schemes to keep student in touch with reading and geared thinking in knowledge of optical mineralogy.

(iii) Methods of assessment of knowledge acquired

1) Periodical Exams (Exams, quizzes).

2) Positive chemistry should be conducted between the student and course coordinator via the oral discussion within classroom.

3) Running homework's to maintain the relation between the student and scientific program, and to run lab reports to assess the acquired knowledge on the subject.

4) Oral and written exam in the lab . to test the student's ability to identify metamorphic rocks , its metamorphism processes, and its minerals under the microscope and also their minerals chemistry and its properties.

5) Running final exam.

b. Cognitive Skills

- Cognitive skills to be developed:

1) Student shall be able to gather all the metamorphic rocks knowledge to solve any problems that might face the students.

2) Student shall be able to apply all optics techniques to determine the diversities of metamorphic rocks.

3) Students will be able to demonstrate the application of chemistry of the crystallized materials by using microprobe and polarized microscope and some other instrumentation to analyse the rock chemically, .

- (ii) Teaching strategies to be used to develop these cognitive skills

1) Helping the students to run the logical analyses to solve problems that they might face by providing all information, and knowledge to identify, demonstrate , to analyse, and to apply the gained skill in future life.

2) Providing the student will all different updated ideas and developed techniques for determining the metamorphic rocks via its texture, minerals, and structure.

(iii) Methods of assessment of students cognitive skills

1) Delegating the students ability in telling, and announcing his belief and

suggestions towards rocks identification by polarized Microscope, microprone analyses , and other practices.

2) Delegating the student ability in using and dealing with instrumentations.

3) Delegation the student ability in applying the basics of physics to identify its chemical character , and by its rock-forming minerals.

4) Delegating and increasing the student ability in dealing and in communicating with his colleagues , i.e. with each others

c. Interpersonal Skills and Responsibility

(i) Description of the interpersonal skills and capacity to carry responsibility to be developed

1) Prompting attendance of classes and laboratory sessions in required of the students.

2) Students learn to manage their time in self-study of the Course material.

3) Personal initiative is encouraged through independent work on assignments and field reports

(ii) Teaching strategies to be used to develop these skills and abilities

1) Positive chemistry should be conducted between the student and course coordinator via the oral discussion within classroom.

2) Running homework's to maintain the relation between the student and scientific program, and to run lab reports to assess the acquired knowledge on the subject.

3) Oral and written exam in the lab . to evaluate the student's achievement

4) Encouraging the student to think self dependent by using all information to build his own knowledge in order to gain experience

5) Provide the appropriate environment either via lectures, resources, and self-learning to meet the learning outcome, and to increase the student abilities to solve and to think positively towards the subject.

6) Provide the student the connection between old knowledge and the present one.

7) Encouraging the student in learning skills to observe, to measure, to act in a row with his knowledge .

8) Increasing the student's deep thinking(Elaborating thinking) built on researches, reports, group discussion .

9) Providing all the necessaries instrumentation to increase the self-learning skills such computers, microscopes, compass, surveying devices, laptops…. Etc.

(iii) Methods of assessment of students interpersonal skills and capacity to carry responsibility

1) Methods include self-learning, oral discussion(student engaguement) within the classroom, outside reading for report's purposes, quizzes, homework, tests and examinations.

2) Training in Lab to apply and to solve some problems in defining either the rock type, petrogensis , and mineral creation

d. Communication, Information Technology and Numerical Skills

(i) Description of the skills to be developed in this domain.

1) Directing the student to generate, and to build up their scientific thinking.

2) Guiding the students to build up , and to practice the dialogue and oral communication style in very organised manner.

3) Writing communication skills created via writing report about certain topics related to the course contents.

4) Writing the scientific reports.

5) Using different geological programs by using the IT center in college.

6) Application of the field work.

7) Usages of the geological equipments for construction geological maps.

(ii) Teaching strategies to be used to develop these skills

1) Preparing written reports summarizing one of the topics related to the course materials or content.

2) Assigning one of student to run presentation about an issues related to the course contents.

3) Oral communication skills created by running an oral debate session within the lecture time concerning an issue related to the course contents.

4) Utilizing of an updated instrumentation.

5) Student's evaluation leads to increase the different skills.

(iii) Methods of assessment of students numerical and communication skills

1) Via written reports.

2) Via topics presentation.

3) Via the dialogue session.

4) Via creating knowledge, communication, sharing, and self-learning skills.

5) Via Quizzes, oral and written exams, and final exam.

6) Via Assignments, Group projects, and Field work s.

e. Psychomotor Skills (if applicable)

(i) Description of the psychomotor skills to be developed and the level of performance required

- Field work, Group work (Team work), Cooperation with others, and sharing projects.

(ii) Teaching strategies to be used to develop these skills

1) Participating in physical development activities and demonstrate an appropriate level of coordination, strength, and general physical within the course and inthe field trip.
2) Participating in physical activities and demonstrate an appropriate level of proficiency.
3) Participate in one or more team sports and demonstrate an appropriate level of proficiency.
4) Demonstrating a working proficiency in entering data on a keyboard.
5) Demonstrate success in using equipment (scientific, etc.) and tools in accomplishing the task or experiment for which the equipment is designed and in avoiding damage or injury.
6) Collective learning and shear of information.

(iii) Methods of assessment of students psychomotor skills

- Within the mid-term and final exams, including the assessment of the term paper

5. Schedule of Assessment Tasks for Students During the Semester**:**

No.	Evaluation Tasks/tools	Week due	%Proportion of the evalua during the course sessio
1	Homework	5-9-12	10%
2	Writing Reports	7	3%
3	First Exam	6	10%
4	Practical (Lab)Test	13	15%
5	Second Test	14	10%
6	Final Exam	15	50
7	Student Attendance+mind-set		2%

D. Student Support

1. Arrangements for availability of faculty for individual student consultations and academic advice. (include amount of time faculty are available each week)

- Each faculty member is instructed to put a timetable shows the time of actual teaching hours and office hours for each week. This timetable should be placed in front of the door of the academic staff member office's door

E Learning Resources

1. Required Text(s)

- **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**.**

2. Essential References

- **Kornprobst**, J. (2002). *Metamorphic Rocks and Their Geodynamic Significanc:. A Petrological Handbook.* Petrology and Structural Geology Series Vol. 12. Kluwer , Dordrecht.
- **Yardley, B. W. D. (**1989) *An Introduction to Metamorphic Petrology***,** Longman, Harlow.
- **Shelley D.** (1993). *Igneous and metamorphic rocks under the microscope*. Chapman & Hall, London.
- **Yardley B.W.D., McKenzie W.S. & Guilford C.** (1990). *Atlas of metamorphic rocks and their textures*. Longman, Harlow.

3. Recommended Books and Reference Material (Journals, Reports, etc) (Attach List)

- **Best M.G.** (2002). *Igneous and Metamorphic Petrology*, 2nd ed. Blackwell.
- **Bucher K. & Frey M.** (1994) *Petrogenesis of Metamorphic Rocks.*
- **Kerrick D.M.** (ed.) (1991) *Contact Metamorphism*. Reviews in Mineralogy, vol. 26. Mineralogical Society of America.
- **Kretz R.** (1994). *Metamorphic Crystallisation*. John Wiley and Sons, Chichester.
- **Miyashiro A.** (1994). *Metamorphism and Metamorphic Belts*. Unwin Hyman, London.
- **Philpotts A.R.** (1990). *Principles of Igneous and Metamorphic Petrology*. Prentice Hall.
- **Desmons J. & Smulikowski W**. (2007). *A systematic nomenclature for metamorphic rocks. 4. High P/T metamorphic rocks. Recommendations by the IUGS Subcommission on the systematics of metamorphic rocks*.
- **Spear, F.S.** (1993). *Metamorphic Phase Equilibria and Pressure-Temperature Time Paths*. Mineralogical Society of America, Washington, D.C.

4-.Electronic Materials, Web Sites etc

- Journal of Metamorphic Geology
- THERMOCALC program and data set.
- Atlas of Igneous and metamorphic rocks, minerals, and textures
- Metamorphic Rocks. A comprehensive review of the subject.
- Introduction to Metamorphic Rocks Dave **Waters**, Department of Earth Sciences, University of Oxford.
- Phase Equilibria in Metamorphic Rocks: Thermodynamic Background and Petrological Applications.

5- Other learning material such as computer-based programs/CD, professional standards/regulations

The Thermocalc software and other relevant programs.

F. Facilities Required

Indicate requirements for the course including size of classrooms and laboratories (ie number of seats in classrooms and laboratories, extent of computer access etc.)

1. Accommodation (Lecture rooms, laboratories, etc.)
   1) Lecture room equipped with a blackboard, overhead projector , and internet connection.
   2) The classroom with more than 30 students.
   3) The lab . facilitated with a blackboard, overhead projector and seating arrangement for the students.

2. Computing resources

- The classrooms have been equipped with data show device. And internet source.

3. Other resources (specify --eg. If specific laboratory equipment is required, list requirements or attach list)

1) The lab is equipped with polarized microscope.
2) A workshop is equipped with the necessary equipments for preparing the mineral's slides for optic and petrology studies.

G. Course Evaluation and Improvement Processes

1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- **The student's feedback on the effectiveness Teaching will be done via a will prepared questionnaire. This questionnaire will be circulated to students.**

It will be used for evaluating the course by students at the end of the course

2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department

1) In regular basis the study plan committee revises the course contents to make sure that all the content fits the outcomes of the course>
2) Faculty assessment of the course and effectiveness of teaching delivery.
3) Periodic self- assessment of the program.
4) Review of **the course material by relevant departmental committee(s)**

3 Processes for Improvement of Teaching

1) Undergraduate Committee will review deficiencies based on the student evaluation, faculty input, course file, and program assessment.
2) Feedback from employers and and graduating students' input are used to identify any deficiencies in students' ability in applying mineral optics knowledge.
3) Organize workshop on effective teaching methods to enable instructors to improve their teaching skill.
4) Teaching method will focus on students' learning and on course learning outcomes.
5) Recommendations are reported to the department on the basis of feedback questionnaires **to take the necessary steps.**
6) **Lecture notes are reviewed regularly and kept up-to-date.**

4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent faculty member of a sample of student work, periodic exchange and remarking of a sample of assignments with a faculty member in another institution)

1) **Undergraduate Committee will review samples of student work in this course to check on the standard of grades and achievements**
2) **A faculty member from a reputable university will evaluate the course material and the students' work to compare the standard of grades and achievements with those at his university. This evaluator will also comment on the laboratory facilities and the adequacy of the equipment used in the lab.**

5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

- **Self- assessment will be carried out every two years. The external evaluation will be run every four years by invited the Evaluating Examiner by program coordinat.. The feedback received of these assessments will be used to modify studies plans courses for seeking further improvement of the course syllabus, teaching method, and delivery of course materials**