Course Book of
Petroleum Geology and Geochemistry

Lecturer: Rzger Abdulkarim Abdula
2014-2015
1. Module Title:
Petroleum Geology and Geochemistry Course Work

2. Module Code:
PGE302

3. Module Level:
Third Year BSc students Petroleum Geosciences at Soran University

4. Module Leader:
Rzger Abdulkarim Abdula

5. Teaching Semester:
Fall Semester/2014

6. Credit Rating for the module:
Three credit hours (2x3)

7. Prerequisites and co-requisites:
Possessing a good level of Organic Chemistry, Physical and Historical Geology and no co-requisites

8. Module Summary:
The module includes the purpose of studying Petroleum Geology, history of petroleum, the carbon cycle, organic matter, composition of oil and gas, how petroleum is formed, migration from source to reservoir, reservoir rock properties, trapping, basin types and their exploration and development, and reserves and resources.

9. Module Aims:
This course aims at introducing the students to the basics of petroleum geology a vast field that includes geochemistry; structural geology; sedimentology; mineralogy; fluid mechanics; mapping; volumetric calculations; risk and uncertainty analysis; and a vast array of industrial technologies.

10. Learning Outcomes:
The course is designed to help students to understand petroleum chemistry, identify various types of organic matter under microscope, geochemical study of organic matter, build up thermal history of sedimentary basin; model Waples-Lopatine method and determination of TTI index, Rock-Eval pyrolysis: data analysis and evaluation, application of vitrinite reflectance in evaluation of OM
maturity and TAI, gas and mass spectrometer data and evaluation in biomarkers study, correlation based on biomarkers and stable isotopes, reservoir dynamics and fluid saturations, O/W and G/O contacts.

11. Syllabus

Week 1
Introduction
Origin of petroleum
Inorganic versus organic

Week 2
Production of organic matter
Processes of preservation
Conditions favorable for preservation
Sedimentation rate
Bottom water oxygen content

Week 3
Productivity and preservation of organic matter- modern environments
Marine organic matter- preservation
Organic productivity and preservation in modern continental environments
Preservation of organic matter in ancient sediments

Week 4
Formation of kerogen
  (1) Diagenesis
  (2) Catagenesis
  (3) Metagenesis

Week 5
Diagenesis and Kerogen
Shallow diagenesis of organic matter
  (1) Reactions of organic matter
    (a) Oxygen
    (b) Nitrate (NO3) and Nitrite (NO2)
    (c) Sulfate
    (d) Carbon dioxide
    (e) other oxidants
  (2) Inorganic reactions
    (a) Iron minerals
    (b) Other carbon minerals


Week 6
Chemistry of Kerogen
(1) Type I
(2) Type II
(3) Type III
Maturation of kerogen
Kinetics
Arrhenius equation
Techniques for determining the quantity of generated hydrocarbons
(1) Level of Organic Maturity (LOM)
(2) Time-temperature index (TTI)

Week 7
Techniques for determining temperature (Paleothermometers)
   (a) Carbon ratio technique
   (b) Electron spin resonance
   (c) Pyrolysis
   (d) Gas chromatography
   (e) Clay mineral analysis
   (f) Fluid inclusions
   (g) Pollen color
   (h) Vitrinite reflectance

Week 8
Migration
Introduction
Two types of migration
   (1) Primary migration-
       (2) Secondary migration
How does primary migration occur?
The major problem is a size problem

Week 9
Release of interstitial water in clay minerals
Interstitial hydrocarbons
Overpressuring

Week 10
Expulsion Mechanisms
   (1) Protopetroleum
   (2) Expulsion at high temperatures
   (3) Micelles
   (4) Gases
Week 11
Petroleum System – Definitions

Petroleum System

Elements of petroleum system
(1) Source rock
(2) Reservoir rock
(3) Seal rock
(4) Overburden rock

Week 12
Review and student’s presentation

12. Assessment Strategy
Briefly, the level of the students in Petroleum Geology and Geochemistry will be checked by executing the semifinal exams, quizzes, and exercises from post chapter questions and problems to support chapter learning objectives with focus on Continues attendance.

13. Summary description of assessment items

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>Description of Item</th>
<th>W%*</th>
<th>Grading*</th>
<th>Tariff *</th>
<th>Week due</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXM*</td>
<td>to support the learning objectives of chapters 1 to 5</td>
<td>10</td>
<td>Out of 20</td>
<td>3 hrs</td>
<td>Week 6</td>
</tr>
<tr>
<td>EXM</td>
<td>to support the learning objectives of chapters 6 to 11</td>
<td>10</td>
<td>Out of 20</td>
<td>3 hrs</td>
<td>Week 12</td>
</tr>
<tr>
<td>GWK*</td>
<td>Solving the post chapter problems 1 to 5</td>
<td>2</td>
<td>Out of 5</td>
<td>-</td>
<td>Week 6</td>
</tr>
<tr>
<td>GWK</td>
<td>Solving the post chapter problems 6 to 11</td>
<td>2</td>
<td>Out of 5</td>
<td>-</td>
<td>Week 11</td>
</tr>
<tr>
<td>Class attendance</td>
<td>Evaluating the effective and ordered attendance of the students in the lectures</td>
<td>1</td>
<td>Out of 5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lab Reports</td>
<td>Evaluating the effective and ordered reports</td>
<td>8</td>
<td>Out of 15</td>
<td>3 hrs</td>
<td>Week 11</td>
</tr>
<tr>
<td>EXM</td>
<td>Two practical exams from the studied experiments</td>
<td>7</td>
<td>Out of 15</td>
<td>3 hrs</td>
<td>Week 11</td>
</tr>
</tbody>
</table>

*EXM: exam, GWK: group work, W% – the percentage of the module’s total assessment, Grading: the grading structure, Tariff: the amount of work required from the student for that assessment, Week due: the week in the semester the course work is to be handed in or the exam or test takes place.

Final Exams (60%) - written tests designed to measure knowledge of presented course material (40%) and practical exam from the lab work (20%).
14. Learning Session Structure
The structure of each weekly learning session will be 2 hours lecture 3 hours practical in the lab.

15. Learning and Teaching Methods
Fundamentals in petroleum geology and geochemistry for petroleum geoscience students are included 12 weeks in which each week is 2 hrs theory and 3 hrs practical of lab experiments. In general, it will be 24 hrs theory and 36 hrs experimental for whole of the first semester.

16. Bibliography

17. Authored by
Rzger Abdulkarim Abdula, 1/9/2014

18. Validated and Verified by
[Another member of staff who has checked the module specification to ensure that it meets the requirements of the course of which it a part and has checked the specification for any errors. This will include the date it was approved.]