**USC Petroleum Engineering**

**PTE 599 Petroleum Geochemistry - Fall 2016**

**Unit: 3**

**Instructor: Hossein Alimi**

**Mondays: from 11 am to 1 pm**

**Office: HED 302, 925 Bloom Walk, Los Angeles, CA 90089-1211**

**Office Hours: 10 am to 4 pm**

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|  | **Topics/Daily Activities** | **Readings and Homework** | **Deliverable/ Due Dates** |
| Week 1 Monday 08/22/2016 | Lecture: Course introduction, objectives, and expectations; an overview of the course content and topics. The Carbon Cycle and Reservation of Organic Matter  Class Discussion: Fate of Organic Matter, its main processes and pathways. | Reading Assignmen- t: Part I, Chapters 1 and 2, Petroleum Formation and Occurrence Handbook, Tissot and Welte, 1984.  Homework Assignment 1: Describing in detail the cycle of organic matter, and also Oxic and Anoxic depositional Environments. | **Due: 08**/**26/2016** |
| Week 2 Monday 08/29/2016 | Lecture: Review of Organic Chemistry (brief).  Class Discussion:  Hydrocarbons and non-hydrocarbons definition and grouping. | Reading Assignment: Part I, Chapter 4, Petroleum Formation and OccurrenceHandbook, Tissot and Welte, 1984; and Part I, Chapter 2, The Biomarker Guide, Vol I, Peters et.al., 2005Homework Assignment 2: Presenting Qualitative and Quantitative Occurrence of important constituents in Bacteria, Phytoplankton, Zooplankton, and Higher Plants. | Due: 09/02/2016 |
| Week 3 Monday 09/12/2016 | Lecture: Diagenesis, Catagenesis, and Metagenesis of organic matter I: Early Transformation of organic matter.  Class Discussion: Diagenesis versus catagenesis, Biochemical degradation, polycondensation; Results and Balance of Diagenesis . | Reading Assignment: Part II, Chapters 1 and 2, Petroleum Formation and Occurrence Handbook, Tissot and Welte, 1984  Homework Assignment 3: Describing and showing the chemical changes of organic matter during diagenesis and catagenesis. | Due:  **09/16/2016** |
| Week 4 Monday 09/19/2016 | Lecture: Diagenesis, Catagenesis, and Metagenesis of organic matter II: Geochemical fossils and their significance in petroleum formation.  Class Discussion:  Sources of hydrocarbons, Biomarkers: n-alkanes; iso-alkanes; isoprenoids, steroids and triterpenoids; Aromatics and heterocompounds. | Reading Assignment: Part II, Chapter 3, Petroleum Formation and Occurrence handbook, Tissot and Welte, 1984.  Homework Assignment 4:   * What is the definition of carbon preference index (CPI) of alkanes, describing CPI and its significance in crude oils and extracts (bitumen), calculating CPI of GC/FID-data provided; * What isoprenoids are from Phytol source? * Fate of steroids and triterpenoids during diagenesis and catagenesis. | Due: **09/23/2016** |
| Week 5 Monday 09/26/2016 | Lecture: Kerogen Composition and Classification.  Class Discussion: Definition, isolation and microscopic constituents of kerogen, chemical analysis, type of kerogen and its evolution paths. | Reading Assignment: Part II, Chapters 4, Petroleum Formation and Occurrence Handbook, Tissot and Welte, 1984  Homework Assignment 5: Describing the macerals and identifying the oil-prone particles | Due: **Monday 09/30/2016** |
| Week 6 Monday 10/03/2016 | Lecture: From kerogen to petroleum and formation of gas.  Class Discussion: Diagenesis, catagenesis and metagenesis of kerogen, formation of hydrocarbons during catagenesis; characterization of petroleum gas. | Reading Assignment: Part II, Chapters 5 and 6, Petroleum Formation and Occurrence Handbook, Tissot and Welte 1984  Homework Assignment 6: Describing catagenesis evolution of type-II kerogen. Showing formation of normal and branched alkanes in different types of kerogen as a function of burial. | Due: **10/07/2016** |
| Week 7 Monday 10/10 2016 | Lecture: Coal and its relation to oil and gas; Oil Shale (an organic-rich sediment).  Class Discussion: The formation of Peat, Coalification process, coal petrology, petroleum generation: Oil Shale: definition, organic matter composition, pyrolysis of oil shale, Oil Shale versus Shale Oil and their distribution and reserves | Reading Assignment: Part II, Chapters 8 and 9, Petroleum Formation and Occurrence Handbook: Tissot and Welte, 1984.  Homework Assignment 7:   * Describing the chemical and physical processes during coalification. * Describing the type of kerogen in oil shale and classifying oil shale. | Due: **10/14/2016** |
| Week 8 Monday 10/17/2016 | Lecture: Geochemical Screening I.  Class Discussion: Project initiation and sample collection, Source –Rock Screening: Total organic Carbon, Rock-Eval, Pyrolysis, Maceral composition, Thermal Maturity: Vitrinite Reflectance and TAI | Reading Assignment: Part V, chapter 1, Petroleum Formation and Occurrence Handbook, Tissot and Welte, 1984  Homework Assignment 8: Characterizing the kerogen type and generation potential of source rock estimating the level of maturation. Analytical data will be provided). | Due: **10/21/2016** |
| Week 9 10/24/2016 | **Midterm Exam** |  | **Due: 10/24/2016** |
| Week 10 Monday 10/31/2016 | Lecture: Geochemical Screening II.  Class Discussion: Tests for investigating indigenous bitumen: Bitumen extraction, Liquid chromatography (LC), physic-chemical analyses, gas chromatographic (GC) fingerprinting, GC-correlation | Reading Assignment: Part I, chapter 4, The Biomarker Guide handbook Vol. I, Peters et. al., 2005, and Part V, chapter 2, Petroleum Formation and Occurrence handbook, Tissot and Welte, 1984.  Homework Assignment 9: Determining source type and maturity of bitumen based on LC and GC data (Results will be provided). | Due:  **11/04/2016** |
| Week 11 Monday 11/07/2016 | Lecture: The Composition and Classification of Crude Oils.  Class Discussions: Petroleum versus SR-bitumen; analytical procedures; main group of compounds in crude oils, classification of crude oils. Reservoir continuity | Reading Assignment: Part IV, Chapters 1 and 2, Petroleum Formation and Occurrence handbook, Tissot and Welte, 1984.  Homework Assignment 10: Calculating the common ratios for characterization and classification of crude oils (results will be provided in class) | Due:  **11/11/2016** |
| Week 12 Monday 11/14/2016 | Lecture: Source of natural gases; Mud Gas Isotope Logging (MGIL).  Class Discussions: How gas forms? Biogenic and thermogenic gases; non-hydrocarbon gases, Hydrocarbon and isotopic composition evaluation. Gas sampling methods. | Reading Assignment: Chapter 5, Petroleum Geochemistry and Geology Handbook, John M. Hunt, 1995, (copies of the chapter and a related published paper will be provided.)  Homework Assignment 11: Characterizing the type of gas samples based on their compound and isotopic compositions. | Due: **11/18/2 016** |
| Week 13 Monday 11/21/2016 | Lecture: Stable isotope ratios  Class Discussions: Standard and notation, stable carbon isotope measurement and its application: Hydrocarbon gases correlation of oils, bitumens and kerogens; isotope type curve, marine versus terrigenous organic input; Compound Specific Isotope Analysis (CSIA); hydrogen and sulfur isotopes (case studies). | Reading Assignment:Part I, chapter 6, The biomarker Guide handbook Vol. I, Peters et.al., 2005.  Homework Assignment 12: Correlating and interpreting oils and source rock bitumens based on their bulk and CSIA compositions (data will be provided in class). | Due: **11/25/2016** |
| Week 14 Monday 11/28/2016 | Lecture: Brief introduction in biomarker analysis  Class Discussion: Separation of biomarker compounds, GC-MS methods, selected ion monitoring, sterane & hopane ; biomarkers as parameters for source input, maturity, kerogen type, paleoenviroment and correlation. | Reading Assignment: Part I, chapter 8, The Biomarker Guide handbook, Vol. I, Peters et.al., 2005 | Due: **12/02/2016** |
| Week 15 Monday 12/05/2016 | Team Project Presentations and Evaluation | Class participation and discussion during project presentation for each team | Final Project presentations  Due: **12/5-6/2016** |
| FINAL12/12/2016 | TBA |  | **Due : 12 / 12 / 2016** |

