# King Fahd University of Petroleum and Minerals
## Department of Mathematical Sciences
## SYLLABUS
## Semester II, 2016-2017 (162)
## Dr. Monther R. Alfuraidan

**Course #:**        Math 531
**Title:**        Real Analysis
**Textbook:**        Real Analysis by H.L. Royden and P.M. Fitzpatrick.
**Additional Reading:**    Real and Abstract Analysis by E. Hewitt and K. Stromberg
**Lecturer:**        **Name: Monther Alfuraidan   Office: 5-313    Phone: 1977**
        **E-mail: monther@kfupm.edu.sa**  (The best way to reach me)
        **Web Site:** http://faculty.kfupm.edu.sa/math/monther
        **Office hours:**  12:00 – 1:00PM (MW) (Other times by appointment)

**Objectives:** The course is designed to introduce graduate students to measure theory. Stress will be particularly given to the Lebesgue measure, integration, and the classical $L^p$ spaces.

| Week | Date | Sec. # | Topics |
|------|------|--------|--------|
| 1 | February 05-09 | 2.1-2.2 | Introduction, Lebesgue outer Measure |
| | | 2.3 | The $\sigma$-Algrbra of Lebesgue Measurable sets |
| 2 | February 12-16 | 2.4 | Outer and Inner Approximation of Lebesgue Measurable |
| | | 2.5 | Countable Additivity, Continuity, and the Borel-Cantelli Lemma |
| 3 | February 19-23 | 3.1,3.2 | Sums, Products, and Compositions Sequential Pointwise Limits and Simple Approximation |
| | | 3.3 | Littlewood's Three Principles, Egoroffs Theorem, and Lusin's Theorem |
| 4 | Feb 26- Mar 02 | 4.1 4.2 | The Riemann Integral The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure |
| | | 4.2 | Continue |
| 5 | March 05-09 | 4.3 | The Lebesgue Integral of a Measurable Nonnegative Function |
| | | 4.4 | The General Lebesgue Integral |
| 6 | March 12-16 | ----- | Review and catch up |
| | | **Exam I** | **Wednesday, Mar 15, 2017, Material (2.1-4.4)** |
| 7 | March 19-23 | 4.5, 4.6 | Countable Additivity and Continuity of Integration Uniform Integrability: The Vitali Convergence |
| 8 | March 26-30 | 5.1 5.2 | Uniform Integrability and Tightness: A General Vitali Convergence Theorem Convergence in Measure |
| | | 5.3 | Characterizations of Riemann and Lebesgue Integrability |
| **April 02-06: Midterm Vacation** | | | |
| 9 | Apr 09-13 | 6.1 6.2 | Continuity of Monotone Functions Differentiability of Monotone Functions: Lebesgue's Theorem |
| | | 6.3 6.4 | Functions of Bounded Variation: Jordan's Theorem Absolutely Continuous Functions |
| 10 | Apr 16-20 | 6.5 | Integrating Derivatives: Differentiating Indefinite Integrals |
| | | 6.6 | Convex Functions |

| 11 | Apr 23-27 | ------ | **Review and catch up** |
|----|-----------|--------|-------------------------|
| | | **Exam II** | **Sunday, Mar 30, 2014, Material (4.5-6.6)** |
| 12 | Apr 30- May 04 | 7.1 | Normed Linear Spaces ............................... |
| | | 7.2 | The Inequalities of Young, Holder, and Minkowski |
| | | 7.3 | $L^p$ is Complete: The Riesz-Fischer Theorem |
| 13 | May 07-11 | 17.1 | Measures and Measurable Sets |
| | | 17.2 | Signed Measures: The Hahn and Jordan Decompositions |
| 14 | May 14-18 | 18.1 | Measurable Functions |
| | | 18.2 | Integration of Nonnegative Measurable Functions |
| 15 | May 21-25 | ----- | Review and Catch up |
| **Final Exam: TBA Material: Comprehensive** | | | |

## Supplemental Instruction:

The students will find supplemental instruction material prepared by Dr Khamsi at: http://www.drkhamsi.com/classe/RA/  This webpage contains many exercises which deal with the content of this course.  Dr Khamsi may be contacted at: Mohamed@utep.edu , if you have any question.

## Outcomes:

It is expected that the student shall be able to know and use the concept of Lebesgue measure on real line, general measure theory, convergence theorems, Lusin's theorem, Egorov's theorem, $L^p$-spaces, Fubini's theorem, functions of bounded variation, absolutely continuous functions and Lebesgue differentiation theorem.

## Evaluation Scheme:

Student will be evaluated and graded on the basis of:

- Two Major Exams (20 points each) 40%
- Homework                 20%
- Final Exam                 40%