

**King Fahd University of Petroleum and Minerals**  
**Department of Mathematics & Statistics**  
**Semester II, 2017-2018 (172)**  
**(Dr. Bilal Chanane)**

**Course #:** MATH 605

**Title:** Asymptotic Expansions and Perturbation Methods

**Textbook:** C. Bender and S. Orszag, Advanced Mathematical Methods for Scientists and Engineers: Asymptotic Methods and Perturbation Theory, Springer 1999

**Course**

**Description:** Asymptotic sequences and series. Asymptotic expansions of integrals. Solution of differential equations at regular and irregular singular points. Nonlinear differential equations. Perturbation methods. Regular and singular perturbations. Matched asymptotic expansions and boundary layer theory. Multiple scales. WKB theory.

**Prerequisites:** Math 430 ; Math 301 or Math 513

**Learning Outcomes:** At the end of this course, the student should be able to

1. Define and discuss the properties of asymptotic sequences and asymptotic series
2. Use Watson's Lemma and Laplace Method to obtain asymptotic expansion of some integrals
3. Apply methods of stationary phase and steepest descent to obtain asymptotic approximations to integrals
4. Review and apply asymptotic methods for differential equations including WKB method
5. Recall and apply regular and singular perturbation methods to differential equations and eigenvalue problems
6. Apply matched asymptotic method including matching and turning points

Week #	Material
1	Introduction to Asymptotic, definition of O and o
2	Asymptotic sequences, Asymptotic power series
3	Asymptotic expansion of Integrals
4	Laplace's method and Watson's lemma
5	Method of stationary phase, method of steepest descents
6	Asymptotic evaluation of sums
7	Solution of differential equations (DE) at regular and irregular singular points
8	Asymptotic expansions for DE
9	Perturbation series
10	Regular and singular perturbation theory
11	Asymptotic matching
12	Summation of series
13	Boundary layer theory
14	WKB method
15	Multiple Scale Analysis

**Grading Policy:**

- Midterm Exam (25%)
- Homework (20%)
- Projects (20%)
- Final Exam (35%) Date: **Saturday May 12, 2018: 7:00pm**

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