**King Fahd University of Petroleum and Minerals**
**Department of Mathematics and Statistics**
**SYLLABUS**
**Term 171 ( 2017-2018)**
**Coordinator: Prof. Bilal Chanane**

**Course #: MATH 301**
**Title: Methods of Applied Mathematics**
**Textbook:** Advanced Engineering Mathematics by Zill and Wright (Fifth Edition)
**Course Description:** Special functions. Bessel's functions and Legendre polynomials. Vector analysis including vector fields, divergence, curl, line and surface integrals, Green's, Gauss' and Stokes' theorems. Sturm-Liouville theory. Laplace transforms. Fourier series and transforms. Introduction to partial differential equations and boundary value problems in rectangular, cylindrical and spherical coordinates.
**Prerequisite:** MATH 202 or MATH 260

| Week | Date | Sections | Topics | Suggested Homework Problems |
|---|---|---|---|---|
| 1 | Sept 17-21. | 9.1<br>9.5 | Vector Functions<br>The Directional Derivative | 1,12,16,17,21,26,33, 41<br>2,7,9,14,17,21,23,32,29 |
| 2 | **Sept 24-28** | 9.7<br>9.8 | Curl and Divergence<br>Line Integral | 2,4,6,9,18,23,25<br>2,5,10,13,18,22,25,33 |
| 3 | Oct 01-05 | 9.9<br>9.12 | Independence of the Path<br>Green's Theorem | 1,3,6,8,13,17<br>2,4,7,11,14 |
| 4 | Oct 07*-12 | 9.13<br>9.14 | Surface Integrals<br>Stokes' Theorem | 2,6,10,14,1722,27<br>2,6,8,11,16,19,24,28,33 |
| 5 | Oct 15-19 | 9.16<br>4.1 | Divergence Theorem<br>Definition of the Laplace transform | 1,10,15,18,21,26<br>1,5,14,26,30,37,43 |
| **EXAM I: Wednesday, Oct. 25th (17:30 – 20:00) 9.1-9.16** | | | | |
| 6 | Oct 22-26 | 4.2<br>4.3 | Inverse Transform, Transforms of Derivatives<br>Translation Theorems | 2,10,19,22,24,32,35<br>2,8,13,20,24,31,37,48,55,63 |
| 7 | Oct 29- Nov 02 | 4.4<br>4.5 | Additional Operational Properties<br>The Dirac Delta Function | 1,10,16,22,27,31,38,46<br>1,4,8,12 |
| 8 | Nov 05-09 | 12.1<br>12.2 | Orthogonal Functions<br>Fourier Series | 2,6,11,13<br>1,6,12,17,20 |
| 9 | Nov 12-16 | 12,3<br>12.5 | Fourier Cosine and Sine Series<br>Sturm-Liouville Theorem | 1,8,12,16,25,35,38<br>2,4,6,12 |
| 10 | Nov 19-23 | 12.6<br>13.1 | Bessel and Legendre Series<br>Separable Partial Differential Equations | 2,4,6,8,15,20<br>2,8,12,16,22,26,27 |
| **EXAM II: Monday, Nov. 27 (17:30 – 20:00) 4.1-12.6** | | | | |
| 11 | Nov 26-30 | 13.3<br>13.4 | Heat Equation<br>Wave Equation | 2,3,6<br>1,6,9,16,23 |
| 12 | Dec 03-07 | 13.5<br>14.2 | Laplace's Equation<br>Problems in Cylindrical Coordinates | 2,4,7,10,14<br>2,4,9,12 |
| 13 | Dec 10-14 | 14.3<br>15.2 | Problems in Spherical Coordinates<br>Applications of the Laplace Transform | 2,5,11,12<br>2,4, 10,14,18,24 |
| 14 | Dec 17-21 | 15.3<br>15.4 | Fourier Integral<br>Fourier Transforms | 1,4,10<br>1,6,10,12,16 |
| 15 | Dec 25-28 | | Catch up and Review | |
| **Final Exam: Monday, Jan. 01, 2018 from 8:00 AM to 11:00 AM Comprehensive** | | | | |

## Important Dates:

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|---|---|
| **07 OCT** | *Normal Sunday Class |
| **28 SEP** | Last day for dropping course(s) without permanent record |
| **26 OCT** | Last day for dropping course(s) with grade of "W" |
| **23 NOV** | Last day for withdrawal from all courses with grade of "W" |

## Grading Policy:

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|---|---|---|
| Exam I | **25 % (100 pts)** | **Wednesday, Oct. 25th (17:30 – 20:00)** 9.1-9.16 |
| Exam II | **25 % (100 pts)** | **Monday, Nov. 27 (17:30 – 20:00)** 4.1-12.6 |
| Final Exam | **35 % (140 pts)** | **Monday, Jan. 01, 2018 from 8:00 AM to 11:00 AM** Comprehensive |
| Class work | **15 % (60 pts)** | **Quizzes+HW+Attendance** |

## Attendance:

- Attendance is compulsory. KFUPM policy with respect to attendance will be strictly enforced.
- Any student accumulating **9 unexcused absences** will be awarded DN Grade in the course.

## Learning Outcomes:

Upon completion of this course, students will be able to

1. Recognize the vector fields, find their curl and divergence, and test whether they are conservative.
2. Evaluate the line integral along plane or space curves and the surface integral over surfaces in 3-space.
3. Use Green's, Stokes' and Divergence theorems to relate and evaluate different types of integral.
4. Evaluate the Laplace transform and inverse Laplace transform of a given function.
5. Apply the Laplace transform, inverse Laplace transform, and their operational properties to solve linear initial-value and boundary-value problems.
6. Find the Fourier series, the Fourier cosine and sine series, and the Bessel and Legendre series of a given function.
7. Find the eigenvalues and eigenfunctions for a given Sturm-Liouville boundary-value problem and state their orthogonality relation.
8. Solve separable partial differential equations.
9. Solve boundary-value problems involving the wave, heat and Laplace equations in various coordinate systems.
10. Evaluate the Fourier integral and the Fourier cosine and sine integrals of a given function.
11. Use the Fourier transform, inverse Fourier transform, and their operational properties to solve linear boundary value problems