**EMT3202 Partial Differential Equations**

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| Period per  Week | Contact  Hour per  Semester | Weighted  Total Mark | Weighted  Exam Mark | Weighted  Continuous Assessment Mark | Credit  Units |

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| 45 | 00 | 15 | 60 | 100 | 60 | 40 | 4 |

**Rationale**

EMT1201 Engineering Mathematics II introduced Differential Equation and Solution Techniques for ODEs with Exact Solutions in terms of Elementary Functions (Algebraic, Trigonometric, Exponential, Logarithmic and Hyperbolic Functions) and EMT2101 Engineering Mathematics III Introduced the Power Series Solutions to ODEs, it was appreciated that the analysis of Engineering Systems containing lumped parameters often leads to ODEs in which time is the only independent variable. However, the assumption that all masses exit as conceptualized mass points; that all springs are weightless; or that elements of an electric circuit are concentrated in idea resistors, capacitors, and inductors, rather than continuously distributed, is frequently not sufficiently accurate. In such cases, a more realistic approach must take into account the fact that the independent variables depend not only on time but also on one or more space variables. With more than one independent variable manifested, the formulation of such problems leads to Partial, rather than Ordinary, Differential Equations. This course introduces the Course Participant to the Concept of Partial Differential Equations (PDEs).

**Objectives**

 An important emphasis of the course is to develop problem solving skills and proof skills by working on specific problems in which it is natural to look at special or simpler cases in order to try to discover patterns. An integral part of the process of mathematical thinking is to wander into blind alleys, sometimes being frustrated, before ultimately obtaining a solution or proof. In this process mathematical scientists often work together with colleagues, and this group work and sharing of ideas often adds great value to a mathematical investigation.

 A major goal of the course is to give a balanced introductory treatment of the area of PDE so that a student appreciates the power of PDE modeling; and is aware of major techniques for their solution. The focus of the course is on analytical techniques for the classical linear PDE of physics and engineering (heat, wave and Laplace equations), and their frequent occurrence in applications.

**Subject Content**

***1. Definition of a Partial Differential Equation***

***2. Derivation of Some Typical PDEs of Mathematical Physics***

 The One-Dimensional Wave Equation (Vibrating String)

 The One-Dimensional Heat Conduction Equation

 The Telegraph or Transmission Line Equation

 The Two-Dimensional Wave Equation (Vibrating Membrane)

 The Two-Dimensional Heat Conduction Equation

 The Three-Dimensional Heat Conduction Equation

***3. Classification of Partial Differential Equations***

 Homogeneous and Non Homogeneous PDE’s

 Linear and Non-Linear PDE’s

 N-Order PDE’s

 Parabolic, Elliptic and Hyperbolic PDE’s

***4. Classification of Boundary Conditions to PDE’s***

 Homogeneous and Non Homogeneous BC’s

 Linear and Non-Linear BC’s

 Dirichlet BC’s

 Neumann BC’s

 Robin BC’s

 Cauchy BC’s

***5. Overview of Methods of Solving Boundary Value Problems***

***6. Solutions of Boundary Value Problems Using the Method of Separation of Variables***

 2nd Order Linear and Homogeneous BVP’s with Period BC’s

 Use of Fourier Series in the Solution of 2nd Order Linear and Homogeneous

Dirichlet and Neumann BVP’s

 Solution of Non-Homogeneous BVP’s

 Direct Originality with Mixed BVP’s

 The Cauchy BVP’s

 Sturm-Liouville Problems

***7. Use of Laplace Transforms in Solving PDEs***

***8. FDM Solutions of Boundary Value Problems involving PDEs***

 Parabolic BVP’s

 Elliptic BVP’s

 Hyperbolic BVP’s

 Use of MATLAB in the Solution of PDE’s

**Recommended and Reference Books**

*[1]* Clarence Raymond Wylie and Louis C. Barrett, 1995. *Advanced Engineering*

*Mathematics*. 6th Ed. International Edition. McGraw-Hill, N. Y. US

*[2]* Erwin Kreyszig, 1999. *Advanced Engineering Mathematics.* 8th Edition. John

Wiley & Sons, INC. New York

*[3]* Murray R. Spiegel, 1981. *Applied Differential Equations*. 3rd Edition. Prentice- Hall, Inc., Englewood Cliffs, N.J. 07632

*[4]* G. Stephenson, 1988. *Mathematical Methods for Science Students*. 2nd Edition.

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