

## **MATH-906 Symmetry Methods for Differential Equations-II**

**Credit Hours:** 3-0

**Prerequisites:** MATH-905 Symmetry Methods for Differential Equations-I

**Course Objectives:** After having completed this course, the students would be expected to find and use symmetries of partial differential equations; they will be familiar with the Noether and the Lie-Backlund symmetries; they will know the Potential symmetries for differential equations and inherited symmetries.

**Core Contents:** Review of symmetry analysis for ODEs including multi-parameter groups, canonical variables, invariants, reduction of order, multi-parameter groups, integration by two symmetries, invariant solutions; contact and higher order symmetries, use of integrating factors, connection with symmetries; potential symmetries for ODEs and inherited symmetries. Review of symmetry analysis for PDEs; invariance for scalar and systems of PDEs, symmetries of DEs and its applications to boundary value problems; Noether's theorem, variational symmetries, conservation laws and higher order conservation laws, Euler-Lagrange and Lie-Backlund operators, Lie-Backlund symmetries, recursion operators for Lie-Backlund symmetries, mappings of infinitesimal generators from specified PDEs to target PDEs, invertible mappings for nonlinear systems of PDEs; potential symmetries for PDEs and inherited symmetries.

**Course Outcomes:** Students have good understanding of use of symmetries of differential equation. Students are able to solve boundary value problem. They have enough knowledge about the Potential symmetries for differential equations and inherited symmetries.

**Text Book:** George W. Bluman and S. Kumei, Symmetries and Differential Equations Springer Verlag 1989.

### **Reference Book:**

1. Nail H. Ibragimov, Elementary Lie Group Analysis and Ordinary Differential Equations, John Wiley & Sons 1999.
2. George W. Bluman and Stephen C. Anco, Symmetry and Integration Methods for Differential Equations Springer Verlag 2002.

<b>Weekly Breakdown</b>		
<b>Week</b>	<b>Section</b>	<b>Topics</b>
1		Review of symmetry analysis for ODEs.
2	3.5-3.7	Applications to Boundary Value Problems
3	4.1 -4.2	Invariance for scalar of PDEs
4	4.3-4.4	Invariance for systems of PDEs, application to boundary value problems.
5	4.4	Formulation of invariance of a BVP for a PDE
6	4.4	Incomplete invariance for a linear system of PDEs
7	5.1, 5.2.1-2	Noether's theorem, variational symmetries and conservation laws; Boyer's Formulation
8	5.2.3-5.2.4	Equivalent Classes of Lie-Backlund transformation; Lie Bucklund Symmetries
9	<b>Mid Semester Exam</b>	
10	5.2.5-5.2.7	Finding variational symmetries; Noether's formulation; higher order conservation laws
11	5.3	Recursion operators for Lie-Backlund symmetries Mappings of infinitesimal generators from specified PDEs to target PDEs.
12-13	6.1 - 6.4	Introduction; Notations; Mappings of infinitesimal generators; Invertible mappings for nonlinear systems of PDEs to linear PDEs
14	6.5 - 6.6	Invertible mappings of linear PDEs to linear PDEs with constant coefficient.
15	7.1, 7.2	Potential symmetries for PDEs and inherited symmetries
16	7.3, 7.4	Potential symmetries for ODEs and inherited symmetries. Review of material.
17	-	Review
18	<b>End Semester Exam</b>	