**Advance Mathematical Techniques in Chemical Engineering**

**(CH 61015)**

**Class Test -1**

**Solution**

**Question 1.**

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| **Governing equations** | **Linear/Nonlinear** | **Homogeneous/ Nonhomogeneous** |
| (i) | Linear | Nonhomogeneous |
| (ii) | Linear | Homogeneous |
| (iii) | Nonlinear | Nonhomogeneous |
| (iv) | Nonlinear | Nonhomogeneous |
| (v) | Linear | Homogeneous |
| (vi) | Nonlinear | Nonhomogeneous |
| (vii) | Nonlinear | Homogeneous |
| (viii) | Linear | Homogeneous |
| (ix) | Nonlinear | Homogeneous |
| (x) | Nonlinear | Nonhomogeneous |

**Question 2.**

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| **Governing equations** | **Coefficients of the matrix** | **Eigenvalues** | **Type of equation** |
| (i) | a11 : 1  a22 : 1  a33 : 1 | 1, 1, 1 | Elliptic |
| (ii) | a11 : 1  a22 : 1  a33 : -1 | 1, 1, -1 | Hyperbolic |
| (iiia) | a11: 1, a12: 0.5  a21: 0.5, a22 : 1  a33 : 1 | 0.5, 1, 1.5 | Elliptic |
| (iiib) | a11 : 1, a12: 1  a21: 1, a22 : 1  a33 : 1 | 0, 1, 2 | Parabolic |
| (iiic) | a11 : 1, a12: -2  a21: -2, a22 : 1  a33 : 1 | 1, -1, 3 | Hyperbolic |

**Question 3.**

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| **Original problem** | **Number of nonhmogeneries** | **Well posed sub-problems** |
|  | Three |  |

**Question 4.**

**Ans:** This problem has to be solved for three cases:

1. For , let us consider , the governing equation becomes: , The general solution is given as: Applying the boundary conditions, we have, A=0, B=0, which produces a trivial solution.
2. For , the governing equation becomes: , The general solution is given as: . Applying the boundary conditions, we have, A=0, B=0, which produces a trivial solution.
3. For , let us consider , the governing equation becomes: , The general solution is given as: 

Applying the boundary conditions, we have, A = -B and , let us take: 

Then, the above equation is simplified as:  which gives the general solutions as: and the eigenvalues are given as: . The final solution is given as: .