23MA801 Qualitative Analysis of Fractional Differential Equations 4-0-0-4

Inequalities: Introduction, Gronwall-type inequalities, Wendorff-type inequalities, Bihari-type inequalities, Multivariate inequalities, Differential inequalities, Integral inequalities, General integral inequalities, Integro-differential inequalities, Difference inequalities, Interval-Valued integral inequalities, Inequalities for Piecewise continuous functions, Reaction-diffusion inequalities.

Lyapunov-Based Stability Analysis: General time delay system (TDS) and the Direct Lyapunov Method, A Linear matrix inequality approach to stability, Delay-Independent conditions for linear TDSs, Lyapunov-Krasovskii method for linear descriptor TDSs, Delay-Dependent criteria: Preliminaries, Delay-Dependent conditions: The Krasovskii method, Interval or Non-small Time-varying delay, Stability of linear systems with distributed delays, General Lyapunov functional for Linear Time invariant (LTI) Retarded systems, Writinger's inequality, its extensions and augmented Lyapunov functionals, About stability analysis of Nonlinear TDSs.

Fractional differential equations: Definitions of Qualitative properties, Lyapunov functions and their fractional derivatives, Fractional comparison lemmas. Stability and Boundedness**:** Lyapunov stability, Theorems on boundedness, Global stability, Mittag-Leffler stability, Practical stability, Lipschitz stability, Stability of sets, Stability of Integral Manifolds.

Almost Periodicity: Almost periodic solutions, Lyapunov method for almost periodic solutions: Impulsive fractional differential systems, Impulsive fractional integro-differential systems, Impulsive fractional functional differential systems; Uncertain fractional differential systems.

Applications: Fractional impulsive neural networks: Stability and synchronization, Almost periodic solutions, The uncertain case; Fractional impulsive biological models: Hutchinson's model, Lasota-Wazewska models, Lotka-Volterra models, Kolmogorov-type models; Fractional impulsive models in Economics: Price fluctuations models, Solow-type models.

TEXTBOOKS/ REFERENCES:

1. Ivanka M. Stamova and Gani Tr. Stamov, *"Functional and Impulsive Differential Equations of Fractional Order"*, CRC Press, Taylor and Francis Group, 2017.
2. Emilia Fridman, *"Introduction to Time-Delay Systems – Analysis and Control"*, Springer International Publishing, Switzerland, 2014
3. V. Lakshmikantham, Srinivasa Leela, Anatoly A. Martynyuk, *"Stability Analysis of Nonlinear Systems"*, Second Edition, Springer International Publishing Switzerland, 2015.
4. Jack K. Hale and Sjoerd M. Verduyn Lunel, *"Introduction to Functional Differential Equations"*, Springer Science + Business Media, LLC, 2013
5. V. Lakshmikantham, D. D. Bainov, P. S. Simeonov, *"Theory of Impulsive Differential Equations"*, World Scientific, 1989