Scalar-tensor gravitational theories

(Thematic of the complex exam)

1. Brans–Dicke scalar-tensor theory and generalizations. Observational constraints.
2. Einstein and Jordan frames. The energy-momentum tensors of matter and scalar field. Conservation laws.
3. The f(R) gravity, as scalar-tensor gravitational theory.
4. The Vainshtein screening mechanism, eliminating the scalar contribution to the dynamics on small scale.
5. Horndeski theories, stability criteria. Constraint on the propagation speed of tensorial modes from observations of gravitational waves.

Bibliography:

1. Y. Fujii, K. Maeda – The Scalar-Tensor Theory of Gravitation, Cambridge Monographs on Mathematical Physics (2003)
2. S. Capozziello, V. Faraoni - Beyond Einstein Gravity, Springer Fundamental Theories of Physics 170 (2011)
3. V. Faraoni - Cosmology in Scalar-Tensor Gravity, Springer Fundamental Theories of Physics (2014)
4. E. Poisson, C. M. Will - Gravity. Newtonian, Post-Newtonian, Relativistic, Cambridge University Press (2014)
5. E. Papantonopoulos (editor) - Modifications of Einstein's Theory of Gravity at Large Distances, Springer Lecture Notes in Physics 892 (2015)
6. T. Kobayashi - Horndeski theory and beyond: a review, Reports on Progress in Physics 82, 086901 (2019) arXiv:1901.07183 [gr-qc]