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Graduate Program in Physics
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Stellar structure and evolution

Course code: FSC3400000

Credit hours: 4

Duration: 18 weeks

DESCRIPTION: Physical properties of the stars. Physical conditions in the stellar interior. Thermodynamics of the stellar interior. Transport of energy in the stellar interior. Opacity. Nuclear processes in the stellar interior. Computation of the stellar structure. Pre-main sequence evolution. Post-main sequence evolution. Evolution in binary systems. Nucleosynthesis.

COURSE CONTENT:

1. Physical conditions in the stellar interior: Introduction; hydrostatic equilibrium. The Virial theorem; ideal gas with radiation. Ionization and excitation; thermodynamical quantities for the hydrogen gas. Degeneracy; the equation of state for the stellar gas. Conservation of energy; transport of energy by radiation and conduction. Opacity; transport of energy by convection

2. Nuclear processes and stellar structure: Nuclear energy production; proton-proton, CNO and triple-alpha cycles. Other nuclear energy processes; energy loss by neutrino. Stellar evolution: a general overview.

3. Stellar evolution: Stellar formation. Internal structure and evolution of the Sun; solar neutrinos. The main sequence. Effects which affect evolution: rotation, mass loss, pulsations and binarity. Post-main sequence evolution; final stages of the stellar evolution. Compact objects; pulsating stars. Evolution in binary systems

BIBLIOGRAPHY:

1. C. J. Hansen & S. D. Kawaler, *Stellar interiors: physical principles, structure and evolution*, Berlin, Springer-Verlag, 1994.
2. R. Kippenhann & A. Weigert, *Stellar structure and evolution*, Berlin, Springer-Verlag, 1994.
3. E. Bohm-Vitense, *Stellar astrophysics*, Vols. 1-3, Cambridge, Cambridge University Press, 1989.
4. W. Maciel, *Introdução à estrutura e evolução estelar*, São Paulo, Editora da USP, 1999.
5. M. Schwarzchild, *Structure and evolution of the stars*, New York, Dover, 1958.