Universidade Federal de Santa Catarina
Centro Tecnológico
Departamento de Engenharia Química e
Engenharia de Alimentos

Programa de Pós-Graduação em Engenharia Química

PLANO DE ENSINO | COURSE PLANNING
TRIMESTRE | 2020.2 SPRING QUARTER **– AULAS REMOTAS |** REMOTE CLASSES

I. IDENTIFICAÇÃO DA DISCIPLINA | COURSE DESCRIPTION

Código | Code	**Nome da disciplina |** Course Name	**Credits**	**Quarter**
ENQ 5100	Tópicos Especiais em Engenharia Química: (Special Topics in Chemical Engineering): **Matter, Energy, Entropy and Information**: Fundamentals, Structure, Properties, Flow and Mathematical Relations	03	2020.2

II. PROFESSOR MINISTRANTE | LECTURER/PROFESSOR

Luismar Marques Porto

III. TUTOR | TEACHING ASSISTANT(S)

N/A

IV. PRESENÇA NAS ATIVIDADES SÍNCRONAS | CLASS ATTENDENCE

Online access registration.

V.CURSO E PÚBLICO-ALVO | GRADUATE PROGRAM AND TARGET AUDIENCE

Master's and Doctorate's Chemical Engineering students/candidates

VI. EMENTA | COURSE PROGRAM

Fundamentals, Structure, Properties, Flow and Mathematical Relations of the key concepts of Matter, Energy, Entropy and Information. Big bang and particle formation, Quantum physics, Standard Model, Information and thermodynamics entropy. Molecular memory models. Conscious and engineering applications.

VII. OBJETIVOS | OBJETIVES

To show the students the fundamental nature of atoms and molecules, through their elementar particles and behavior. The student should then better understand the connections between matter and energy, and the role of entropy and related information theories.

VIII. CONTEÚDO PROGRAMÁTICO | PROGRAM CONTENTS

The course will present and discuss core concepts and the nature of matter, energy, entropy and information that are important for science and technology developments. From modern principles of

theoretical physics to advanced thermodynamics concepts, the course will address structures and properties of elementary particles and processes involving matter, energy, entropy and information transfer that may be relevant for the development of innovation and advanced interpretation of molecular and macroscopic phenomena, in physical, chemical and biological applications.

IX. METODOLOGIA DE ENSINO / FORMA DE TRABALHO | METHODOLOGY

Atividades síncronas | Synchronous activities
Copy the class notes to their own notebooks and return proof of their own handwriting in a PDF file.
Interact through chat and video and answer proposed questions

Atividades assíncronas (via Moodle) | Asynchronous activities
Read suggested materials (book sections and papers), search the Internet on specific topics and return short abstracts of the reading materials;
Go over equation deductions

X. METODOLOGIA DE AVALIAÇÃO | COURSE GRADINGS

Participation and interaction during classes
Handwriting notes (%)
Short abstracts
Middle term examination
Final examination

XI. CRONOGRAMA | CLASS SCHEDULLE

Class 1 – Course introduction, topics description, course rules, grading and homework. What is matter, energy, entropy and information? Where all this came from? The Big Bang and information basis. The fundamental forces of Nature. Radiation and particles. Newton, Maxwell and Einstein's discoveries. Dark matter and dark energy. The Black Body radiation, Planck and others. Blackbody equation, The birth and development of Quantum Mechanics.
Class 2 – The Standard Model of Particle Physics, Planck's approach, Photoelectric effect, Atomic theory, De Broglie, D'Alembert and the wave equations, Euler's Formula, Time independent Schrödinger's equation, Probability, Superposition, Wave equations Heisenberg Principle, Commutation relations.
Class 3 – Schrödinger equations (transient), Inner product, Quantum 1D box, Phase of the wave equation, Operators, Hamiltonian operator, Normalized wave function, Fields, Two photon scattering, Two photon fluctuations, Threshold temperature, Unified view of the fundamental forces.
Class 4 – Structure of a proton, Kaon decay, Feynman diagrams, Interactions, Scattering amplitude Lagrangian field theory, Electron-positron annihilation, General scattering process, Quantum scattering. Scattering of light.
Class 5 – The scale factor, Metrics, Proper distance, Friedman equation, Sean Carrol's equation, Noether theorem, Conservation quantities (symmetry), Discrete transformation, Continuous transformation, Canonical quantization.
Class 6 – Feynman rules, Gauge theory, The weak interaction, Interaction between particles, Internal energy, Kinetic energy, Potential energy.
Class 7 – Entropy, entropy balances, entropy definitions. CPT theorem.
Class 8 – Brain connectivity and behavior, tripartite memory model, Cuinfo, nECM components, Memory and Engram.
Entropy and Information, Boltzmann's entropy, Information theory, The information function, Conditional entropy, Memory processing, Information balance
Class 9 – Information and integration, Time evolution operator U, Particles in the Universe, Neural memory traits.

Class 10 – Entropy and Conditional Entropy, Communication channel, Kolmogorov complexity (applications), Conscious (Tegmark), Innovation and engineering applications.

XII. BIBLIOGRAFIA | REFERENCES

Weblinks via Moodlle.

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Um Bom Trimestre a todos(as)!!!

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Prof. Dr. Luismar Marques Porto
Docente da Disciplina

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