Annexure 2: Syllabus for the written test for M.Tech. in Energy Transition and Sustainability

The paper shall consist of two parts:

1) **Part A:** This part shall be common for all eligible candidates with qualifying degrees in different disciplines. The questions may be of an objective /short answer or subjective type.

2) **Part B:** For this part, a candidate would have to select one of the options for the entrance examination out of the following four options: Thermal Science & Engineering, Electrical Science & Engineering, Chemical Science & Engineering, General Engineering.

Part A:
Solution of linear equations, matrices, first order linear and nonlinear differential equations, basic probability theorem, measures of central tendency and dispersion, basics of Laplace transform.
Basics of energy, introductory thermodynamics, energy and sustainable development goals, climate science and climate change, the impact of various types of generation sources on CO_2 emissions, anthropogenic greenhouse gas emission, options to mitigate CO_2 emissions for energy sector: energy efficiency and harnessing of renewable energy sources.

Part B:
Thermal Sciences and Engineering
Thermodynamics: Properties, laws of thermodynamics, calculation of work, heat, availability, irreversibility; Vapour and gas power cycles and refrigeration cycles; properties of moist air, psychrometric chart. Basics of I.C. engine, gas turbine and steam thermal power plant. Heat-Transfer: One-dimensional steady and unsteady heat conduction; Convection: Boundary layer, dimensionless parameters, heat transfer correlations, effect of turbulence; Heat exchangers; basics of radiation.

Electrical Sciences and Engineering
Solution of AC/DC circuits, Thevenin equivalent, three phase systems, basics of AC/DC generators, transformers, transfer function of a control system, pole zero analysis, system stability, AC/DC transmission, basics of power system operations, impact of load-generation balance on system frequency, basic power electronic converters.

Chemical Sciences and Engineering
Thermodynamics: Equations of state, First and Second Law; Chemical Equilibrium; Vapor-Liquid Equilibrium, Unit operations: fluid mechanics, heat transfer and mass transfer, Reactors: Basic description of homogeneous and catalytic processes; Ideal reactors.

General Engineering
Basic circuit analysis, Electrical Machines, First and second law of Thermodynamics, Basics of hydrostatics, Bernoulli equation, basic hydrodynamics, Fourier Law of Heat Conduction, Convection, Fick's Law of Diffusion, Basics of Heat Transfer, Design of Heat exchangers, Energy and Environment.

Suggested Readings

(This is only an indicative list. Candidate may choose based on the contents of the part B they wish to opt.):

- Applied Thermodynamics of Engineering Technologists, T.D. Eastop, A. Mcconkey. Person Publications.
- Thermodynamics: An Engg. Approach -- Cengel and Boles. Mcgraw-Hill.
- Fundamentals of Heat and Mass Transfer, Incropera and Dewitt, Sixth Edition, John Wiley.
- Heat Transfer, Y Cengel, McGraw-Hill.
- Fundamentals of Electric Circuits, by Charles K. Alexander, Matthew N. O. Sadiku, McGraw-Hill.
- Principles of Electric Machines and Power Electronics, P.C. Sen, John Wiley and Sons.
- Electrical Power System Technology, Stephen W. Fardo, Dale R. Patrick, River Publishers
- Introduction To Chemical Engineering Thermodynamics (8th Edition), J. M. Smith, H. C. Van Ness, M. M. Abbott, M. T. Swihart, McGraw Hill.
- Unit Operations of Chemical Engineering (7th Edition), Warren L. McCabe, Peter
- Harriott, Julian C. Smith, McGraw Hill.
- Elements of Chemical Reaction Engineering (6th Edition), H. Scott Fogler, Prentice Hall.