ALAGAPPA UNIVERSITY, KARAIKUDI

(Syllabus for Pre-Registration Qualifying Entrance Examination for Ph.D. Programme)

Discipline: **ENERGY SCIENCE**

UNIT I

Physical Sciences:

Work and energy, Force, Newton's laws of motion, Kinetic energy, Potential energy, Power, Gravitation, Heat, Mechanics, Thermodynamics, Current electricity, Magnetism, Ray optics and Optical instruments, Electrons, Photons, Atoms, Molecules, Nuclei, Solids and Semiconductor Devices.

Chemical Sciences:

Acids and Bases, Properties of matter, Molar concentration, Chemical bonding, Atomic structure, Periodic properties, Solids and Liquids, Chemical thermodynamics, Exothermic and Endothermic process. Chemical kinetics, Surface chemistry, Catalysis, Oxidation and Reduction, Electrochemistry, Nanomaterials, Polymers, Green Chemistry, Sustainable Chemical Processes, Photochemistry, Composite materials, Organic naming reactions.

UNIT II

Energy Sources:

Forms of Energy, Sources of Energy, Non-renewable and Renewable energy systems, Comparison - coal, oil and natural gas, availability, applications, merits and demerits. Renewable energy sources - solar energy, nature of solar radiation, components - solar heaters, solar cookers, water desalination. Photovoltaic generation – basics, merits and demerits of solar energy. Biomass energy – classification, photosynthesis, respiration and nitrogen fixation. Biomass conversion process – gobar gas plants, wood gasification, ethanol from cellulosic materials, advantages, and disadvantages of biomass as energy source. Geothermal energy, wind energy, ocean thermal energy conversion (OTEC) - Energy from waves and tides.

UNIT III

Energy Conversion and Storage:

Solar Photovoltaic Energy Conversion, Photovoltaic principle – p-n junction, homo and heterojunctions. Solar thermal energy conversion, Hydrogen Energy production by photolysis and electrolysis. Bioenergy- aerobic and anaerobic bioconversion process. Role of microbes in Energy science - Biohydrogen production, Biodiesel production, Bioethanol production,

and Microbial fuel cell technology. Energy storage systems – Physical Energy Storage, Chemical Energy Storage, Biological Energy Storage.

UNIT IV

Synthesis of Energy Materials:

Growth of Nanostructured Materials by Solution growth techniques – Electrochemical methods, Electrospinning, Sol-gel technique, Co-precipitation, Hydrolysis, Sonochemical method, Combustion technique, Colloidal precipitation and Template process. Ultra-high vacuum systems, laser ablation - RF/DC magnetron sputtering, Microwave plasma evaporation.

UNIT V

Analytical Techniques:

Electrochemical Techniques – Voltammetry, Conductometry, Potentiometry, Ultraviolet spectroscopy, Fourier Transform Infrared spectroscopy, Raman spectroscopy, X-ray photoelectron spectroscopy, Chemi-luminescence, Fluorescence Techniques, X-ray diffraction, Scanning Electron Microscopy, Atomic Force Microscopy, Transmission Electron Microscopy, Nuclear Magnetic Resonance, Gas Chromatography, High Performance Liquid Chromatography.

References

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2. S. Mohan, V. Arjunan, Sujin P. Jose and M. Kanchana Mala, Principles of Materials science, MJP Publishers, 2012.
3. V. Quaschining, Renewable Energy and Climate Change, IEEE Press, 2012.
4. B. E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer-Plenum Press, New York, 1999.
5. S. Lee and Y. T. Shah, Biofuels and Bioenergy Processes and Technology, CRC Press, Taylor & Francis Group, 2012.
6. J. Cheng, Biomass to Renewable Energy processes, CRC Press, Taylor & Francis Group, 2009.
7. Willard, Merit Dean and Settle, Instrumental Methods of Analysis, CBS Publishers, IV Edn., 1986.
8. M.C. Math, Non-Conventional Energy Sources, Yes Dee Publishers, 2019.