Ref. No.: Ex/PG/POW/PC/T/111/2025

M.E. POWER ENGINEERING FIRST YEAR FIRST SEMESTER - 2025
ENERGY RESOURCES, STORAGE, AND THEIR MANAGEMENT

Time: 3 Hrs **Full Marks**: 100

Use separate answer script for each part.

PART 1 (30 Marks)

Q1. CO1 (Answer any 5) 3x5=15

i) What is B2?
ii) What are the different BESS technologies?
iii) What are the different vegetative plants generally utilised for Biofuel?
iv) What is Coal Gasification?
v) How is flame Stability Maintained in a Thermal Power Plant?
vi) How is heat released and Captured in CFB Boilers?
vii) What is smart Yaw Control?
viii) What is a Bio Refinary?
ix) What is a TGA?
x) What are the main components of a pico hydro plant?
xi) What How ionization is done in working fluid of a MHD Generation?
xii) What is Topping Cycle and Bottoming Cycle for Co Generation?
xiii) What is a Smart Microgrid?
xiv) What is Anderson Type OTEC?
xv) What is Electrolyte Polarization for Fuel Cell?

Q2. CO3 (Answer any 5) 3x5 =15

i) Name a few HESS.
ii) What are the different types of Fuel Blending?
iii) What is Hybrid Flow Battery?
iv) What is HFCEV?
v) What is non-cooperative energy bidding?
vi) What is a CO_2 Battery?
vii) What is the role of Bacteria in Biomass energy generation?
viii) What are the different protection systems for a Microgrid?
ix) What are the general components of MSW?
x) What is Steam Methane reforming?
xi) What is Internet of Vechile?
xii) What is PEM Electrolysis?
xiii) What are different V1G and V2G Connections?
xiv) What are the four components of Energy management Plan?

[Turn over

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Time: 3 Hrs Full Marks: 100

Part – II (70 marks)

Use Separate Answer scripts for each part

Q1. Answer any four questions: (CO2) $4 \times 10 = 40$

(a) Define depth of discharge, state of charge and life cycle of battery. Develop the mathematical model of battery.

(b) Compare the constant voltage and constant current charging of the battery. What is float charging? Develop equations for the energy stored in a battery bank during charging and discharging process.

(c) Is hydrogen an energy source or an energy carrier? Justify your answer. Discuss the Steam Methane Reforming (SMR) process of hydrogen production.

(d) What are the different fuel cell types used commercially? Which type of the fuel type possesses the most promising technology for the power plant operation? Discuss its operation along with the proper diagram.

(e) Discuss the operation of the Polymer Electrolyte Membrane Fuel Cell with the help of suitable illustration. Mention its uses and advantages.

(f) Classify the solar thermal energy storage system systems. Explain the sensible heat storage system used in case of water tank storage employing solar collector. Derive the equation of water storage temperature as a function of time.

Q2. Answer any one question: (CO3) $1 \times 20 = 20$

(a) Design a battery based standalone system feeding both DC and AC load using proper converters, Li-ion battery, filters and other circuit elements.

(b) Develop a standalone power system employing a fuel cell of suitable capacity to feed a DC load. Use PEM, SOFC fuel cell and compare the output.

Q3. Answer any one question: (CO4) $1 \times 10 = 10$

(a) Draw and explain the structure of the CAN bus based Li-ion battery management system (BMS) for Electric Vehicle.

(b) Develop a suitable battery monitoring unit for 48 V output and write the corresponding algorithm.