Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

II SEM. M.TECH. (ADVANCED THERMAL POWER & ENERGY SYSTEMS)

END SEMESTER EXAMINATIONS, MAY 2016

ENERGY STORAGE SYSTEMS (PROGRAM ELECTIVE-II) (MME 589)
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.

1A What are the advantages of energy storage systems? **(02)**

1B Compare the merits and demerits of PHES system with that of battery energy storage system. **(02)**

1C In a pumped hydro storage system the storage head is 120m, charging period is 12hrs while the discharging is 2 hrs. The efficiency of the turbine is 88% and that of the pump is 75%.Assume head loss due to friction is 8% of the total head during pumping mode and 7% during generating mode. Assume that there is 10% loss of pumped water during the storage period due to evaporation and seepage. The diameter of the penstock used for turbine is 0.5 m and the permissible flow velocity of the water is 15m/s. Assume that in each cycle the storage is completely utilized. Determine the pond size, turbine power, pump power rating and turnaround efficiency. **(06)**

2A What are the advantages of latent heat storage over sensible heat storage system? **(02)**

2B With a neat sketch explain the working of a flywheel energy storage system. **(02)**

2C In a simple compressed air energy storage system the average air flow rate into a salt mine is 120m^3/min and charging period is 8hrs.The discharge period is 10hrs. Air enters the compressor at 1 bar & 20^{0}C and leaves at 90 bar. There is a pressure loss of 2bar and 50^{0}C drop in temperature in the pipe line connecting the compressor and the salt mine. The isentropic efficiency of the compression is 75% and the turbine efficiency is 80%. The air is stored in the salt mine adiabatically. Determine the (i) volume of the salt mine (ii) Compressor rating (iii) Turbine rating (iv) Turn around efficiency. **(06)**

3A Write a short note on classification of batteries. **(02)**

3B With a neat sketch explain the construction and working of a Leclanche cell. **(04)**

3C Determine the dimension of a cylindrical storage reservoir for the latent heat storage of 1GJ of energy using sodium nitrate as phase changing material. The melting point is 308^0C, density is 1874kg/m^3,latent heat of melting is 177kJ/kg, volume of the charging tube = 15% of the solid volume of the PCM. The ratio of the liquid to solid density is 0.925, storage efficiency is 87% and height to diameter ratio of the storage cylinder is 1.2. **(04)**

4A Explain how thermal energy storage is possible using aquifers. **(03)**

4B What are the similarities and differences between the pumped hydro energy storage system and compressed air energy storage system **(03)**

4C What do you mean by secondary batteries? Explain the working of a lead acid battery by clearly mentioning the electrode materials, electrolyte and its composition. **(04)**

5A Explain how solar pond can be used for thermal energy storage. **(03)**

5B Explain the electrolytic production of hydrogen and list the advantages and disadvantages of the method. **(03)**

5C With a neat sketch explain the working of a Hydrogen fuel cell and list the advantages and disadvantages of the same. **(04)**

6A What do you mean by super capacitor? How it can be used for energy storage? **(02)**

6B Explain the application of PCM in solar thermal energy storage system. Also list the problems associated with the PCM in its practical application. **(03)**

6C With a neat sketch explain the working of a super conducting magnetic energy storage system.
What are the advantages of super conducting magnetic energy storage system over other energy storage system? **(05)**