TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION

BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC ENGINEERING

EEE 2512: ENERGY SYSTEMS

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: SEPTEMBER 2018

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt **Question ONE (Compulsory)** and any other **TWO Questions**

Do not write on the question paper.

QUESTION ONE [Compulsory-30 marks]

a) Give three advantages of a hydro power station. **(3Marks)**

b) A diesel engine power plant has one 700kW and two 500kW generating units. The fuel consumption is 0.28kg per kWh and the calorific value of oil is 10200kcal/kg. Estimate

i) the fuel oil required for a month of 30 days **(3Marks)**

ii) overall efficiency, Plant capacity factor=40% **(3Marks)**

c) A hydro-electric power station is supplied from a reservoir of capacity $3x10^7 m^3$ at a head of 150m. Determine the total energy available in kWh if the overall efficiency of the plant is 70%.

(5Marks)

d) A generating station has the following data

Time in hrs	0-6	6-10	10-12	12-16	16-20	20-24
Load in MW	20	25	30	25	35	20

Draw the load curve and determine

(i) Maximum demand **(2Marks)**

(ii) Units generated per day **(2Marks)**

(iii) Average load and **(2Marks)**

(iv) Load factor **(2Marks)**

e) What are the factors considered when choosing a site for a hydro power plant **(3Marks)**

f) A power station has a daily load cycle as under: 260MW for 6hours; 200MW for 8 hours; 160MW for 4 hours, 100MW for 6hrs. If the power station is equipped with 4 sets of 75MW each, calculate,

i) daily load factor

ii) Plant capacity factor

iii) daily requirement if the calorific value of oil used were 10,000kcal/kg and the average heat rate of station were 2860kcal/kg **5Marks**

QUESTION TWO

a) Give three advantages of solid fuels over liquid fuels (**3Marks)**

b) A hydro-electric power station has a reservoir of area 2.4 square kilometres and a capacity 5 x $10^6 m^3$. The effective head of water is 100 metres. The penstock, turbine and generation efficiencies are respectively 95%, 90% and 85%.

i) Calculate the total electrical energy that can be generated from the power station. **(5Marks)**

ii) If a load of 15,000kW has been supplied for 3 hours, find the fall in the reservoir level. **(7Marks**

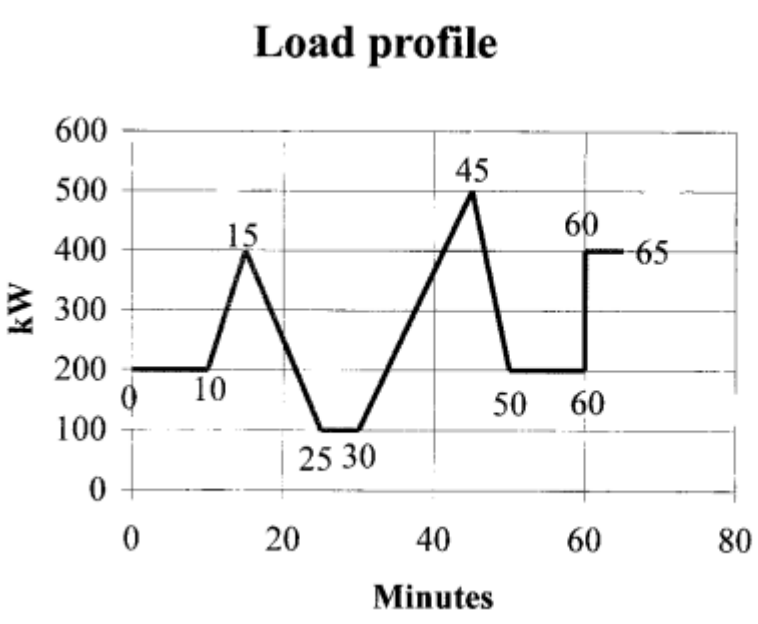
c) A hydro-electric generating station is supplied from a reservoir of capacity 5x10^6 cubic metres at a head of 200metres. Find the total energy available if the overall efficiency is 75%. **(5Marks)**

QUESTION THREE

a) A power station has a maximum demand of 15000kW. The annual load factor is 50% and plant capacity factor is 40%. Determine the reserve capacity of the plant **(3Marks)**

b) The diagram below represents a load profile of a company. What is the billing demand and how many kWh did they use in that period?

A utility changes based on a a 30-minute synchronous charge period **(10Marks)**



Minutes	kW
0	200
10	200
15	400
25	100
30	100
45	500
50	200
60	200
60	400
65	400

c) A hydroelectric power station is to operate with a head of 50metres. It makes use of water collected over a catchment area of 200km2 over which the average annual rainfall is 420cm with a 30% loss due to evaporation. Assuming a turbine efficiency of 85% and alternator efficiency of 80%. Calculate the power that can be generated. **(7Marks)**

QUESTION FOUR

a) A generating station has a connected load of 43MW and a maximum demand of 20MW. The unites generated being 61.5 x 10^6 kWh per annum. Calculate;

(i) The demand factor **(2Marks)**

(ii) Load factor **(2Marks)**

b) The daily demands of three consumers are given as below

Time	Consumer 1	Consumer 2	Consumer 3
12 am at mid-night	No load	200W	No load
8AA TO 2PM	600W	No load	200W
2PM to 4PM	200W	1000W	1200W
4PM to 10PM	800W	No load	No load
10PM to midnight	No load	200W	200W

Plot a load file and find

(i) Maximum demand of individual consumer **(5Marks)**

(ii) Load factor of the individual consumer **(6Marks)**

(iii)Diversity factor **(2Marks)**

(iv)Load factor of the station **(3Marks)**

QUESTION FIVE

a) Give six types of wind turbines **(6marks)**

b) Define the following terms **(4Marks)**

i) Utilization factor,

ii) Plant capacity factor

iii) Load Diversity

iv) Maximum Demand

c) A base load station having a capacity of 18MW and a standby station having a capacity of 20MW share a common load. Find the annual load factors and plant capacity factor of two power stations from the following data:

Annual standby station =7.36 x 10^6 kWh

Annual bas load dtation output =101.35 x 10^6 kWh

Peak load on standby station =12MW

a) Hours of use by standby station/year2190hrs (10 Marks)