



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

..... YEAR **SECOND** SEMESTER EXAMINATION FOR, BACHELOR OF
SCIENCE IN

EES 520– ENERGY CONSERVATION AND MANAGEMENT

DURATION: 2 HOURS

Instructions to candidates:

1. Answer question One and Any Other Two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a) Define the following terms as used in energy system (4marks)
- i) Maximum demand
 - ii) Demand factor
 - iii) Average load
 - iv) Diversity factor
- b) The daily demands of three consumers are given below

Time	Consumer 1	Consumer 2	Consumer 3
2 midnight to 8A.M	No load	200w	No load
8PM to 2P.M	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 the load curve and find;
- i) Maximum demand of individual consumer
 - ii) Load factor of individual consumer
 - iii) Diversity factor and
 - iv) Load factor of the station (8marks)
- c) Mechanical energy is supplied to a.d.c generator at the rate of 4200j/s. the generator delivers 32.2 A at 120W (3marks)
- i) What is the percentage efficiency of the generator?
 - ii) How much energy is lost per minute of operation?
- d) It is proposed to use a forward curve centrifugal fan in a mechanical ventilation system. The fan is required to deliver a volume flow rate of $1.8\text{m}^3/\text{s}$ and the estimated system resistance is 500 pa. However the proposed fan delivers $2.06\text{m}^3/\text{s}$ against a resistance of 500pa while running at a speed of 1440r.p.m. Determine the fan power input, if;
- i) A volume control damper is used to achieve a volume flow rate of $1.8\text{m}^3/\text{s}$ by increasing the total system resistance to 750pa.
 - ii) The fan speed is reduced in order to deliver $1.8\text{m}^3/\text{s}$
 - iii) Comment on the energy consumption of the fan as used the mechanical ventilation system (6marks)
- e) Define energy Audit and outline three types of energy audits that support energy management (4marks)
- f) Identify the 3 main pillars of energy conservation (3marks)

- g) With respect to solar plants, differentiate between concentrating thermal power plants and solar photovoltaic plants (2marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

- a) State TWO advantages of liquid fuels over the solid fuels (2marks)
 b) Identify atleast TWO main factors which influence the energy consumption of lighting scheme (2marks)
 c) Using a simple diagram, explain the generation of AC electrical energy (3marks)
 d) A power supply is having the following loads shown in table Q2d

Types of load	Max demand(w)	Diversity of group	Demand factor
domestic	1500	1.2	0.8
commercial	2000	1.1	0.9
industrial	10,000	1.25	1

- If the overall system diversity factor is 1.35, determine (5marks)
- i. The maximum demand and
 - ii. Connected load of each type
- e) A 100w light bulb is left accidentally on overnight (8hours) (3marks)
- i. How much energy does it consume?
 - ii. And how much money does this cost, if electricity cost no cent per kilowatt hour?
- f) Briefly outline the elements of the Demand-side management planning framework as used in energy conservation and management (5marks)

QUESTION THREE (20 MARKS)

- a) State the THREE Laws of Thermodynamics (3marks)
 b) State the four basic method by which lighting installation can be controlled (2marks)
 c) A generating station has connected load of 43MW and a maximum demand of 20mw, the units generated being 61.5×10^6 per annum. Calculate (4marks)
- i. The demand factor and
 - ii. Load factor
- d) Outline TWO reasons why it is important conserve energy (2marks)
 e) Discuss the following types of electric vehicle(EVs) stating clearly how energy storage is handled in each of them
- i. Plug-in electric vehicle
 - ii. Hybrid EVs

iii. On and off road EVs

QUESTION FOUR (20 MARKS)

- a) State THREE importance of electrical energy (3marks)
- b) With the aid of a simple sketch, explain the principle of operation of a variable frequency drive(USD) system indicating the energy savings obtained from the same. (5marks)
- c) Distinguish between load factor and plant capacity factor as used in energy systems (3marks)
- d) A generating station has the following daily load cycle

Time(hours)	0-6	6-10	10-12	12-16	16-20	20-24
Load(mw)	40	50	60	50	70	40

Draw the load curve and find

- i. Maximum demand
- ii. Units generated per day
- iii. Average load and
- iv. Load factor