Strathmore UNIVERSITY

SCHOOL OF COMPUTING AND ENGINEERING SCIENCES
MASTER OF SCIENCE IN SUSTAINABLE ENERGY TRANSITIONS
END OF SEMESTER EXAMINATION
MSSET 8302: ENERGY PRACTICUM DESIGN

DATE: 25th April, 2024 **Time: 18:00-20:30 Hours**

Instructions

1. This examination consists of **FOUR** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

QUESTION ONE **(Total: 20 Marks)**

Case Study 1

Study this case study and answer the following questions

Global Power Corporation (GPC) is a multinational energy company specializing in the production of electricity from various sources, including fossil fuels, renewable energy, and nuclear power. With operations spanning across multiple countries, GPC has been a key player in the energy sector, providing essential services to millions of consumers worldwide. Recently, GPC has been facing increasing pressure from environmental activists, regulatory bodies, and concerned citizens regarding its reliance on fossil fuels, particularly coal-fired power plants. While coal has traditionally been a significant source of energy for GPC, it is also one of the leading contributors to greenhouse gas emissions and air pollution, contributing to climate change and public health concerns. Despite growing awareness of the environmental and social impacts associated with coal-fired power generation, GPC has been hesitant to transition to cleaner alternatives due to various reasons, including financial considerations, existing infrastructure investments, and energy security concerns. This reluctance has sparked criticism from stakeholders who advocate for a swift transition to renewable energy sources to mitigate climate change and reduce environmental harm. Moreover, GPC has faced several allegations including environmental degradation, human rights violations, and corruption. These allegations have tarnished the company's reputation and raised questions about its commitment to sustainability and corporate social responsibility.

a. Identify and discuss two ethical considerations associated with GPC's reliance on coal-fired power generation. (4 Marks)

b. Discuss the ethical implications of GPC's reluctance to transition to renewable energy sources despite increasing pressure from stakeholders and growing awareness of environmental concerns. (3 Marks)

c. Propose a comprehensive ethical framework for GPC to guide its decision-making processes and operations, considering the competing interests of stakeholders and the need to balance economic viability with environmental and social responsibility. (3 Marks)

d. Illustrate and discuss the concept of balancing the constraints in implementing the solutions to industrial related problems. (3 Marks)

e. Consultants offer expert research, solutions, and experience to improve business performance. Discuss a 7-step consulting framework. (4 Marks)

f. Identify and discuss three strategies for occupation health and safety in energy sector. (3 Marks)

QUESTION TWO **(Total: 15 Marks)**

Case Study 2

Study this case study and answer the following questions

BrightEnergetics is a leading power generation company specializing in renewable energy solutions, with a focus on solar and wind power projects. The company operates multiple power plants across the country, supplying clean energy to residential, commercial, and industrial consumers. Despite its commitment to sustainability, BrightEnergetics faces challenges in optimizing energy efficiency and reducing operational costs across its power generation facilities associated with underutilization of renewable energy sources, equipment malfunctions, and transmission losses. Additionally, the company is struggling to meet regulatory requirements for energy efficiency and carbon emissions reduction.

a. Using a 10-step problem solving process, discuss how BrightEnergetics can address its challenges. (5 Marks)

b. Identify and explain any four project constraints in this scenario? (4 Marks)

c. Critically analyze the role of problem-solving and need recognition in the energy sector's transition to a sustainable and low-carbon future. (3 Marks)

d. SWOT and Pareto analysis are some of the most commonly used problem identification techniques. Discuss what these two entails? (3 Marks)

QUESTION THREE **(Total: 15 Marks)**

Case Study 3

Study this case study and answer the following questions

You have been selected to join a team of 10 design engineers tasked with the design and construction of a nuclear power plant. Your role as an "Engineer in Training" will involve collaborating with experienced nuclear plant designers to develop a safe, efficient, and reliable facility capable of generating electricity to meet the growing energy demands of the region. The project involves the design and construction of a next-generation nuclear power plant equipped with advanced safety features and state-of-the-art reactor technology. The plant will utilize nuclear fission to produce heat, which will be converted into electricity through steam turbines. The facility aims to adhere to the highest standards of safety, environmental sustainability, and regulatory compliance.

a. Identify and discuss five challenges that you are most likely to encounter in case study no. 3 (5 Marks)

b. Identify and explain four key regulatory requirements that must be addressed in the design and construction of the nuclear power plant. (2 Marks)

c. Outline strategies for engaging with stakeholders to address concerns and build support for the nuclear power plant project. (3 Marks)

d. Develop a comprehensive roadmap solution for addressing energy-related problems in the Industry: (5 Marks)

QUESTION FOUR **(Total: 15 Marks)**

a. SolaTech Inc. has been contracted to develop a solar farm for a medium scale steel industry. The company has two options, each with different initial costs and operational characteristics shown in table 1. As an engineer, evaluate the following two options for purchasing solar panels for this solar farm project and advice the company on which option to implement. (6 Marks)

Table 1

No.	Specifications	Machine 1	Machine 2
1	Cost of acquisition (Ksh)	500 000	600 000
2	Duration of service (years)	15	20
3	Efficiency	18 %	20 %
4	Annual Maintenance cost	Ksh 10 000	Ksh 8 000
5	Annual output	150,000 kWh	180,000 kWh

b. As SolarTech Inc. (*from Q4a above*) continues to expand its operations, ensuring workplace health and safety becomes paramount to protect employees and uphold its commitment to sustainability as they deliver services to its clients. Discuss three major reasons for managing workplace health and safety. (3 Marks)

c. Critically analyze 2 major ergonomic challenges prevalent in industrial setting. (2 Mark)

d. From ergonomic challenges discussed in Q4c above, evaluate the root causes of these problems and propose effective solutions to mitigate ergonomic risks and improve working conditions. (4 Marks)