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: 17th January, 2023 **Time: 2½ 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

Peter has been working with the xyz Oil Company's local affiliate for several years, and he has established a strong, trusting relationship with Jesse, manager of the local facility. The facility, on Peter's recommendations, has followed all of the environmental regulations to the letter, and it has a solid reputation with the state regulatory agency. The local facility receives various petrochemical products via pipelines and tank trucks, and it blends them for resale to the private sector. Jesse has been so pleased with Peter's work that he has recommended that Peter be retained as the corporate consulting engineer. This would be a significant advancement for Peter and his consulting firm, cementing Peter's steady and impressive rise in the firm. There is talk of peter making a partner in a few years.

One day, over coffee, Jesse starts telling Peter a story about a mysterious loss in one of the raw petrochemicals he receives by pipeline. Sometime during the 1950s, when operations were more lax, a loss of one of the process chemicals was discovered when the books were audited. There were apparently 10,000 gallons of the chemical missing. After running pressure tests on the pipelines, the plant manager found that one of the pipes had corroded and had been leaking the chemical into the ground. After stopping the leak, the company sank observation and sampling wells and found that the product was sitting in a vertical plume, slowly diffusing into a deep aquifer. Because there was no surface or groundwater pollution off the plant property, the plant manager decided to do nothing. Jesse thought that somewhere under the plant there still sits this plume, although the last tests from the sampling wells showed that the concentration of the chemical in the groundwater within 400 feet of the surface was essentially zero. The wells were capped, and the story never appeared in the press.

Peter is taken aback by this apparently innocent revelation. He recognizes that state law requires him to report all spills, but what about spills that occurred years ago, where the effects of the spill seem to have dissipated? He frowns and says to Jesse, "We have to report this spill to the state, you know."

Jesse is incredulous. "But there is no spill. If the state made us look for it, we probably could not find it; and even if we did, it makes no sense whatever to pump it out or contain it in any way."

"But the law says that we have to report...," replies Peter.

"Hey, look. I told you this in confidence. Your own engineering code of ethics requires client confidentiality. And what would be the good of going to the state? There is nothing to be done. The only thing that would happen is that the company would get into trouble and have to spend useless dollars to correct a situation that cannot be corrected and does not need remediation."

"But...."
"Peter, let me be frank. If you go to the state with this, you will not be doing anyone any good--not the company, not the environment, and certainly not your own career. I cannot have a consulting engineer who does not value client loyalty and confidentiality."

a. Identify and discuss any **two** ethical issues in this case. (2 Marks)

b. Environment management and protection can be viewed from three perspectives; Planetary Management, Stewardship, and Environmental Wisdom. Analyze the environment in this scenario with respect to these three concepts. (3 Marks)

c. The paradigm of complexity offers a challenge to traditional reductive explanations, which are premised on the assumption that complex systems can be completely understood in terms of their component parts. This is a common issue when it comes to ethics. Highlight the three complexities in ethics. (1½ Marks)

d. For each of the complexities in Q.c above, identify a case where these complexities of ethics can be seen (form the case study) and explain. (3 Marks)

e. Ethical dilemma/paradox a problem in the decision-making process between two possible options, neither of which is absolutely acceptable from an ethical perspective. Briefly **discuss** the **5** steps in resolving ethical dilemma (5 Marks)

f. Identify and discuss (if any) moral/ethical dilemma in case study 1. (2½ Marks)

g. A line drawing methodology (LDM) is a guide to decision making and situations with ethical dilemma. Using LDM, analyse **three** ethical scenarios in this case. *(use the format shown in table 1 for your analysis).* (3 Marks)

Table 1

No.	Feature	Paradigm (Ethical)	Test Case	Paradigm (Non-Ethical)
1				
2				
3				

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

Case Study 2

Study this case study and answer the following questions

John and Kevin are lead project engineers in a small company that provides service to power utilities. The management has initiated a development project for performing electrical power line inspection with unmanned aerial vehicle (UAV) technology, i.e. a camera mounted on a UAV. John is assigned to lead a team for the camera selection, communication link design, and image processing software development. Kevin on the other hand is assigned to lead a team for UAV selection and related operational issues definition. The company has not used UAVs before. John's team quickly selects a camera and starts link and software development. This team wants to obtain realistic link and image data, and so they obtain a quad-rotor UAV from a potential supplier as a rent free loan. (This company in interested in bidding as the ultimate UAV supplier.) John's team starts flying their camera on this UAV near the power lines that are located on company property. Kevin's team has another project to finish for a deadline and is not scheduled to start on the official UAV aspects for another month. Kevin feels that legal and safety aspects of UAV operation is not well understood by anyone in the company, as well as the requirements

for operating near power lines. Kevin sends a memo to Sally, who is the company manager for development and direct supervisor for both John and Kevin. Kevin expresses his concern that the company is moving too fast by using the loaner UAV and by operating this UAV without fully understanding the legal and safety issues. Sally telephones in response and says "to not worry about it" and "the rapid development is a business decision not a technical one." Afterward Kevin's office staff complains that they feel spied upon by the UAV operating during their lunch in the company's outdoor area and that they have seen the UAV operating over the adjacent public park and farmers market.

a. Identify (if any) ethical issues in this scenario and discuss them? (3 Marks)

b. Discuss four major elements of an effective safety and health program (4 Marks)

c. Are there any occupational health and safety (OSHA) issues in this scenario? If yes, identify and discuss. If no, what can be done to ensure that OSHA issues do not occur in future? (3½ Marks)

d. One of the well-known injury prevention framework is referred to as the 3 E's. Discuss this approach with respect to case study 2. (4½ Marks)

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

Case Study 3

Study this case study and answer the following questions

As a Mechanical Engineer working for iBuild company, some of your responsibilities include designing of Pressure Vessel. Jude, a managing director of Dove Distillers, has inquired about the possibility of your company designing and supplying presser vessel for LPGs to be installed in their 47 distribution branches all over the country. Jude has a fixed budget and they have to get all the 47 pressure vessels at the same time. On carrying out the design and simulations using a specific "design code" that requires a material thickness of 20mm, you discovered that the budget that Jude has can on fund 44 pressure vessels. You then forward this information to your immediate boss Vishnu, the technical director of iBuild. Vishnu is concerned about the report as it would mean that Jude may seek the services from another company. Furthermore, Jude's company was expanding to the whole of Eastern Africa and he had promised to contract iBuild to design for all their other upcoming branches. Vishu therefore, has asked you to redesign the vessel to 18mm so that that budget can be enough then we can correct the design for other possible upcoming projects. Also, that this information should be kept secret and that Jude should never know. For your secrecy, you have been promised a paid for vacation in Tahiti with your family. Failure to do so, Vishnu has threatened to terminate you contract on insubordination and get another engineer to can get the job done.

a. Considering all the angles in this case, explain your final decision and why. (1 Mark)

b. Sometimes, you may be faced with an ethical dilemma which can be referred to as on-the-Job Ethical Dilemma as it relates to the common business ethical challenge. This type of the dilemma can be categorized into 4 distinct categories. Describe these four categories. (4 Marks)

c. From the four categories discussed in Q3b and identify scenarios where there is on-the-job ethical dilemma related to those categories from the case and discuss them briefly. (4 Marks)

d. Identify and explain **three** project constraints associated with the design of pressure vessels in this scenario. (3 Marks)

e. Explain how you can manage project constraints identified in Q3d. (3 Marks)

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

Case Study 4

Study this case study and answer the following questions

Excel corporation is a new solar power independent power producer located in the eastern region of Kenya with a capacity of producing 50 MW and has been in production for the last 18 months. The solar farm covers 30 acres of land of which, it is claimed by the locals that the land was a community land that was allocated illegally to the developer. The residents of the community are generally small scale pastoralists and farmers who mainly rear goats and sheep. Over the past 6 months, there have claims by the locals that some of the herds have been burnt by rays reflected by the solar panels. Also, the villagers claim that some trees have dried in the area and the weather, especially the temperature, has changed for the worse. Worse is that there is a claim of skin burns experienced by locals when they are within a certain distance. Upon various complaints by the locals to the local author, a local county engineer had carried out his own research (privately) and beliefs that there could be a problem with the design of the Solar Panel mountings. He believes that the problem could be due to the angel of tilt of the panels or the distance between the panels and the ground surface. He therefore, recommends further studies be carried out by professional and experienced engineer to unearth the problem.

a. Briefly discuss the steps followed in solving any engineering related problem. (5 Marks)

b. As an engineer, discuss the strategy that you will take to solve this problem. (2 Marks)

c. Using design thinking methodology, discuss and clearly illustrate how you are going to solve the problem in case study 4. (8 Marks)