

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

2013/2014 EXAMINATIONS

1. AEN 4131 Farm structure
2. EA 401 Farm power
3. EEE 2019 Principles of electronics I
4. ENG 2139 Introduction to information technology
5. ENG 2159 Engineering workshop technology

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THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
MID YEAR FINAL EXAMINATIONS
2013/14 ACADEMIC YEAR

MARCH 7, 2014

AEN 4131 – FARM STRUCTURES

TIME: THREE (3) HOURS

INSTRUCTIONS:

ANSWER: ANY FIVE QUESTIONS

INFORMATION:

- 1. THIS EXAMINATION PAPER CONTAINS SEVEN QUESTIONS**
 - 2. ALL QUESTIONS CARRY 20 MARKS**
 - 3. THE MARKS FOR EACH QUESTION ARE GIVEN IN BRACKETS**
-

Question One

- a) Timber as a building material can be used as round poles or as sawn timber in the form of planks. There are many timber sawing methods and these affect the quality factors of timber differently. List any FOUR factors that are affected by timber sawing methods. (4)
- b) Using short notes, explain how the following aspects affect the strength of timber. (2)
 - i. Density of timber (2)
 - ii. Moisture content (2)
 - iii. Tree species (2)
- c) Earth is one of the most common building materials known and it has attributes that encourage and facilitate self-help and community participation in house building in rural communities. Give TWO positive attributes and TWO limitations of earth as a building material. (4)
- d) One way of overcoming the limitations of earth as a building material is through the use of burnt bricks. What FOUR factors would make burnt bricks recommendable to a rural farmer intending to build a farm residential house? (6)

Question Two

- a) Define the following:
- i. Aggregate particle density (2.5)
 - ii. Aggregate bulk density (2.5)
- b) A farmer is building a maize shed concrete slab of 30m long, 15m wide and 0.1m thick. The farmer has already built the foundation walls and has already backfilled the foundation. You are told to approximate the cost of building the slab. You feel for a maize shed slab a nominal mix of 1:3:4 is ideal. Calculate the total cost of building the concrete slab assuming it has no reinforcement. The concrete should have the water to cement ratio of 0.75. You are informed of the following unit costs for the necessary materials and labour. Stones cost K70.00/tonne, Sand costs K65.00/tonne, Cement costs K70.00/50kg (37L) bag, Labour costs are charged per completed slab as K4,500.00 and Water is drawn from the neighbouring farm at a cost of K15.00/200L drum.
- Properties of the aggregate you intend to buy are as follows:
Moisture content of sand: 2%, Moisture content of stones: 1%, Bulk density of the sand: 1400 kg/m^3 , Bulk density of the stones: 1600 kg/m^3 .
Taking decrease in volume to be 34% and wastage to be 6%

(15)

Question Three

- a) For the design of beams, a sign convention is set so that there is no confusion in the interpretation of the values and signs found. In most cases, the sign convention used to indicate positive loading is as shown on the top drawing in Fig. Q3 (a). Sketch the three drawings of the figure and using arrows show on both sections of the middle drawing the direction of the positive internal shear forces (V) and the positive internal bending moment (M) on both sections of the bottom drawing. (5)
- b) One of the beams for unshelled maize store for a rural farmer is loaded as shown in Fig. Q3 (b). For the beam:
- i. Determine the reactions at the supports B and C. (2)
 - ii. Showing all the necessary calculations, draw the shear force and bending moment diagrams for the beam. (10)
 - iii. State the maximum shear force and bending moment and give their location (3)

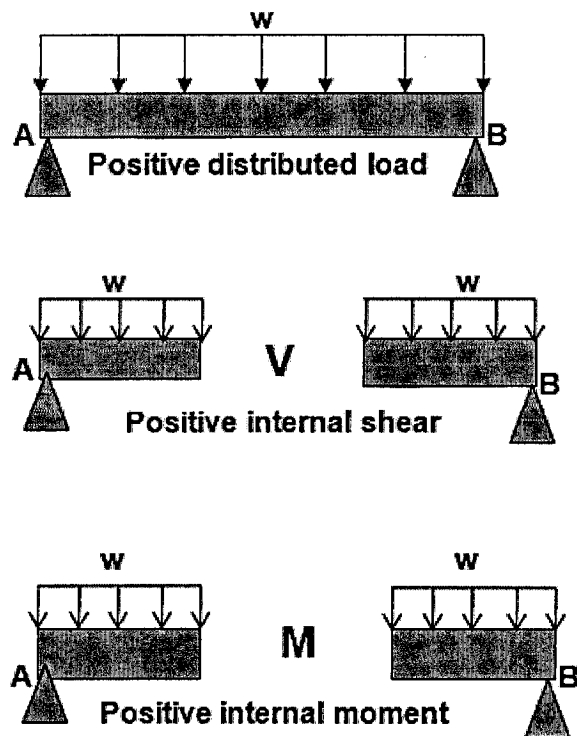


Fig. Q3 (a)

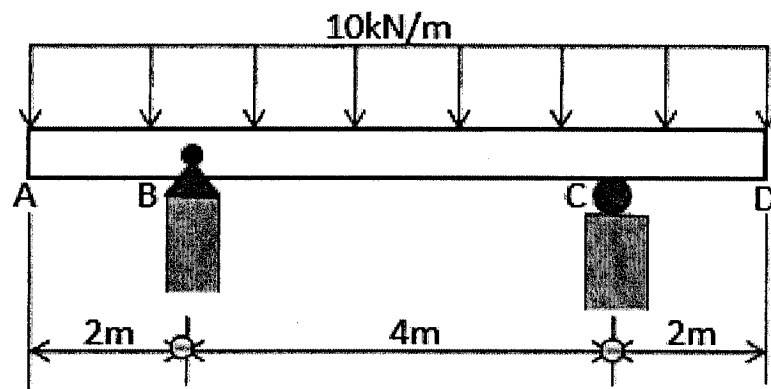


Fig. Q3 (b)

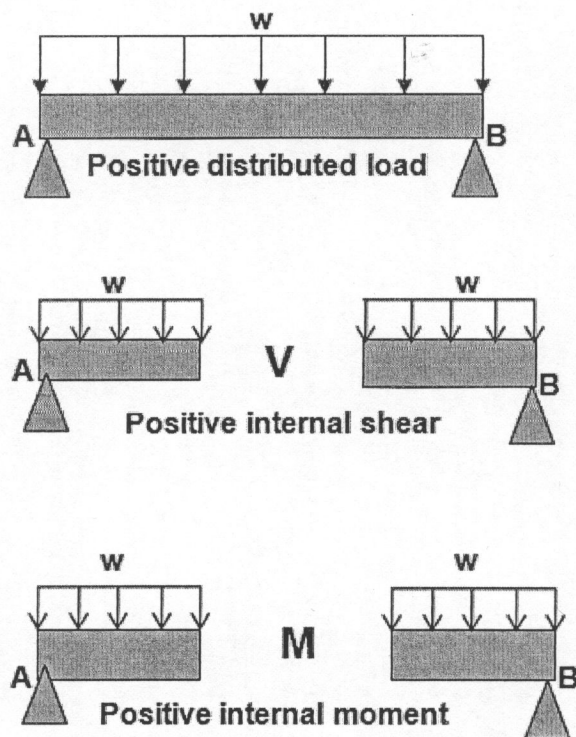


Fig. Q3 (a)

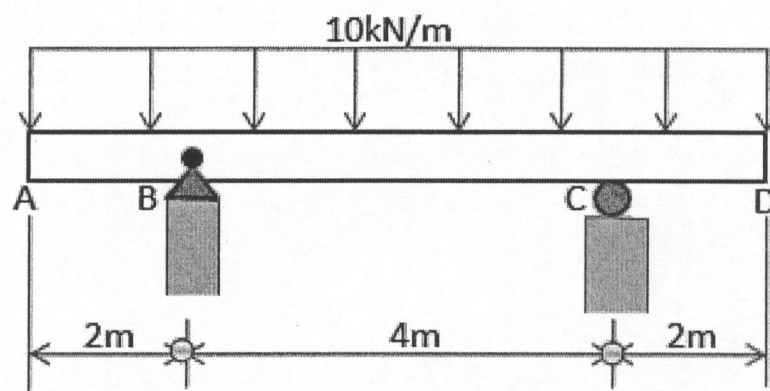


Fig. Q3 (b)

Question Four

- a) For the T - beam shown in Fig. Q 4(a), determine
- The centroid C of the cross section
 - The second moment of area of the cross section

(5)

(5)

A farmer stores his maize on a suspended floor in such a way that each of the three centre rectangular timber beams is loaded as shown in Fig.Q4 (b):

Given that the maximum bending moment and the maximum shear force in the beam are 10kNm and 12.5kN respectively, determine the minimum dimensions (b) and (h) for the beam cross section. The relationship between b and h is such that $h=1.2b$. The allowable normal compressive stress σ_{allow} is 9000kPa and the allowable shear stress τ_{allow} is 450kPa. (10)

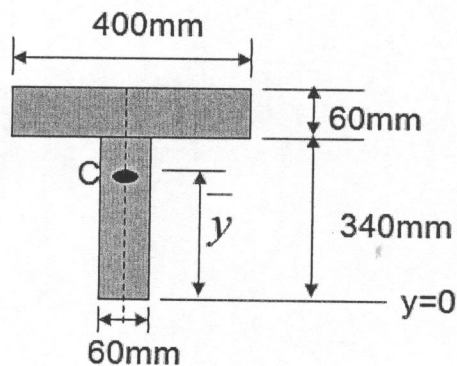


Fig. Q4 (a)

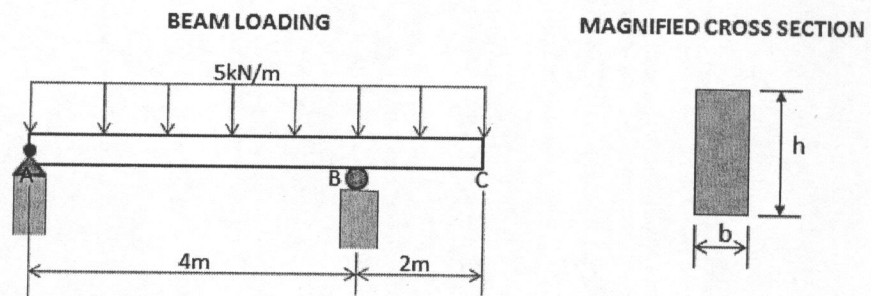


Fig Q4 (b)

Question Five

- a) An understanding of heat transfer and air movements is vital if one is to control the internal environment in farm structures. Define the following terms:
- i. Sensible heat (2)
 - ii. Adiabatic process (2)
 - iii. Natural ventilation (2)
- b) A 30m long and 10m wide pig building has the height to the eaves of 2m and the height to the ridge of 3m. This naturally ventilated structure has a 0.08m eave opening along one side, a 0.12m ridge opening and no ceiling. Determine the ventilation air flow rate due to stack effect only if the outside temperature is 10°C , the inside temperature is 30°C and the wind speed is 5m/s. Use the effectiveness of opening (E) and the reduction factor (μ) values as 0.35 and 0.63 respectively. (5)
- c) At an air temperature of 30°C , air in a farm building contains 16 grams of water vapour per kilogram of dry air. Use the psychrometric chart for 1500m above sea level to determine the following:
- i. The relative humidity of the air. (1)
 - ii. The specific volume of the air. (2)
 - iii. The heat content of the air. (2)
 - iv. The amount of water added to the air if an evaporative cooler reduces the temperature adiabatically to the minimum possible temperature. (2)
 - v. The temperature at which water will start condensing if the air is cooled without any change in water content. (2)

Question Six

- a) Among the environmental factors that affect animal productivity are climatic, chemical and biological factors. Explain briefly how the following aspects linked to the above mentioned factors affect animal comfort and productivity in animal housing structures:
- i. Air humidity (3)
 - ii. Air movement (3)
 - iii. Dust (air quality) (3)
- b) With respect to environmental control and crop storage, farm produce can be grouped in THREE categories. Name these categories and for each category give an example of a crop. (6)
- c) Using a table presentation or very short notes give any five contrasts between durable crops and perishable crops. (5)

Question Seven

- a) Good management and adequate housing conditions will result in pigs producing more meat for less feed in a short time.

Write short notes on the following with respect to pig environment management.

- i. Ventilation (4)
- ii. Air quality (4)

- b) A farmer is running a pig unit with 20 sows. The farmer practices the following in rearing his pigs:

It takes an average of 15 days from weaning to the day when a sow is successfully mated. The gestating sow is taken to the farrowing pen 7 days before farrowing. After farrowing, Piglets are weaned at 8 weeks but remain in the pen till they are 12 weeks. On average, 10 piglets per litter survive to 12 weeks and beyond. After the weaners are removed from the farrowing pens, they take 5 months to grow and fatten, then the pigs are sold immediately. Apart from the farrowing pens which house 1 sow per pen, the size of the farm's other pens is such that a pen can house 10 gestating sows or 12 growing/ fattening pigs. After a group of pigs is removed from a pen, the pen is left unoccupied for seven days. This is for cleaning and disinfection purposes.

Given that on average, 1 month has 30 days and that the gestation period for pigs is 3 months, 3 weeks and 3 days;

Determine the following:

- i. The number of farrowing per sow per year. (3)
- ii. The number of farrowing pens the farmer is expected to have. (3)
- iii. The number of dry sow/gestating sow pens. (3)
- iv. The number of growing/fattening pens (3)

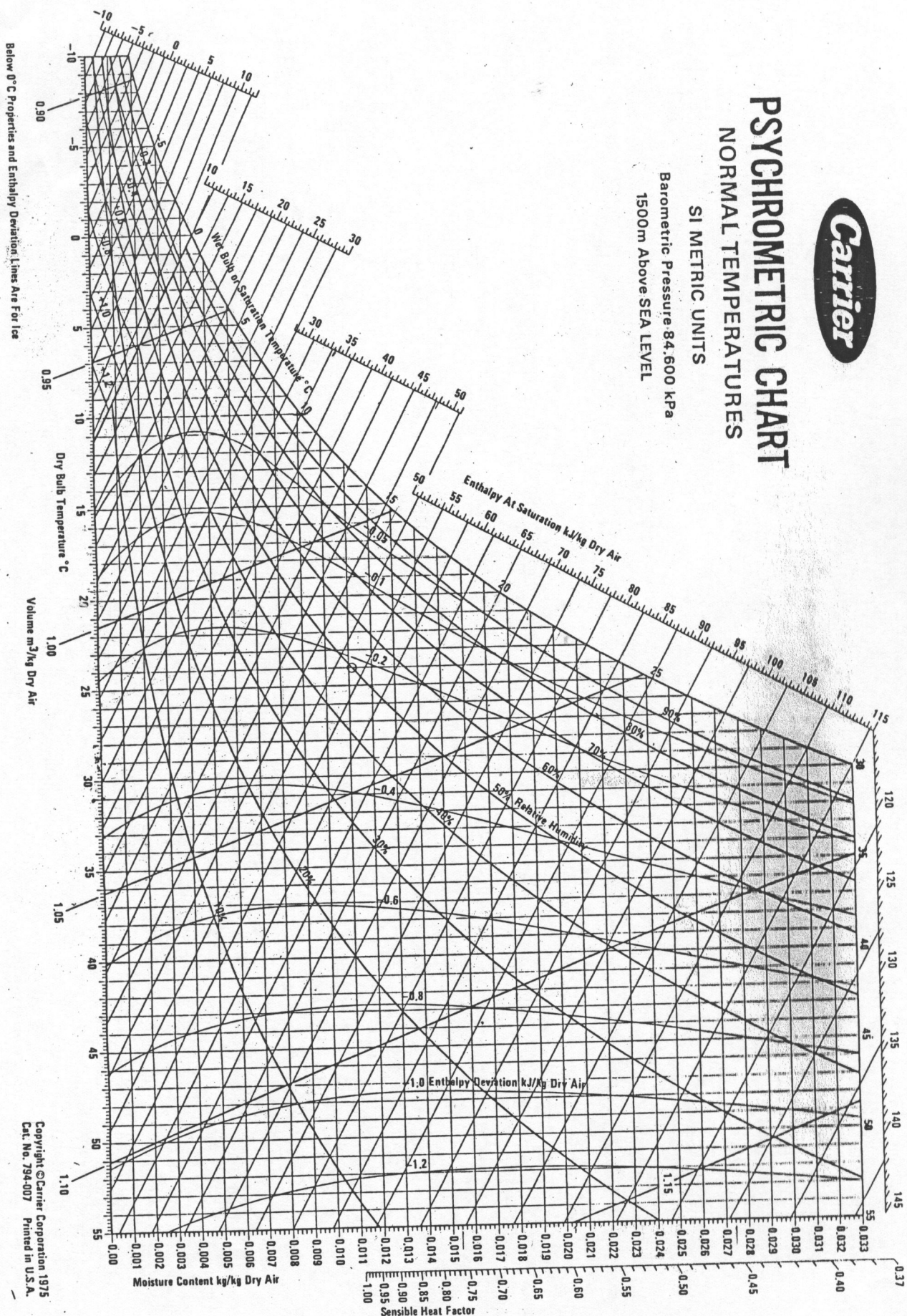


PSYCHROMETRIC CHART

NORMAL TEMPERATURES

SI METRIC UNITS

Barometric Pressure 84.600 kPa
1500m Above SEA LEVEL



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SOME USEFUL EQUATIONS

$$Q = A \cdot \mu (2gH(T_i - T_o)/Ti)^{1/2}$$

$$\tau_{allowable} \geq \tau_{max} = \frac{4V_{Max}}{3A} = \frac{16V_{Max}}{3\pi d^2}$$

$$R_T = R_{air} + R_{wall} + R_{air}$$

$$I = \sum I_{ANx} = \sum \left[\bar{I}_{AN'} + A(d_y)^2 \right]$$

$$\sigma_{max} = \frac{Mc}{I}$$

$$\tau_{allowable} \geq \tau_{max} = \frac{V_{Max}}{A}$$

$$\tau_{allowable} \geq \tau_{max} = \frac{3V_{Max}}{2A} = \frac{3V_{Max}}{2bd}$$

$$q = m(h_y - h_x)$$

$$I = \frac{1}{12} bd^3$$

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
2012/2013 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS - FEBRUARY 2013
EA 401 (FARM POWER)

TIME ALLOWED: THREE HOURS.

INSTRUCTIONS : ATTEMPT FIVE QUESTIONS ONLY. THIS QUESTION PAPER COMPRISES SIX QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS (20 MARKS EACH).

QUESTION 1

- a) Define the following terms in relation to energy conversion in draft animals:
- i) Maintenance energy
 - ii) Digestible energy
 - iii) Appetite limit
- [6 marks]**
- b) A farmer has a pair of oxen, each weighing 500 kg that he primarily uses for ploughing the field and transporting farm inputs and produce. For a period of two weeks in the month of December, the typical routine of tasks performed by the oxen comprised ploughing the field for five hours in the morning and transporting fertilizer for three hours in the afternoon. The average forces required to pull the plough and the ox-cart are 1250N and 300N respectively. The oxen are primarily fed on Sudan grass during that time. Assuming oxen have an average working speed of 3.6 km/h when ploughing and 4.32 km/h when pulling a cart;
- i) Determine the total energy output provided by the oxen for the two tasks performed.
- [4 marks]**
- ii) Calculate the total daily energy requirement for each ox
- [4 marks]**
- iii) Determine whether the feed given to the oxen is able to provide all the energy the oxen need per day.
- [6 marks]**

Table Q1. Energy content of typical animal feeds

Feed	Dry Matter (%)	Gross Energy of Dry Matter (MJ/kg)	$\frac{DE}{GE}$
Guinea grass	26	14.4	0.50
Sudan grass	31	17	0.65
Hay (average quality)	85	17	0.50
Maize silage	27	18.8	0.75
Maize grain	86	19	0.80
Groundnut cake	90	20.7	0.85

$$\text{Maintenance Ration} = 8.3 + (0.091W) \text{ MJ}$$

$$\text{Appetite Limit} = 0.025W \text{ kg of dry matter}$$

QUESTION 2

- a) Outline the **four** steps in the energy conversion process of an internal combustion engine. [4marks]
- b) State the Second Law of Thermodynamics and briefly explain its significance to the operation of a heat engine. [4 marks]
- c) With the help of a well-labeled indicator (p-v) diagram, outline the operation of a theoretical diesel cycle engine. [4 marks]
- d) A farmer is intending to invest in a diesel engine powered water pump for irrigation and domestic water supply. The meteorological data indicates that the average lowest temperature in the area where the pump is to be installed is 5°C. The auto ignition temperature of diesel fuel is 387°C. The compression ratio of the engine is 14.5:1 and polytropic constant, $n = 1.30$
- i) Determine whether the engine will be able to start on the average coldest day. Justify your answer. [4 marks]
- ii) If the engine does not start, state two modifications that can be made to the engine to guarantee smooth start even on the coldest day. [4 marks]

QUESTION 3

- a) Define the following terms:
- i) isomers
- ii) excess air factor
- iii) net heat value of a fuel [6 marks]
- b) If air consists of 20.8% oxygen and 79.2% of nitrogen by volume, show that air contains 23.1% oxygen and 76.9% nitrogen by weight. [4 marks]

Element		Atomic Weight	Molecular Formula	Weight
Carbon:	C	12	C	12
Hydrogen:	H	1	H ₂	2
Oxygen:	O	16	O ₂	32
Nitrogen:	N	14	N ₂	28

- c) Write a balanced equation for the ideal combustion of Ethyl Stearate (C₂₀H₄₀O₂), a biodiesel, and calculate its stoichiometric air to fuel ratio. [6 marks]
- d) What is a naturally aspirated engine and how is the power output maximized in such engines? [4 marks]

QUESTION 4

- a) Briefly explain the difference between full flow and bypass oil filtration systems. [4 marks]
- b) What is a positive displacement pump and why are they widely used in hydraulic systems. [2 marks]
- c) Draw the JIC symbols and state the major function(s) of each of the following components in a hydraulic circuit. [6 marks]
- i) pressure relief valve
 - ii) hydraulic motor
 - iii) manually operated closed centre direction control valve
- d) A double-acting hydraulic cylinder for a forklift has the following specifications:
- piston diameter = 10.16 cm
 - rod diameter = 2.54 cm
 - stroke length = 50.0 cm
 - maximum operating pressure = 17.2 MPa
- i) What is the maximum safe load the cylinder can move while extending? [2 Marks]
 - ii) What is the maximum safe load the cylinder can move while retracting? [2 Marks]
 - iii) If the pump supplies oil at 68.13 l/min, how fast will the cylinder move while extending? [2 Marks]
 - iv) How fast will it move while retracting? [2 Marks]

QUESTION 5

- a) Briefly explain why the final drive of a tractor is located as close as possible to the drive wheels. [4 marks]
- b) State two advantages of using a planetary gear set at the final drive of a tractor. [4 marks]
- c) Derive the expression for the gear ratio for a planetary gear set given that power comes in through the sun gear and out through the planet carrier, while the ring gear is held stationary. [4 marks]
- d) State two differences between inline input and output and parallel input and output sliding gear transmissions. [4 marks]
- e) Briefly explain the function of a differential lock on a tractor and state two situations which may necessitate engaging the differential lock when performing field operations. [4 marks]

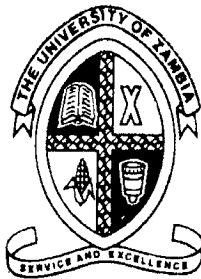
QUESTION 6

- a) Why is the voltage for power generated at a power station stepped up before being transmitted over a long distance?
[5 marks]
- b) Briefly explain how “operating an electrical installation at a low power factor increases power transmission costs and reduces line capacity”.
[5 marks]
- c) Following an energy audit, it was found that a small food processing plant on a farm had an electric load of 500 kVA with a power factor of 0.72.
- i) What size of capacitor banks (in farad) are needed to improve the power factor to 0.95. Assume electrical power supply voltage of 415 V.
[5 marks]
- ii) If the factory is running 18 hours a day and 25 days a month, how much can be saved on energy cost by correcting the power factor to 0.95? Assume electricity tariff base rate of ZMW0.50/kWh for power factor of 0.95 or above, based on true power consumption.
[5 marks]

TABLE Q6 POWER FACTOR IMPROVEMENT TABLES

kW Multipliers for Determining Capacitor kVAR's						
Original Power Factor %	Desired Improved Power Factor					
	80%	85%	90%	92%	95%	100%
50	0.982	1.112	1.248	1.306	1.403	1.732
54	0.809	0.939	1.075	1.133	1.230	1.559
58	0.655	0.785	0.921	0.979	1.076	1.405
60	0.583	0.713	0.849	0.907	1.004	1.333
62	0.516	0.646	0.782	0.84	0.937	1.266
64	0.451	0.581	0.717	0.775	0.872	1.201
66	0.388	0.518	0.654	0.712	0.809	1.138
68	0.328	0.458	0.594	0.652	0.749	1.078
70	0.270	0.400	0.536	0.594	0.691	1.020
72	0.214	0.344	0.480	0.538	0.635	0.964
74	0.159	0.289	0.425	0.483	0.580	0.909
76	0.105	0.235	0.371	0.429	0.526	0.855
78	0.052	0.182	0.318	0.376	0.473	0.802
80		0.130	0.266	0.324	0.421	0.750
82		0.078	0.214	0.272	0.369	0.698
84		0.026	0.162	0.22	0.317	0.646
86			0.109	0.167	0.264	0.593
88			0.056	0.114	0.211	0.540
90				0.058	0.155	0.484
92					0.097	0.426
94					0.034	0.363
96						0.292
98						0.203
99						0.143

END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS

END OF 2013/2014 ACADEMIC YEAR EXAM - 25TH JULY 2014

EEE 2019

PRINCIPLES OF ELECTRICITY I

TIME	: Three (3) hours
INSTRUCTIONS	: Answer any FIVE questions: THREE from SECTION A and another TWO from SECTION B . Each section must be answered in a separate booklet.
ADDITIONAL INSTRUCTIONS	: Where not stated, resistances are in ohms. All questions carry equal marks, Total 100 Marks .

SECTION A

Question 1:

- a) Find the equivalent resistance, R and the equivalent capacitance, C , as shown in Fig.Q1a. **[4 marks]**
- b) For the circuit shown in Fig. Q1b, use nodal analysis to find the power supplied by the 3-A source. **[8 marks]**
- c) Transform the voltage source into a current source and find the power supplied by the new ideal current source. **[8 marks]**

Question 2:

- a) Write all the linearly independent KCL and KVL equations for the circuit of Fig. Q2. **[6 marks]**
- b) A circuit contains six nodes lettered **A, B, C, D, E, and F**. Let V_{AB} be the voltage between nodes A and B with its positive reference at the first-named node, here A. Sketch the diagram and find V_{AC} , V_{AD} , V_{AE} and V_{AF} if $V_{AB}=6V$, $V_{BD}=-3V$, $V_{CF}=-8V$, $V_{EC}=4V$, and (i) $V_{DE}=1V$; (ii) $V_{CD}=1V$; (iii) $V_{FE}=4V$. **[14 marks]**

Question 3:

- a) Use the principle of superposition to determine the magnitude and direction of the current in the $4\ \Omega$ resistor of Fig.Q3a. **[8 marks]**
- b) After being closed for a long time, the switch in the circuit of Fig.Q3b is opened at $t=0$. Find $v(t)$ for $t > 0$. **[6 marks]**
- c) Find the voltage across the capacitor, the phasor current through each element and construct a phasor diagram for the circuit in Fig.Q3c. **[6 marks]**

Question 4:

- a) Find the Thevenin equivalent of the network shown in Fig.Q4a, if $K_1=0$, $K_2=12V$. **[8 marks]**
- b) For the circuit shown in Fig.Q4b, find i and v as functions of time for $t > 0$. **[8 marks]**
- c) What is the impedance of a circuit if $100\angle 10^\circ V$ cause a current of $7.07 + j7.07 A$? **[4 marks]**

Question 5:

- a) Find V_X in the circuit of Fig.Q5 by mesh analysis method. **[6 marks]**
- b) Given that a $v(t)=100\cos(100\pi t) V$ is applied to a $50\ \Omega$ resistance. Find: V_{rms} , the average power, P_{avg} , and $p(t)$. **[6 marks]**
- c) A voltage $V_c(t)=100\cos(200t)$ is applied to a $0.25 H$ inductance. (i) Find the impedance of the inductance, the phasor current, and the phasor voltage. (ii) Draw the phasor diagram. **[4 marks]**
- d) A voltage $V_c(t)=100\cos(200t)$ is applied to a $50\ \Omega$ resistance. (i) Find the impedance of the resistance, the phasor current, and the phasor voltage. (ii) Draw the phasor diagram **[4 marks]**

SECTION B

Question 6:

- a) Consider the ideal diode circuit in Fig. Q6 where the input voltage is a sinusoid $v_{in} = 15 \sin \omega t$.
- i) Sketch the output v_{out} and label all pertinent points. [3 marks]
 - ii) Determine the dc level of the output. [3 marks]
 - iii) Calculate the peak-inverse voltage (PIV) experienced by the diode. [4 marks]
- b) If the ideal diode of Fig. Q6 is replaced by a Germanium diode whose inherent barrier voltage is 0.3 V, then:
- i) Sketch the output v_{out} and label all pertinent points. [3 marks]
 - ii) Determine the dc level of the output. [3 marks]
 - iii) Calculate the peak-inverse voltage (PIV) experienced by the diode. [4 marks]

Question 7:

- a) Consider the RC circuit shown in Fig. Q7a, with V_1 and V_2 constant DC voltage sources, where $V_2 > V_1$. Switch S has been in position 1 for a long time. At time $t = 0$ the switch is moved to position 2.
- i) Find the step response in form of the voltage $v(t)$ across the capacitor C . [5 marks]
 - ii) Hence, if $V_1 = 0$ V, determine the step response in terms of the current $i(t)$ through the capacitor. [5 marks]
- b) Express the voltage pulse in Fig. Q7b in terms of the unit step functions. [4 marks]
- c) Sketch the output waveform for each block of the regulated dc power supply in Fig. 7c. [6 marks]

Question 8:

- a) A full-wave bridge rectifier is shown in Fig. Q8a. The transformer in the circuit steps down the sinusoidal 220Vrms mains voltage to 120V rms which is used as input v_{in} to the bridge. The rectifier output is connected to a 2 k Ω load resistor.
- i) If germanium diodes of barrier voltage 0.3V are employed, calculate the DC voltage available at the load. [4 marks]
 - ii) Determine the required peak-inverse-voltage (PIV) rating of each diode. [4 marks]
 - iii) Find the maximum current through each diode during conduction. [4 marks]
- b) For the diode limiting circuit of Fig. Q8b, perform the following:
- i) Assuming the diode is ideal, sketch the output waveform v_o and label all pertinent points. [4 marks]
 - ii) If the ideal diode of Fig. Q8b is replaced by a silicon diode of barrier voltage 0.7V, sketch the output waveform v_o and label all pertinent points. [4 marks]

Figures Referred to in Exam

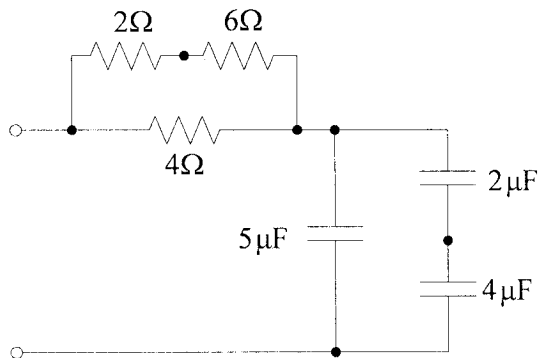


Fig. Q1a

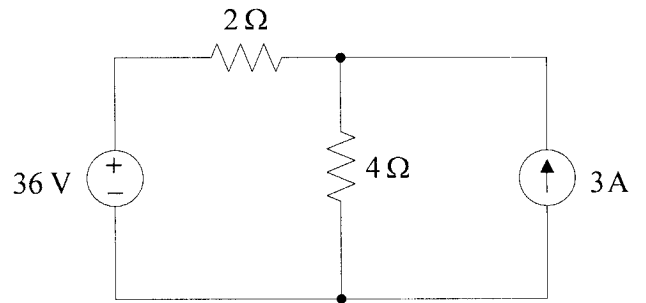


Fig. Q1b

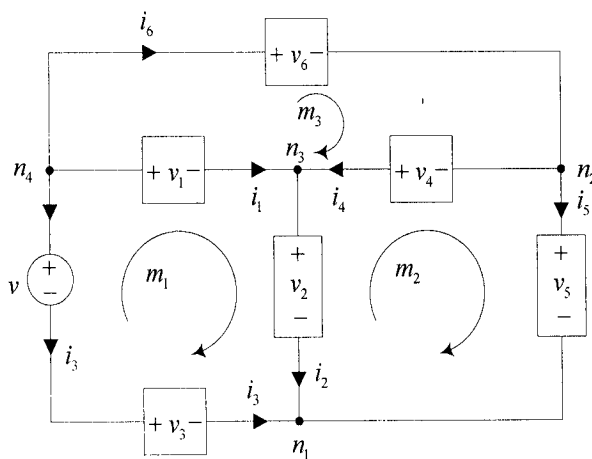


Fig. Q2

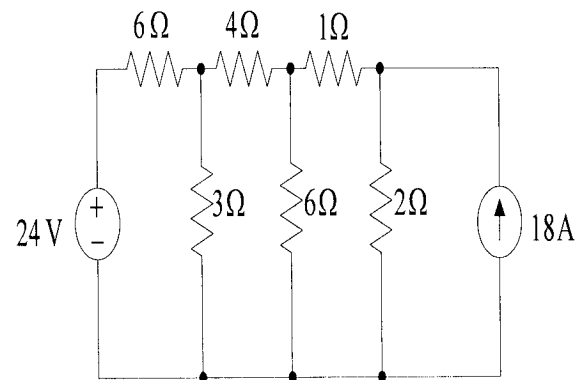


Fig. Q3a

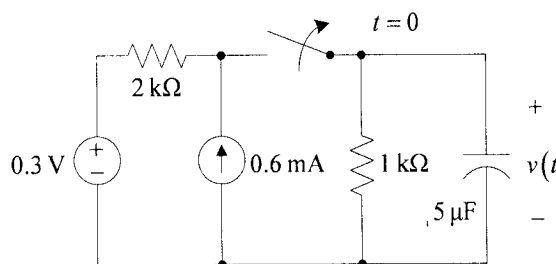


Fig. Q3b

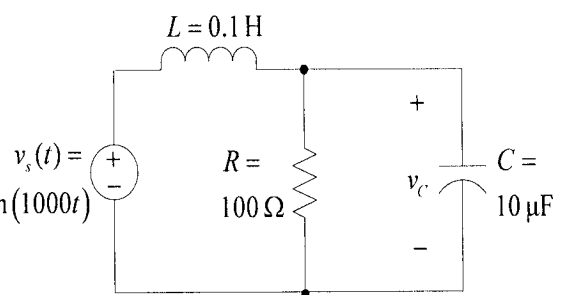


Fig. Q3c

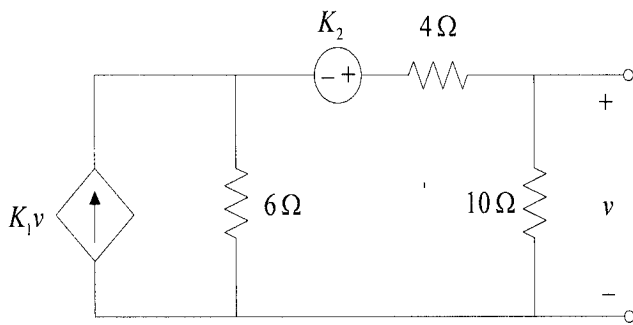


Fig. Q4a

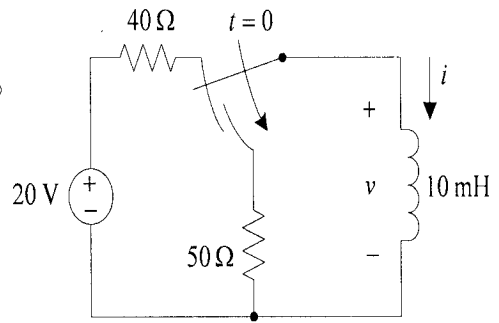


Fig. Q4b

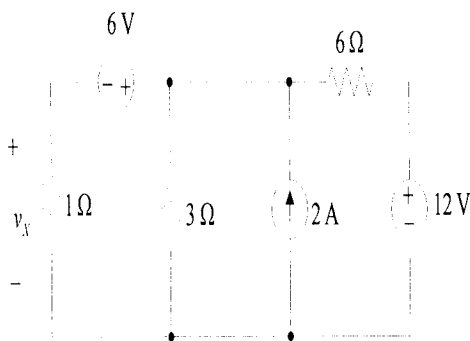
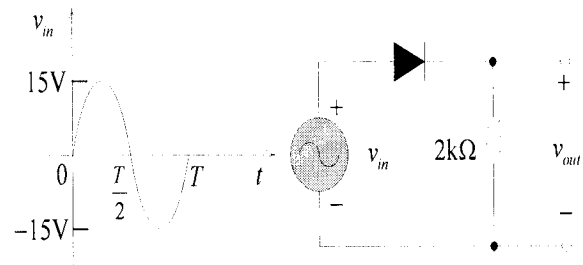


Fig. Q5



Input waveform.

Circuit

Fig. Q6

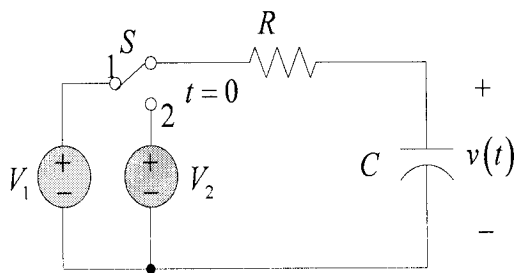


Fig. Q7a

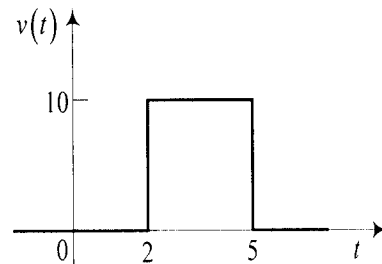


Fig. Q7b

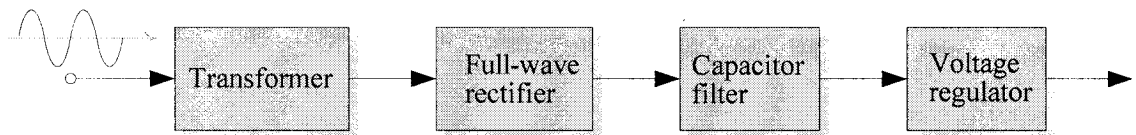


Fig. Q7c

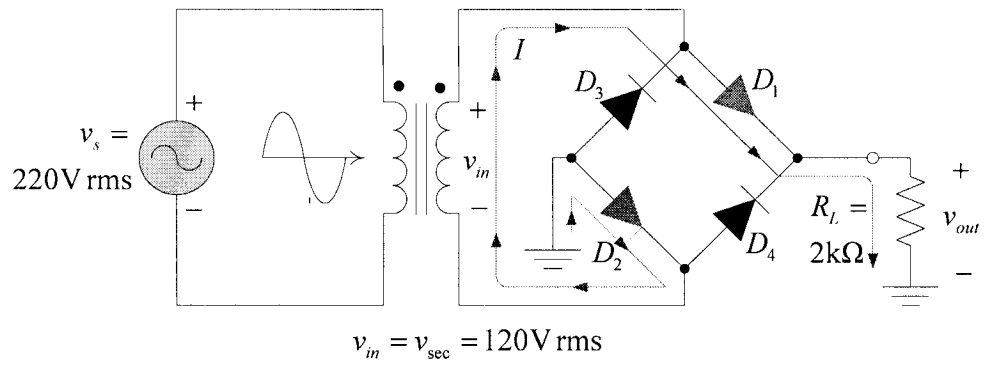


Fig. Q8a

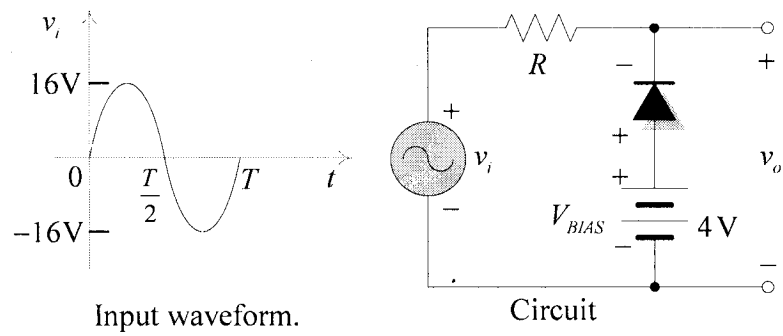
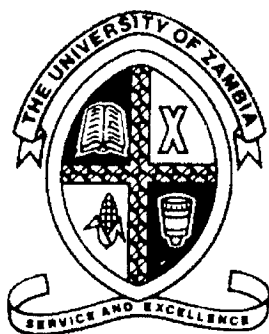


Fig. Q8b



THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS JULY 2014

2013 – 2014 ACADEMIC YEAR

ENG 2139

INTRODUCTION TO INFORMATION & COMMUNICATION TECHNOLOGY (ICT)

DATE: 28th July, 2014

TIME	:	Three (3) hours
INSTRUCTIONS	:	<ol style="list-style-type: none">1. This exam paper has seven (7) questions, organised in Part I (1 – 4) and Part II (5 – 7), which must be answered, clearly labeled and answer booklets bound <u>SEPARATELY</u>.2. You should answer any five (5) questions in which question one (No 1) is <u>COMPULSORY</u>.3. Show clearly all working leading to the answer.

PART I

QUESTION 1

(Part A)

Please answer all the following questions:

- (a) When writing a C++ program, you think that you should design three functions to solve individual subtasks, as well as the usual `int main(void)` function to put all the pieces together in the correct order to solve the actual task completely. Which of these functions do you design first ?
[2 marks]
- (b) What are the three pieces usually necessary when using a while loop in C++ programming ?
[3 marks]
- (c) In C++ programming, where does the declaration of a new variable belong ?
[1 mark]
- (d) Can you declare a variable, and at the same time assign a value to it ?
[1 mark]
- (e) Can you declare a variable without assigning a value to it ?
[1 mark]
- (f) In C++ programming, what is the difference between `=` and `==` ?
[2 marks]
- (g) When using C++, you create a loop that keeps multiplying a positive integer by other positive integers. Can, for the computer, the integers ever become negative ? If so, explain. [2 marks]

(Part B)

Write some C++ program segments that solves the indicated tasks (you do not have to write a complete program, nor be concerned about "good" output; a small code segment will be sufficient).

- (a) A program that gets a double number from the user, decides whether that number is positive, negative, or zero and display its decision on the screen. [4 marks]
- (b) A program to reads a real number as input and adds it to a running total until the user enters the number -1. At that time the program should print out the final sum (not including, of course, the number -1). [4 marks]

QUESTION 2

Write a menu driven C++ program with following option:

- (a) Accept elements of an array. [2 marks]
- (b) Display elements of an array. [2 marks]
- (c) Sort the array using insertion sort method. [4 marks]
- (d) Sort the array using selection sort method. [4 marks]
- (e) Sort the array using bubble sort method. [4 marks]

Write C++ functions for all options. The functions should have two parameters ,name of the array and number of elements in the array. [4 marks]

QUESTION 3

- (a) Write a program that takes length as input in feet and inches. The program should then convert the lengths in centimeters and display it on screen. Assume that the given lengths in feet and inches are integers. **[4 marks]**

Based on the problem, you need to design an algorithm as follows:

1. Get the length in feet and inches.
2. Convert the length into total inches.
3. Convert total inches into centimeters.
4. Output centimeters.

To calculate the equivalent length in centimeters, you need to multiply the total inches by 2.54. Instead of using the value 2.54 directly in the program, you will declare this value as a named constant.

Similarly, to find the total inches, you need to multiply the feet by 12 and add the inches. Instead of using 12 directly in the program, you will also declare this value as a named constant. Using a named constant makes it easier to modify the program later.

To write the complete length conversion program, follow these steps:

1. Begin the program with comments for documentation.
2. Include header files, if any are used in the program.
3. Declare named constants, if any.
4. Write the definition of the function main.

- (b) Write a program to find the factorial value of any number entered through the keyboard. **[4 marks]**
- (c) Two numbers are entered through the keyboard. Write a program to find the value of one number raised to the power of another. **[4 marks]**
- (d) Write a program to compare two strings they are exact equal or not. **[4 marks]**
- (e) Write a program to find a substring within a string. If found display its starting position. **[4 marks]**

QUESTION 4

- (a) Write a program to convert a string in lowercase. **[5 marks]**
- (b) Write a program to find the length of string. **[5 marks]**
- (c) Write a program that lets the user perform arithmetic operations on two numbers. Your program must be menu driven, allowing the user to select the operation (+, -, *, or /) and input the numbers. Furthermore, your program must consist of following functions:
1. Function showChoice: This function shows the options to the user and explains how to enter data. **[2 marks]**

2. Function add: This function accepts two number as arguments and returns sum. [2 marks]
3. Function subtract: This function accepts two number as arguments and returns their difference. [2 marks]
4. Function multiply: This function accepts two number as arguments and returns product. [2 marks]
5. Function divide: This function accepts two number as arguments and returns quotient. [2 marks]

PART II

QUESTION 5

- (a) Describe **with details** the process of booting up a computer system. [10 marks]
- (b) Discuss the difference between megabytes (MB) and megabits per second (Mbps) by illustrating your answer with practical examples. [4 marks]
- (c) Describe para-virtualisation and explain the problem para-virtualisation was invented to solve? [6 marks]

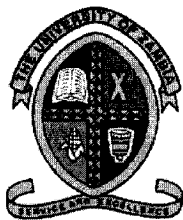
QUESTION 6

- (a) A small e-Commerce company whose main business is online selling of Zambian curios has hired you as a trainee Network Administrator. One morning, you arrive at work, only to be greeted by your supervisor complaints that there have been no sales queries since last evening. Employees can surf the Internet, accessing other external web sites; but no one from outside can access the company's web site which is locally hosted. Hurriedly, you start troubleshooting the problem; few minutes later, you discover that on the company's firewall, both port 80 and port 8080 are blocked. Write a short report (in which you will define a firewall to a lay person) to explain the problem and propose the solution to the General Manager through your supervisor. [8 marks]
- (b) Explain the importance of network protocols in today's distributed computing environment. [8 marks]
- (c) Select all false statements about a network router: [4 marks]
 - A. It is a security network device
 - B. It operates at layer 3 (Internet/IP/Network) of the TCP/IP stack
 - C. It is used to connect devices in a Local Area Network (LAN)
 - D. It directs traffic using IP addresses and routing tables
 - E. None of the above statement is false
 - F. All the above statement are false

QUESTION 7

- (a) List and explain all the buses in modern computer architecture. **[4 marks]**
- (b) Define a database management system. **[2 marks]**
- (c) In today's world of distributed computing systems and information-driven society, database management systems (DBMS) have become very critical and essential to the operations of organisations and businesses. Explain the reason behind this trend. **[4 marks]**
- (d) If you have an application software written in a high-level programming language such as C++, Java or C#; how does the Operating System (OS) interact on one hand with the application and on the other hand the hardware (i.e. CPU) to ensure that the user can obtain expected results from this application software? **[10 marks]**

=== END AND GOOD LUCK! ===



THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

2013-2014 ACADEMIC YEAR
FINAL EXAMINATIONS

ENG 2159: ENGINEERING WORKSHOP TECHNOLOGY

TIME: THREE HOURS

INSTRUCTIONS

1. This examination is Closed Book and contains five sections
 2. Calculators are permitted
 3. Answer ALL the question from each section
 4. Show all the work leading to the solution
 5. The Sections should be answered in separate booklets
-

SECTION A - AGRICULTURAL ENGINEERING

QUESTION 1:

- (a) (i) State one of the goals of engineering in agriculture.

[1 mark]

- (ii) Use a diagram to show the three classes of soil water in reference to its availability to plants.

[2 marks]

- (iii) Why is hygroscopic water not available for plant growth?

[1 mark]

- (b) Given the following data for the soil profile of an irrigated farm which consists of two horizons:

Horizon	<u>A</u>	<u>B</u>
Thickness of horizon, cm	30	90
Bulk density, g/cm ³	1.15	1.35
Mass basis moisture content, (%)		
Wilting point	10 = 11.5	25 = 33.35
Field capacity	28 = 32.2	38 = 51.3
Saturation	40 = 46	47 = 63.45
Initial volumetric moisture content, (%)	15 =	35 =

Plot the resultant moisture content of the soil profile after 16.57 cm of water is added by irrigation. Assume that the A-B horizon interface does not impede the flow of water from the A horizon to B horizon.

[6 marks]

- (c) Briefly describe one simple method used under field conditions to determine the hydraulic conductivity of a soil.

[3 marks]

- (d) For the drainage of a golf course, drain pipes with a radius of 10 cm will be used. They will be placed at a depth of 1.5 m below the soil surface. An impermeable soil layer was found at a depth of 5.5 m below the soil surface. From the auger hole tests, the hydraulic conductivity above this impermeable layer was estimated as 0.6 m/day. The inflow rate for the area is $v = 4$ mm/day. What drain spacing must be applied when an average water table depth of 100 cm below the soil surface is to be maintained? The equivalent depth d' as a function of drain spacing is given below for $d = 4$ m:

Drain Spacing, S (m)	25	30	35	40	45	50	75	80	85	90
Equivalent depth d (m)	2.02	2.22	2.37	2.51	2.62	2.71	3.04	3.08	3.12	3.16

The drain spacing formula is given as: $S^2 = \frac{4K_a H^2}{v} + \frac{8K_b d' H}{v}$

[7 marks]

END OF SECTION A

SECTION B - Civil and Environmental Engineering

QUESTION 2

- a) Give one major distinction between mass concrete and reinforced concrete.
- b) Explain why concrete that has not been properly cured will not attain its expected strength.
- c) The foundations of the Confucius Institute at the University of Zambia are being cast using grade C25 concrete which is attained by mixing the constituents in the proportion of 1:2:4. *C : F : A : C A*
- i) What is the meaning of the term C25 in this context?
- ii) In the above mix, if 4m^3 of Portland cement is used and given that:
- fine aggregate is river sand from Kafue with a density of $1,600\text{kg/m}^3$; and
 - coarse aggregate is crushed limestone rock from United Quarries with a density of $1,300\text{kg/m}^3$.

Compute

- 1) The volume of fine aggregate required.
- 2) The mass of coarse aggregate required.
- d) In order to come up with concrete of a quality to resist a compressive force of 20N/mm^2 , the engineer got coarse aggregates from four different suppliers. He also got fine aggregates from three different sources and Portland cement from Larfarge in Chilanga. He then mixed these constituents in different proportions and also varied the amounts of water. From each resulting concrete mixture, he made $15 \times 15 \times 15\text{cm}$ cubes which he cured under water for seven days after which he subjected the cubes to the crushing test. From the results, he found out that he would get stronger cubes when he mixes the Portland cement, quarry dust and coarse aggregate from United Quarries in the ratio 1:2:3 and water/cement ratio of 0.45. What is the technical term for this rigorous process? *mixed design*
- e) Explain one condition under which you, as a Civil Engineer, would propose the use of pile foundations.

- f) Give one function of each of the following in a building
- i. Conforce wire
 - ii. Brickforce wire
 - iii. Damp Proof Coarse (DPC)
 - iv. Wall plate

[2 + 3 + 6 + 1 + 2 + 6 marks]

END OF SECTION B

SECTION C - Electrical & Electronic Engineering

QUESTION 3

- a) State any three factors on which severity of electrical shocks depend? While clearly indicating any two minimum requirements needed for safety in electrical equipment. [5 marks]
- b) Briefly explain what is meant by the term ELECTRICAL CODE OF PRACTICE? State any three types of personnel to whom this CODE of practice applies? [5 marks]
- c) The circuit in figure 2 shows the battery supplying energy to two lamps and LED.

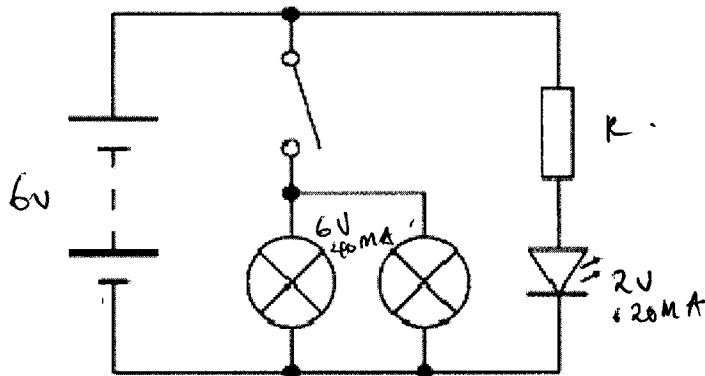


Figure 2

Circuit Component Data:

Battery is rated 6V, ~~4.5Ah~~ and LED is rated 2V, 20mA, Each Lamp is rated 6V, 40mA.

Calculate:

- a) Resistor required for limiting current through LED. [2 marks]
- b) Voltage drop across the resistor. [1 mark]
- c) The total current supplied from the Battery. [2 marks]
- d) Resistance and power rating of each lamp. [2 marks]
- e) Assume now two LEDs each with same rating as the previous LED have replaced one LED connected in series. Calculate
- The resistor required for limiting current through two LEDs. [1.5 marks]
 - The total current of LEDs. [0.5 mark]

iii. New voltage drop across the resistor.

[1 mark]

Total [20 marks]

END OF SECTION C

SECTION D - Geomatic Engineering

QUESTION 4

QUESTION4 (a)

An extract from a levelling field book is given below, in which various booking are missing.

- Fill in the missing values and indicate how you have determined them.
- Carry out all necessary arithmetic checks

N.B. You are only allowed to answer using one of the two methods. Use the forms provided.

[10 marks]

Rise and Fall Method

Point	BS	IS	FS	Rise	Fall	Reduced Level
TBM	a					1247.201
1		2.322			1.128	b
2		0.707		1.615		c
3	2.167		d		e	1245.025
4	f		1.692	0.475		1245.500
5		2.246		0.610		1246.110
6		2.657			g	1245.699
7	h		i		0.491	j
TBM			1.292	1.856		1247.064

Height of Instrument Method

Point	BS	IS	FS	Height of Instrument	Reduced Level
TBM	1.199			1248.395	1247.201
1		2.322			1246.073
2		0.707			1247.688
3	2.167		1.317	1247.192	1245.025
4	2.856		1.692	1248.356	1245.500
5		2.246			1246.110
6		2.657		1248.558	1245.699
7	h		i	1248.356	1247.064
TBM			1.292		1247.064

QUESTION4 (b)

Two fixed points A and B have the following coordinates as shown in figure 1 below:

Point	Easting (m)	Northing (m)
A	10,000.00	10,000.00
B	13,462.56	11,373.62

A Total Station was set on A and oriented to B, then measured distance and angle to C. Then the Total Station was set on B, oriented to A and distance and angle to C were measured. Calculate the coordinates of C given the following observations?

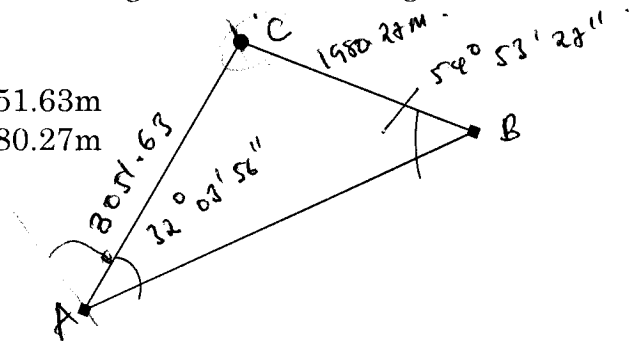
$$\angle CAB = 32^\circ 03' 56''$$

$$\angle ABC = 54^\circ 53' 27''$$

B

$$D_{AC} = 3051.63\text{m}$$

$$D_{BC} = 1980.27\text{m}$$



[10 Marks]

END OF SECTION D

SECTION E - Mechanical Engineering

QUESTION 5

- (a) Give two reasons why the pattern in sand casting is not exactly identical to the shape of the part being made. [2 marks]
- (b) You would like to make one bronze casting of your face, life size, and hollow. How would you do this? [5marks]
- (c) As I fill the mold, what two parameters of the sand casting operation affect the hydrostatic pressure in the mold cavity. What does this pressure determine? [3 marks]
- (d) Name the ten 10 most common operations which can be performed on a lathe machine. [5marks]
- (e) Name seven (7) operations performed on a drilling machine [3marks]
- (f) Describe the two feed mechanisms in engine lathes which cause the cutting tool to move when engaged [2marks]

END OF SECTION E