THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

2016/2017 END OF YEAR EXAMS

1. CEE 2219 STATICS AND INTRODUCTION TO MECHANICS OF MATERIALS
2. EEE 2019 PRINCIPLES OF ELECTRICAL AND ELECTRONIC ENGINEERING
3. EEE 4221 DIGITAL SIGNAL PROCESSSING
4. ENG 2139 INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)
5. ENG 4129 ENGINEERING MANAGEMENT AND ENTREPRENUERSHIP
6. ENG 5129 ENGINEERING MANAGEMENT AND SOCIETY II (2ND HALF EXAM)
7. MEC 2309 PROPERTIES OF ENGINEERING MATERIALS 1

CEE 6262 BRIDGE DESIGN
CEE 6782 MONITORING AND EVALUATION.
EEE 4352 ELECTRICAL MACHINES
GEE 5610 GEOGRAPHIC INFORMATION INFRASTRUCTURE.
GEE 3622 PRINCIPLES OF DATA ACQUISITION AND PROCESSING.
MEC 2009 ENGINEERING DRAWING 1
MEC 5855 AUTOMOBILE ENGINEERING.

THE UNIVERSITY OF ZAMBIA

School of Engineering

Department of Civil & Environmental Engineering

CEE 2219-Statics and Introduction to Mechanics of Materials

Academic Year 2015/2016

FINAL EXAM

September 2015 **Time allowed: Three hours**

CLOSED BOOK Examination

Instructions to candidates:

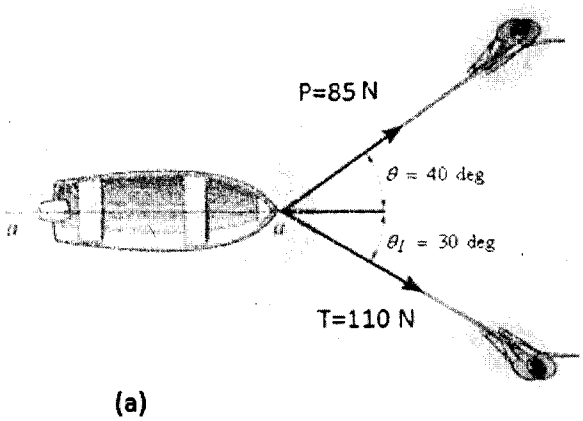
1. **Candidates must ensure that their computer numbers are clearly written on each answer sheet**
2. **Answer any FIVE questions. All questions carry equal marks (20%)**

Question 1

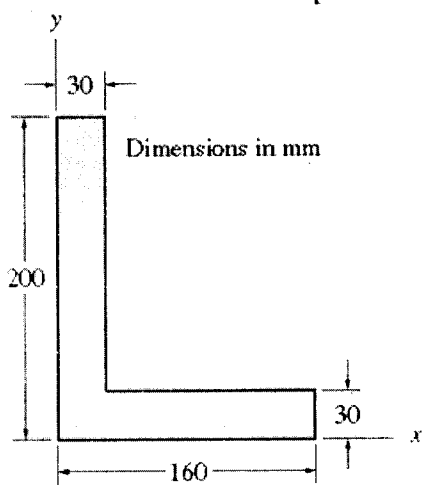
a) The boat shown in Figure1.0:Q1(a) is being pulled onto the shore using two ropes. Determine the magnitude and direction of the resultant force.

[10 marks]

b) Determine the second area moment about the *x-axis* for the cross-section shown in Figure 1:Q1(b). **[10 marks]**



(a)



(b)

Figure 1:Q1

Question 2

a) The plate shown in Figure 2:Q2(a) is fixed connected along *AB* and held in the horizontal guides at its top and bottom, *AD* and *BC*. If it's right side *CD* is given a uniform horizontal displacement of 2 mm, determine the shear strain at *E* relative to the *x*, *y* axes.

[10 marks]

b) The center of gravity of the 850-N man is at *G* (Figure 2:Q2(b)). If the man pulls on the rope with a 388-N force, determine the horizontal distance *b* between the man's feet and *G*.

[10marks]

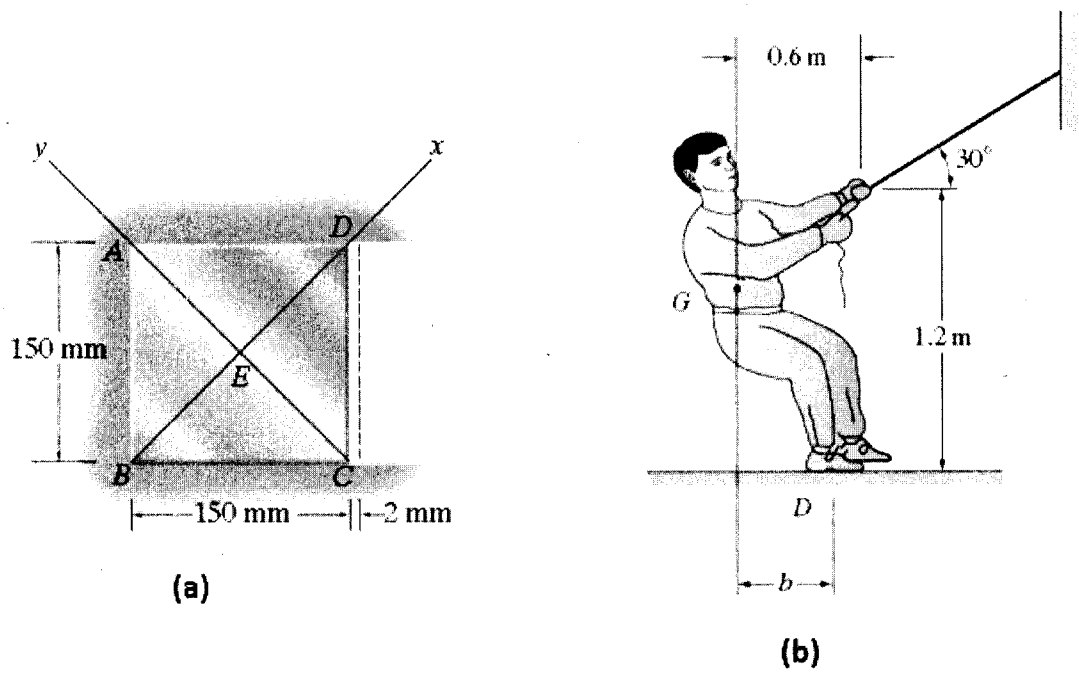


Figure 2:Q2

Question 3

The beam *ABC* shown in Figure 3.0:Q3 is subjected to a uniform distributed load. The supports at *A*, *C* and *B* are pinned.

a) Determine the magnitude the reaction force at supports *B* and the vertical reaction at support *A*.

[10 marks]

b) Draw the shear force diagram for the beam *ABC*

[10 marks]

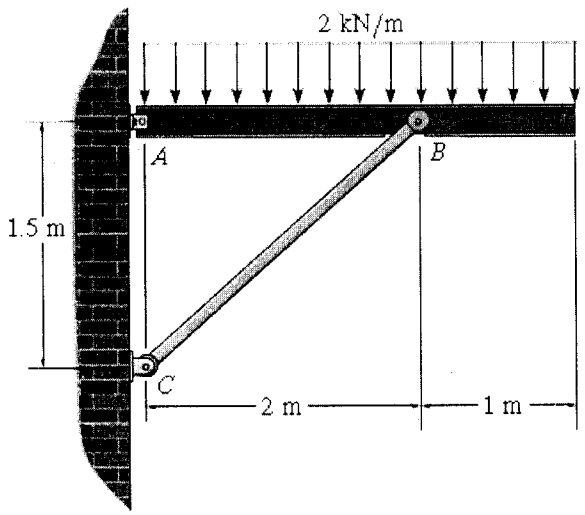


Figure 3:Q3

Question 4

The square steel plate has a thickness of 10 mm and is subjected to the edge loading shown in Figure 4.0:Q4.

a) Determine the maximum shear stress in the plane of the plate. Use clearly labeled stress elements in your solution.

[8 marks]

b) Determine the stress components on the inclined plane *AB* given θ=20°. Use clearly labeled stress elements in your solution.

[12 marks]

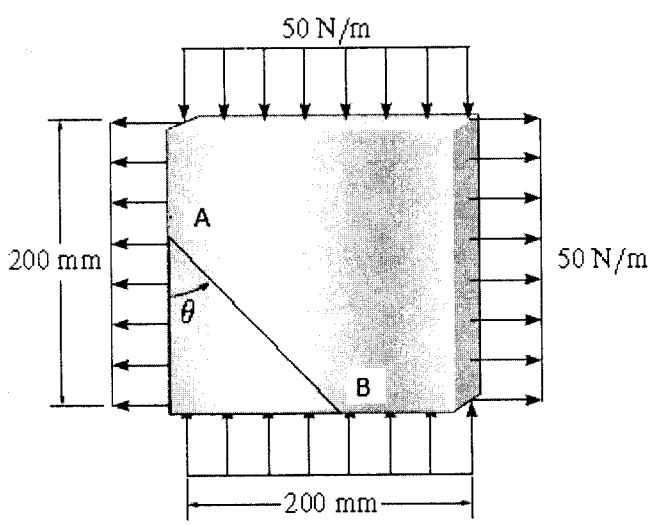


Figure 4:Q4

Question 5

A *3000 kg* front-wheel-drive truck (SUV) has a center of mass at *G* (see Figure 5: Q5). Determine the maximum mass of the log that can be towed by the truck. The coefficient of static friction between the log and the ground is $\mu_s = 0.8$, and the coefficient of static friction between the front wheels of the truck and the ground is $\mu'_s = 0.4$ .The rear wheels are free to roll. Assume that the engine of the truck is powerful enough to generate a torque that will cause the front wheels to slip.

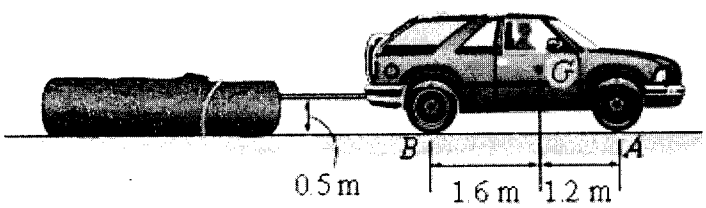


Figure 5:Q5

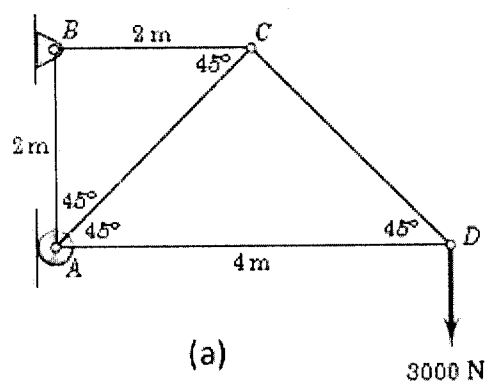
[20 marks]

Question 6

a) Determine the magnitude and direction of the force in member *BC* of the loaded truss shown in Figure 6.0:Q6 (a).

[5 marks]

b) If the wood joint in Figure 6.0:Q6 (b) has a thickness of 150 mm, determine the average shear stress developed along shear planes *a–a* and *b–b*. For each plane, represent the state of stress on an element of the material. **[15 marks]**



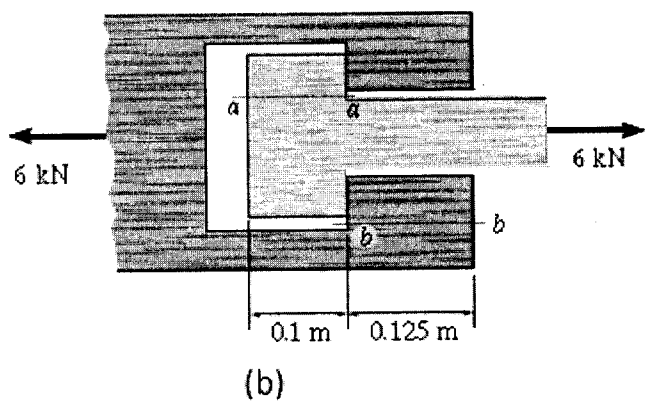


Figure 6:Q6

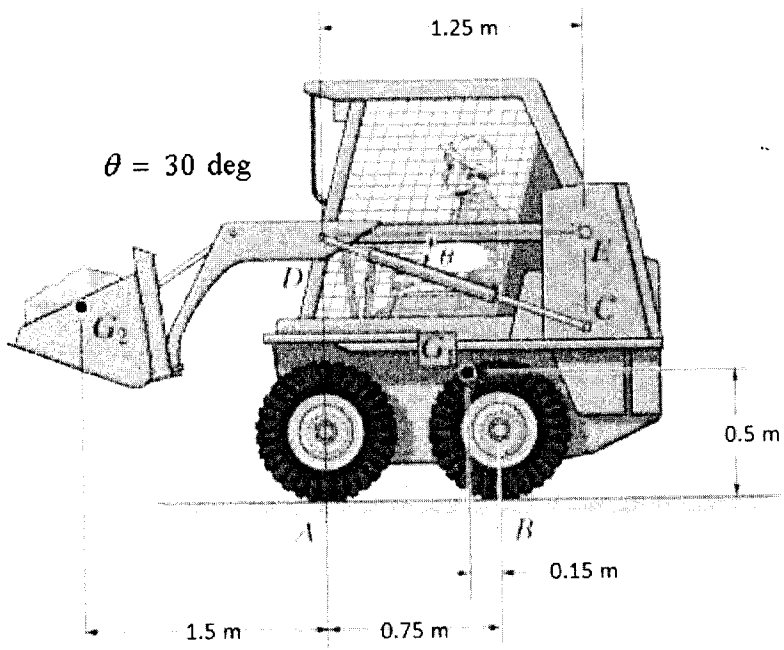
Question 7

a) The skid steer loader shown in Figure 7:Q7 (a) has a mass *1180 kg*, and in the position shown the center of mass is at G_1. If there is a stone of mass *300 kg* in the bucket, with center of mass at G_2 determine the force in the hydraulic cylinder *CD*. There is a similar linkage on each side of the loader.

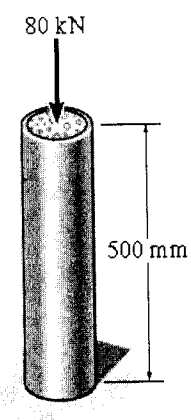
[8 marks]

b) The steel pipe shown in Figure 7:Q7 (b) is filled with concrete and subjected to a compressive force of *80 kN*. Determine the average normal stress in the concrete due to this loading. The pipe has an outer diameter of *80 mm* and an inner diameter of *70 mm*. *Est = 200 GPa, Ec = 24 GPa.*

[12 marks]



(a)



(b)

Figure 7:Q7

THE END

Second Area Moments Equations

Rectangular Area Second Area moment

$$\bar{I}_x = \frac{1}{12} b h^3$$
$$\bar{I}_y = \frac{1}{12} b^3 h$$

Second area Transformation Equations

$$I = \bar{I} + Ad^2$$
$$I_{x'} = \frac{I_x + I_y}{2} + \frac{I_x - I_y}{2} \cos 2\theta - I_{xy} \sin 2\theta$$
$$I_{y'} = \frac{I_x + I_y}{2} - \frac{I_x - I_y}{2} \cos 2\theta + I_{xy} \sin 2\theta$$
$$I_{x'y'} = \frac{I_x - I_y}{2} \sin 2\theta + I_{xy} \cos 2\theta$$

Stress Transformations

$$tan2\theta_p = \frac{\tau_{xy}}{(\sigma_x - \sigma_y)/2}$$

$$\sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + {\tau_{xy}}^2}$$

$$tan2\theta_s = \frac{-(\sigma_x - \sigma_y)/2}{\tau_{xy}}$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + {\tau_{xy}}^2}$$

$$\sigma_{avg} = \frac{\sigma_x + \sigma_y}{2}$$

$$\sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$$

$$\tau_{x'y'} = -\left(\frac{\sigma_x + \sigma_y}{2}\right) \sin 2\theta + \tau_{xy} \cos 2\theta$$

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS

END OF 2016/2017 ACADEMIC YEAR EXAM
21 SEPTEMBER 2017

EEE 2019

PRINCIPLES OF ELECTRICAL AND ELECTRONIC ENGINEERING

TIME	:	Three (3) hours
INSTRUCTIONS	:	Answer **FIVE** questions: **At least TWO** questions from **EACH SECTION**. 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 power supplied or dissipated in each element of Figure Q1(a), given that the values of each element are given in Table 1 (a). **[10 marks]**

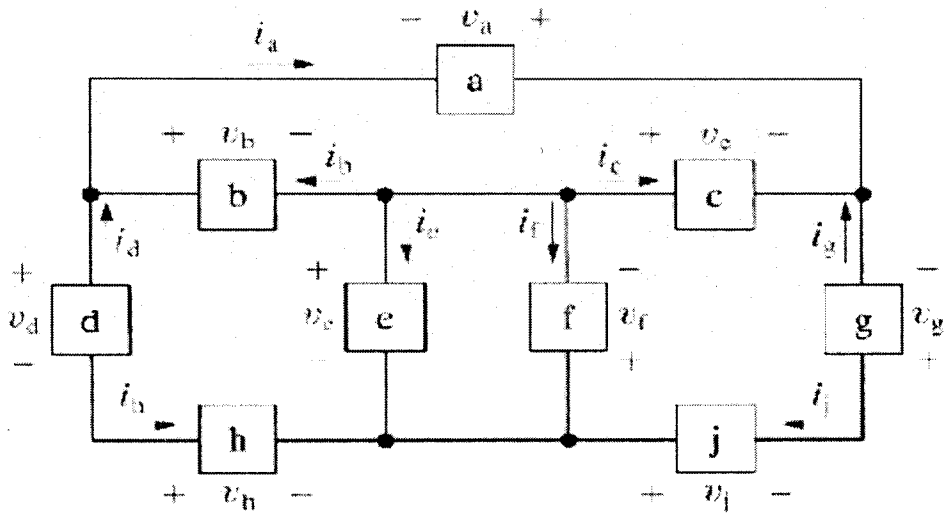


Figure Q1 (a)

Table 1 (a)

Element	Voltage (V)	Current (mA)	Power (W)
a	1.6	80	
b	2.6	60	
c	–4.2	–50	
d	1.2	20	
e	1.8	30	
f	–1.8	–40	
g	–3.6	–30	
h	3.2	–20	
j	–2.4	30	

Question 1 (b)

For the circuit shown in Figure 1 (b),

(a) Is the interconnection of ideal sources in the circuit shown in Figure 1 (b) valid? Explain. **[4 marks]**

(b) Identify which sources are developing power and which sources are absorbing power. **[4 marks]**

(c) Verify that the total power developed in the circuit equals the total power absorbed. **[2 marks]**

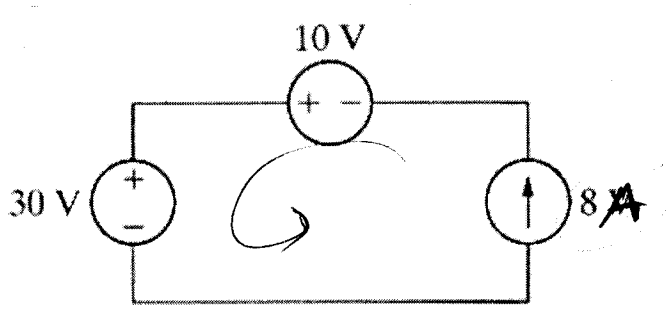


Figure 1 (b)

Question 2 (a)

The currents i_1 and i_2 in the circuit shown in Figure Q2 (a) are 10 A and 25 A, respectively. Use KVL and KCL to find the following:

(a) The power supplied by each voltage source **[6 marks]**

(b) Show that the total power supplied equals the total power dissipated in the resistors **[4 marks]**

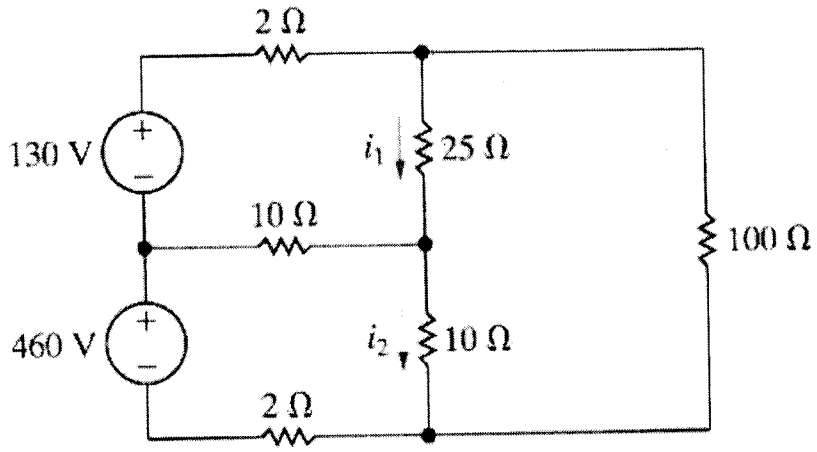


Figure Q2 (a)

Question 2 (b)

For the circuit shown in Figure Q2 (b), use KVL and KCL to find the following:

(a) i_Δ and v_o, **[6 marks]**

(b) Show that the total power supplied equals the total power dissipated in the resistors **[4 marks]**

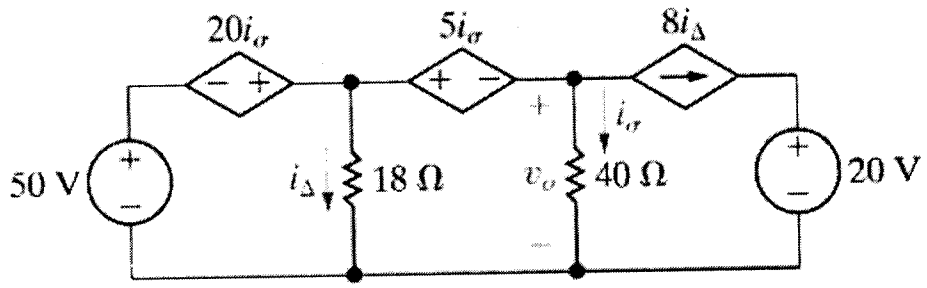


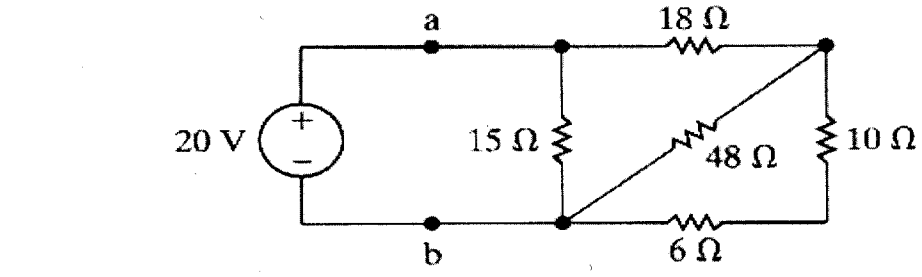
Figure Q2 (b)

Question 3 ✓

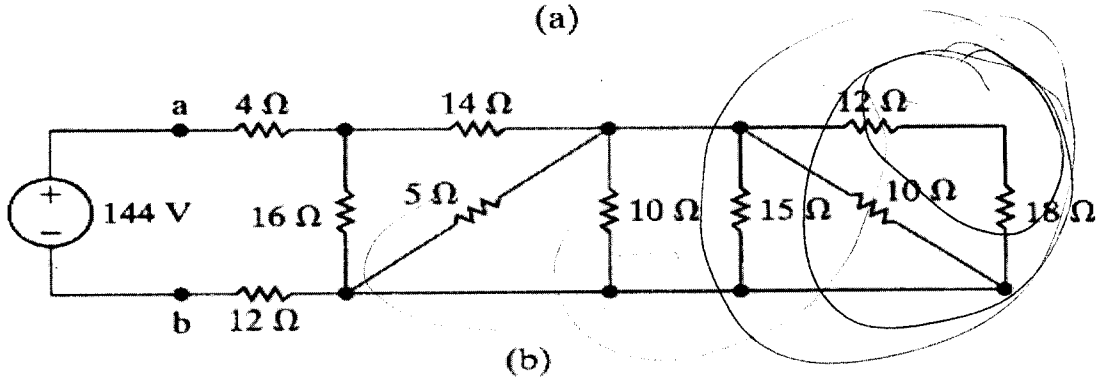
In the circuits shown in Figure Q3 (a)-(c),

(a) Find the equivalent resistance R_{ab}, **[8 marks]**

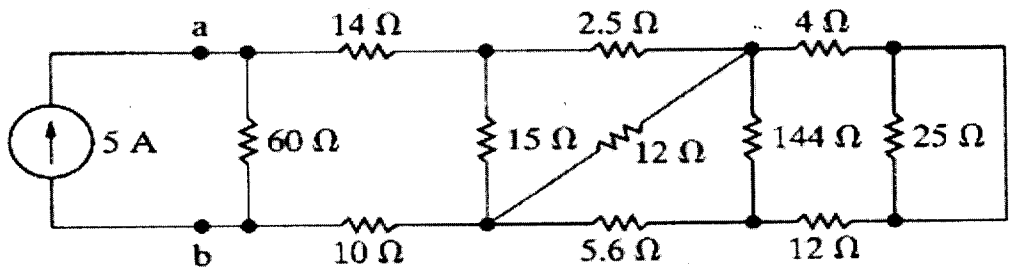
(b) For each circuit find the power delivered by the source. **[12 marks]**



(a)



(b)



(c)

Figure Q 3

Question 4 (a) ✓

For the circuit shown in Figure Q4 (a):

(i) Use the node-voltage method to find v_1, v_3 and v_4 in the circuit **[6 marks]**

(ii) Find the total power developed and the total power dissipated in the circuit. **[6 marks]**

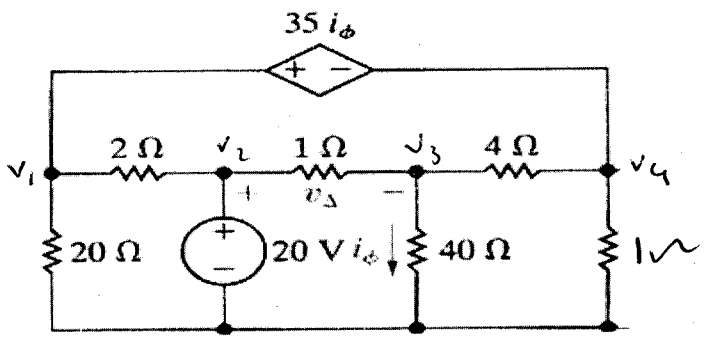


Figure Q 4 (a)

Question 4 (b)

For the circuit shown in Figure Q 4(b), find the Thevenin equivalent with respect to the terminals a, b. **[8 marks]**

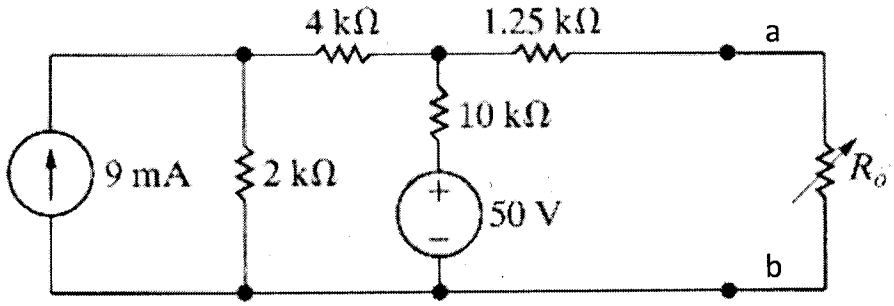


Figure Q 4 (b)

SECTION B

QUESTION 5

a) Use the principle of superposition to find v_1 and v_2 in the circuit of Figure Q5 (a). **[10 Marks]**

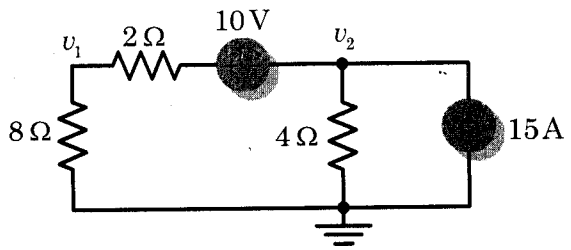


Figure Q5 (a)

b) Find i_x in the ac circuit of Figure Q5 (b) using nodal analysis. **[10 Marks]**

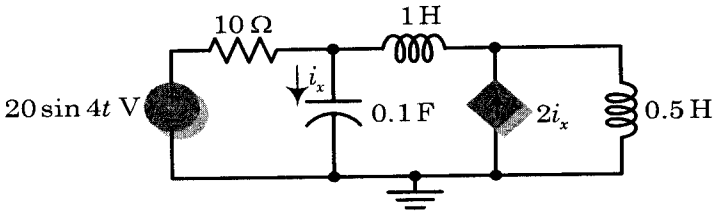


Figure Q5(b)

QUESTION 6

a) A 120 V dc generator energizes a motor whose coil has an inductance of 50 H and a resistance of 100 Ω. A field discharge resistor of 400 Ω is connected in parallel with the motor to avoid damage to the motor, as shown in Figure Q6 (a). The system is at steady state. Determine the current through the discharge resistor 100 ms after the switch is tripped. **[10 Marks]**

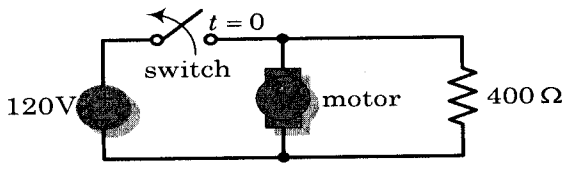


Figure Q6 (a)

5.714

b) Given the circuit in Figure Q6 (b), find the average power supplied or absorbed by each element. **[10 Marks]**

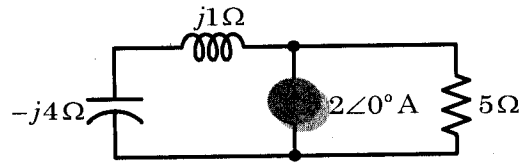


Figure Q6 (b)

QUESTION 7

a) In the circuit of **Figure Q7(a)**, determine $i(t)$ for $t > 0$ if $i(0) = 6\,\text{A}$. **[10 Marks]**

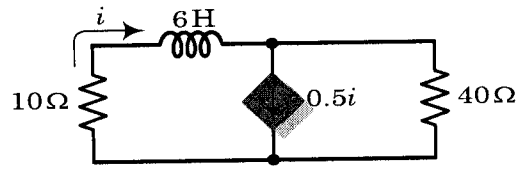


Figure Q7 (a)

b) Obtain the Norton equivalent of the circuit depicted in Figure Q7 (b) at terminals *a-b*. **[10 Marks]**

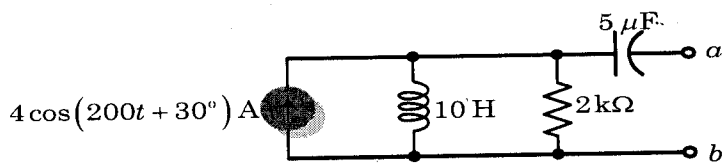


Figure Q7 (b)

QUESTION 8

a) An *RC* circuit consists of a series connection of a 120 V dc-source, a switch, a 34 MΩ resistor, and a 15 μF capacitor. The circuit is used in estimating the speed of a horse running a 4 km racetrack. The switch closes when the horse begins and opens when the horse crosses the finish line. Assuming that the capacitor charges to 85.6 V, calculate the speed of the horse. **[10 Marks]**

b) Use mesh analysis to find current i_o in the circuit of Figure Q8 (b). **[10 Marks]**

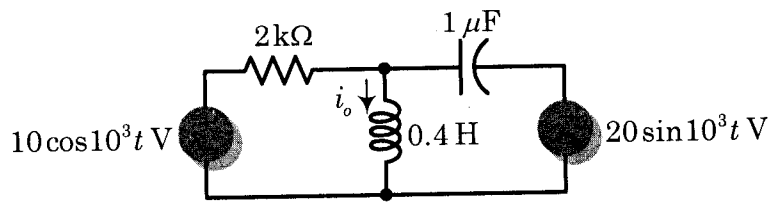


Figure Q8 (b)

END OF EEE 2019 EXAM

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS

DEFERRED EXAM – 2015/2016 – October 14, 2016

EEE 4221

EEE 4221: DIGITAL SIGNAL PROCESSING

TIME	:	Three (3) hours
INSTRUCTIONS	:	Answer any five (5) questions
ADDITIONAL INFORMATION	:	Tables of common Fourier Transforms and z-Transforms are provided

QUESTION 1

(a) Show that the frequency response, $H(e^{j\omega}) = \sum_{n=-\infty}^{\infty} h[n]e^{-j\omega n}$, of discrete-time linear shift-invariant systems is always a periodic function of the frequency variable ω with period 2π. **[5 Marks]**

(b) A stable linear time-invariant (LTI) system is of the form of a linear difference equation $y[n]-(1/2)y[n-1]=x[n]-(1/4)x[n-1]$.

Use the Discrete-time Fourier Transform $X(e^{j\omega}) = \sum_{n=-\infty}^{\infty} x[n]e^{-j\omega n}$ to determine the impulse response $h[n]$ of the system to an impulse excitation $x[n]=\delta[n]$. **[10 Marks]**

(c) The N-point DFT of a sequence, $x[n]$ is $X[k]=\sum_{n=0}^{N-1} \tilde{x}[n]e^{-j(2\pi/N)kn}$, $0 \le k \le N-1$.

Find the 4-point DFT of the sequence $x[n]=\cos\left(\frac{\pi n}{2}\right)$, $n = 0,1,2,3.$ **[5 Marks]**

[Total 20 Marks]

QUESTION 2

(a) A causal LSI system has the system function

$$H(z)=\frac{1+2z^{-1}+z^{-2}}{\left(1+\frac{1}{2}z^{-1}\right)\left(1-z^{-1}\right)}.$$

Using partial fraction method find the impulse response of the system, $h[n]$. **[7 Marks]**

(b) The z-Transform of a sequence $x[n]$ is defined as $X(z) = \sum_{n=-\infty}^{\infty} x[n]z^{-n}$. Prove the differentiation property by showing that the transform of the sequence $nx[n]$ is $-z\frac{dX(z)}{dz}$, where $ROC = R_x$. **[5 Marks]**

(c) By direct evaluation of the convolution sum $y[n]=x[n]*h[n]=\sum_{k=-\infty}^{\infty} x[k]h[n-k]$, determine the step response of a linear shift-invariant system whose impulse response is $h[n]=a^{-n}u[-n]$, $\forall\ 0<a<1$. **[8 Marks]**

[Total 20 Marks]

QUESTION 3

(a) Exploit the differentiation property $nx[n] \leftrightarrow -z\frac{dX(z)}{dz}$, together with the time-shifting property $x[n-n_0] \leftrightarrow z^{-n_0}X(z)$, to determine the inverse z-Transform of

$$X(z)=\log\left(1+az^{-1}\right), \quad |z|>|a|.$$ **[8 Marks]**

(b) The N-point circular convolution is defined as $x_3[n]=\sum_{m=0}^{N-1} x_1[m]x_2[((n-m))_N]$.

(i) Figure Q3 shows two finite-length sequences $x_1[n]$ and $x_2[n]$. Sketch their 6-point circular convolution $x_3[n]=x_1[n]\textcircled{6}x_2[n]$. **[8 Marks]**

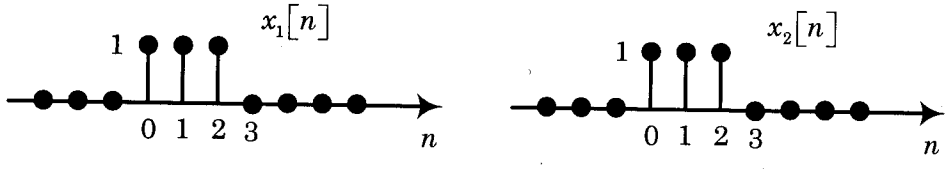


Figure Q3.

(ii) Explain how the circular convolution of two finite-length sequences $x[n]$ and $h[n]$ can be calculated without performing the circular convolution itself. **[4 Marks]**

[Total 20 Marks]

QUESTION 4

(a) Determine the causal signal $x(n)$ if its z-tranform $X(z)$ is given by

$$X(z)=\frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}$$ **[6 Marks]**

(b) Compute the response of the system

$$y(n) = 0.7y(n - 1) - 0.12y(n - 2) + x(n - 1) + x(n - 2)$$

to the input $x(n)=nu(n)$.
Is the system stable? **[7 Marks]**

(c) Show that the following systems are equivalent.

1. $y(n) = 0.2y(n - 1) + x(n) – 0.3x(n - 1) + 0.02x(n - 2)$
2. $y(n) = x(n) – 0.1x(n - 1)$

[7 Marks]

[Total 20 Marks]

QUESTION 5

(a) Consider the system

$$H(z)=\frac{1-2z^{-1}+2z^{-2}-z^{-3}}{(1-z^{-1})(1-0.5z^{-1})(1-0.2z^{-1})},\qquad \text{ROC: } 0.5|z|>1$$

(i) Sketch the pole-zero pattern. **[4 Marks]**

(ii) Determine the impulse response of the system. **[6 Marks]**

(b) Design a causal discrete-time LTI system such that when the input is

$$x(n) = (\frac{1}{2})^n u(n) - \frac{1}{4}(\frac{1}{2})^{n-1}u(n-1)$$

Then the output is

$$y(n) = (\frac{1}{3})^n u(n)$$

(i) Determine the impulse response $h(n)$ and the system function $H(z)$ of a system that satisfies this condition. **[3 Marks]**

(ii) Find the difference equation that characterizes this system. **[4 Marks]**

(iii) Determine a realization of the system that requires the minimum possible amount of memory. **[3 Marks]**

[Total 20 Marks]

QUESTION 6

(a) Determine and sketch the amplitude response of the following system:
$y(n) = 0.5[x(n + 1) + x(n - 1)]$ **[6 Marks]**

(b) Determine the steady-state response of the system $y(n) = 0.5[x(n) - x(n - 2)]$ to the input signal

$$x(n) = 5 + 3\sin(0.5\pi n+60°) + 4\sin(\pi n+45°), \quad -\infty < n < \infty$$ **[5 Marks]**

(c) Determine the coefficients of a linear-phase FIR filter

$$y(n) = b_0x(n) + b_1x(n - 1) + b_2x(n - 2)$$

such that:

(i) It rejects completely a frequency component at $\omega_0=2\pi/3$. **[2 Marks]**

(ii) Its frequency response is normalized so that $H(0) = 1$. **[2 Marks]**

(iii) Compute and sketch the magnitude and phase response of the filter to check if it satisfies the requirements. **[5 Marks]**

[Total 20 Marks]

QUESTION 7

(a) Consider an LTI system, initially at rest, described by the difference equation
$y(n) = 0.25y(n - 2) + x(n)$

(i) Determine the impulse response, $h(n)$, of the system. **[2 Marks]**

(ii) Determine the response to the input $x(n) = [0.5^n + (-0.5)^n]u(n)$ **[4 Marks]**

(iii) Determine the direct form II and cascade-form realizations for this system. **[4 Marks]**

(b) Consider the filter shown in Figure. Q7.

(i) Determine the difference equation $y(n)$. **[3 Marks]**

(ii) Determine $H(z)$ and Sketch the pole-zero plot and check for stability if
$b_0 = b_2 = 1, \quad b_1 = 2, \quad a_1 = -1.5, \quad a_2 = -0.9$ **[3 Marks]**

(iii) Determine the response to $x(n) = \cos(\pi n/3)$ if
$b_0 = 1, \quad b_2 = b_1 = 0, \quad a_1 = -1, \quad a_2 = 0.99.$ **[2 Marks]**

(c) Describe the windowing Technique for designing FIR filters. **[2 Marks]**

[Total 20 Marks]

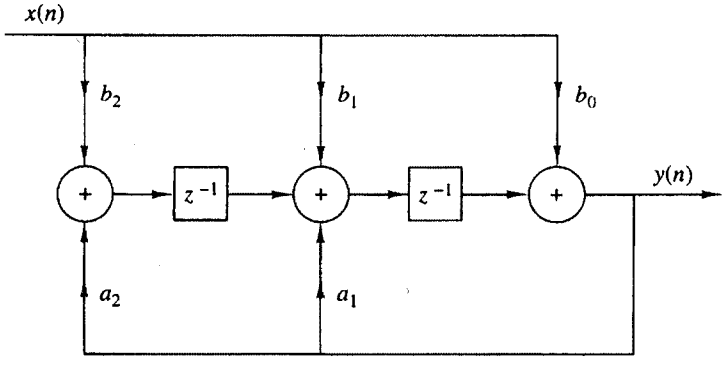


Figure Q7. Filter Structure

END OF EEE 4221 EXAMINATION

Tables of some common Fourier and z-Transform pairs

	Sequence	Fourier Transform
1.	$\delta[n]$	1
2.	$\delta[n-n_0]$	$e^{-j\omega n_0}$
3.	$1 \quad (-\infty < n < \infty)$	$\sum_{k=-\infty}^{\infty} 2\pi\delta(\omega + 2\pi k)$
4.	$a^n u[n] \quad (\lvert a\rvert < 1)$	$\frac{1}{1-ae^{-j\omega}}$
5.	$a^{n-1}u[n-1] \quad (\lvert a\rvert < 1)$	$\frac{e^{-j\omega}}{1-ae^{-j\omega}}$
6.	$u[n]$	$\frac{1}{1-e^{j\omega}} + \sum_{k=-\infty}^{\infty} \pi\delta(\omega + 2\pi k)$

	Sequence, $x[n]$	z-Transform, $X[z]$	ROC
1.	$\delta[n]$	1	All z
2.	$u[n]$	$\frac{1}{1-z^{-1}}$	$\lvert z\rvert > 1$
3.	$-u[-n-1]$	$\frac{1}{1-z^{-1}}$	$\lvert z\rvert < 1$
4.	$a^n u[n]$	$\frac{1}{1-az^{-1}}$	$\lvert z\rvert > \lvert a\rvert$
5.	$-a^n u[-n-1]$	$\frac{1}{1-az^{-1}}$	$\lvert z\rvert < \lvert a\rvert$
6.	$a^{n-1}u[n-1]$	$\frac{z^{-1}}{1-az^{-1}}$	$\lvert z\rvert > \lvert a\rvert$
7.	$na^n u[n]$	$\frac{az^{-1}}{(1-az^{-1})^2}$	$\lvert z\rvert > \lvert a\rvert$
8.	$-na^n u[-n-1]$	$\frac{az^{-1}}{(1-az^{-1})^2}$	$\lvert z\rvert < \lvert a\rvert$
9.	$(\cos\omega_0 n)u[n]$	$\frac{1-z^{-1}\cos\omega_0}{1-2z^{-1}\cos\omega_0+z^{-2}}$	$\lvert z\rvert > 1$
10.	$(\sin\omega_0 n)u[n]$	$\frac{z^{-1}\sin\omega_0}{1-2z^{-1}\cos\omega_0+z^{-2}}$	$\lvert z\rvert > 1$
11.	$(a^n\cos\omega_0 n)u[n]$	$\frac{1-az^{-1}\cos\omega_0}{1-2az^{-1}\cos\omega_0+a^2z^{-2}}$	$\lvert z\rvert > \lvert a\rvert$
12.	$(a^n\sin\omega_0 n)u[n]$	$\frac{az^{-1}\sin\omega_0}{1-2az^{-1}\cos\omega_0+a^2z^{-2}}$	$\lvert z\rvert > \lvert a\rvert$

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS
2016/2017

ENG 2139: INTRODUCION TO INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)

DATE: 18th September, 2017

TIME	:	**Three (3) hours**
INSTRUCTIONS	:	**1. This exam paper has seven questions, divided into two parts (sections), Part I (Questions 1 – 4) and Part II (the rest).** **2. You should answer any five (5) questions in such a way that there will be two questions at minimum from each part (section).** **3. Show clearly all working ideas and processes, leading to the final answer.** **4. All questions carry equal marks.**

PART 1: FUNDAMENTALS OF HARDWARE, DATA NETWORKS & APPLICATIONS

Question One

a) Define and explain a bus from a computer hardware architecture perspective. **[3 Marks]**

b) List and explain computer hardware bus(es) which is (are) bi-directional. **[3 Marks]**

c) We often here in computer terminologies terms such as this is a 8-bit, 16-bit, 32-bit or 64-bit computer architecture. Name the computer hardware bus which determines a given computer architecture? **[3 Marks]**

d) During a start-up of a computer system, there is one phase known as POST; explain this phase as it occurs during a computer start-up or boot up. **[6 Marks]**

e) A friend of yours went to a local computer shop and saw a laptop with Hard Disk Drive (HDD) of 1 TB (Terabytes) and an Intel i5-processor of 2.25GHz. What are these two specifications of that laptop as you would explain to your friend. **[5 Marks]**

Question Two

a) Discuss ARPANET from a data networks historical background. **[3 Marks]**

b) Define and briefly discuss the concept of a Wide Area Network (WAN). **[5 Marks]**

c) Analyse the diagram presented below:

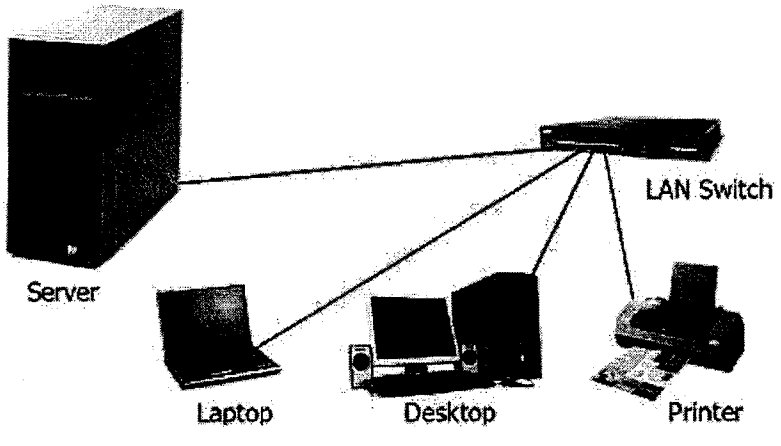


Figure 3.1.: A small Local Area Network (LAN)

Suppose the LAN Switch is brand new and the above local area network has just been set up. Explain how the Lan Switch will go about discovering all devices connected to it for an efficient communication to take place. **[6 Marks]**

d) What makes it possible for an HP laptop, an Xerox printer, a Mac desktop and an IBM
server to be connected together and work seamlessly well in a data network? **[6 Marks]**

Question Three

The Operating System (OS) is very critical to the working a computer system. Among its main functionalities, two of these features could be said to play certain roles in the design and development
of applications/computer programs, these are: Memory Management and Communication Services.

a) How does the operating system's memory management help the software engineer as they develop applications which will be running on a computer system?
[8.5 Marks]

b) And how do the operating system's communication services ensure that the software engineer produces modern applications? **[8.5 Marks]**

c) A browser, Microsoft Excel and a C++ program which you may develop, all share a common feature; what is this feature?
[3 Marks]

Question Four

a) Why type 1 virtualisation is preferred to type 2 when it comes to commercial implementation of virtualised systems? **[5 Marks]**
b) How would one achieve virtualisation on a laptop? **[5 Marks]**
c) Define and explain what we mean when we say Relational Database Management Systems. **[4 Marks]**
d) Select all false statements about Relational Database Management Systems (RDBMS): **[6 Marks]**

a. RDBMS systems are no longer needed because of Cloud computing.
b. E-commerce systems heavily rely on RDBMS to a larger extent.
c. All databases are not based on RDBMS.
d. Actually RDBMS systems are simply web sites.
e. RDBMS are used in Business Intelligence.

PART 2: FUNDAMENTALS OF C++ PROGRAMMING

Question Five

a) Find below a short C++ program:

```
1.  #include <iostream>
2.  using namepace std;
3.
4.  int man()
5.  {
6.      string visitorName;
7.      int visitorAge;
8.      coat << Enter your name:   " << endl
9.      cin >> visitorName;
10.     cout << "Enter your age: " << endl;
11.     can >> visitaCage
12.     cut << "Your name is: " <<visitorname << and you are: " << visitorAge << " old" ;
13.
14.    return 0;
15. }
```

List lines numbers, find all associated syntax and other types of errors, and give corrected program elements which can then make this program compile. **[10 Marks]**

b) Give short definitions of the following terms: **[6 Marks]**

1. Member variable;
2. Member function;
3. Class instance;
4. Inheritance

c) How do you declare an abstract class in C++? **[4 Marks]**

Question Six

a) Find below a short C++ program:

```
1.  #include <iostream>
2.  using namepace std;
3.
4.  int main()
5.  {
6.    string fruitName;
7.    int fruitNumber;
8.
```

```
9.   cout << "Enter the name of your favourite fruit and the number to buy" <<endl;
10.  cin >> fruitName >> fruitNumber;
11.  cout << "You entered: " << fruitName << " and " << fruitNumber;
12.  return 0;
13. }
```

Read carefully the code above and explain in details what is happening in the following lines:

(a) Line 4 **[4 Marks]**

(b) Lines 6 & 7 **[2 Marks]**

(c) Line 10 **[4 Marks]**

b) Create a class named Student with three member variables: first name, computer number and their age with appropriate data types. Implement the class with a constructor which takes three parameters which will be used to initialise the three class member variables; a destructor and three member functions (accessors): getFirstname(), getComputerNumber() and getAge().

In the main function, use the above implemented class as follows:

(a) Instantiate this class as an object and display the three member variables by calling the three given accessors. HINT: Use the "." operator. **[5 Marks]**

(b) Instantiate the same class as a pointer to the object by using "new" operator , and display the three member variables by calling the three given accessors. HINT: Use the "->" operator. **[5 Marks]**

Question Seven

Suppose that you have been given some details of sales at a small metal fabrication shop specialised in making door and window frames in your neighbourhood. Weekly sales are given in the form of the following arrays:

float week1Sales[6] = {7556.25, 3938.82, 4265.49, 8629.33}
float week2Sales[6] = {4237.45, 5837.92, 3250.23, 7375.89, 8742.68, 6492.58}
float week3Sales[6] = {3859.35, 7570.73, 9265.49, 6492.58, 5629.33}
float week4Sales[6] = {8556.25,7 938.82, 8265.49}

(a) Develop some design ideas which will help you develop a program which will compute the total monthly sales for this small metal fabrication shop. Come up with ideas on how you will go about implementing such a solution with C++ control flow constructs which will be more appropriate to use in such a scenario. **[10 Marks]**

(b) Write a short C++ program to calculate the total monthly sales for the given small metal fabrication shop in Zambian Kwacha [ZMW]. **[15 Marks]**

------- *END OF EXAM & GOOD LUCK!*-------

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

2016/17 ACADEMIC YEAR

EXAMINATION DATE: 8/ 09/2017

END OF YEAR FINAL EXAM

BACHELORS OF ENGINEERING

ENG 4129: ENGINEERING MANAGEMENT AND ENTREPRENUERSHIP

TIME: THREE (3) HOURS

INSTRUCTIONS:

1. THIS EXAMINATION PAPER CONTAINS THREE SECTIONS - A, B AND C
2. SECTION A AND B CONTAINS THREE QUESTIONS EACH AND YOU ARE EXPECTED TO **ANSWER ANY TWO (2) QUESTIONS FROM EACH SECTION.**
3. **SECTION C** CONTAINS ONLY ONE QUESTION AND IT IS **A COMPULSORY QUESTION.**
4. MAKE SURE THAT THE STUDENT NUMBER IS CLEARLY INDICATED ON ALL BOOKLETS TOGETHER WITH THE QUESTIONS ATTEMPTED.
5. THE ANSWER FOR EACH QUESTION SHOULD BEGIN ON A NEW SHEET.
6. ANSWER **EACH SECTION IN A SEPARATE BOOK** AND REMEMBER TO CLEARLY NUMBER YOUR SOLUTIONS.
7. CALCULATIONS IF ANY **MUST** BE CLEAR AND LOGICAL.
8. WHERE INFORMATION IS NOT GIVEN, MAKE AND STATE YOUR RELEVANT ASSUMPTIONS.
9. MARKS WILL BE LOST FOR ILLEGIBLE, UNTIDY AND UNORGANISED PRESENTATION.
10. THE EXAMINATION IS STRICTLY CLOSED BOOK.
11. TOTAL **MARKS** IN THIS EXAMINATION PAPER EQUAL **100.**

SECTION A

Question One

From the following information, draw up a Trial Balance of UNZA as at 31st March, 2017:

Transactions	ZMW	Transactions	ZMW
Capital	1,50,000	Sales	1,05,400
Purchases	40,000	Sundry Creditor	5,000
Cash in Hand	7,000	Rent	2,000
Cash at Bank	8,500	Furniture	16,000
Electricity exp.	4,800	Bank Loan	10,000
Stationery	500	Investment	6,000
Office Equipment	2,400	Commission paid	1,050
Sundry Debtors	8,000	Opening Stock	3,200
Machinery	1,60,000	Commission Received	1,200
Salaries	11,400	Postage & Telegram	750

[20 Marks]

Question Two

Prepare a Cash Book with discount column of UNZA from the following transactions and show the Balance:

2017

March 1 Balance of cash in Hand K 25,000

March 3 Rent paid K 2,000

March 5 Purchased goods for cash K10, 000

March 10 Stationery purchased K 2,500

March 12 Sold Goods for Cash for K 8,000

March 15 Cash received from Ram K 980 and discount allowed K 20

March 18 Cash paid to UNZA K 950 and discount Received K 50

March 25 Wages Paid K 2,000

[20 Marks]

Question Three

The Table below shows the accounting documents used in a typical accounting department. Complete the table by providing detailed information on the content and purpose of each document.

DOCUMENTS	**CONTENT**	**PURPOSE**
Quotation		
Purchase order		
Sales Order		
Good Dispatched note(**GDN**)		
Goods Received Note (**GRN**)		
Invoice		
Statement		
Credit note		
Debit note		
Receipt		

[20 Marks]

SECTION B

Question One - *Microeconomics*

The concept of demand and supply are fundamental to economic analysis. Briefly explain the following:

1.1 What is the difference between a "change in demand" and a "change in quantity demanded"? Similarly, a "change in supply" and a "change in quantity supplied" Graph your answers. (4 marks)

1.2 "All other things being equal", briefly outline four factors that can cause a change in demand of a normal good in a competitive market. (4 marks)

1.3 "All other things being equal", briefly, outline four factors that can cause a change in supply of a normal good in a competitive market. (4 marks)

1.4 Perfectly competitive firms can earn economic profit in the short run but make zero economic profit in the long run. (4 marks)

1.5 The short-run supply curve for a competitive firm is the portion of its marginal cost curve which lies above average variable cost. (4 marks)

[20 Marks]

Question Two - *Macroeconomics*

In most countries, Zambia included much effort by monetary authorities is focused on maintaining a low and stable inflation. Among the measures economists use to monitor the average level of prices in the economy are the Consumer Price Index(CPI) and the Gross Domestic Product Deflator (GDP Deflator).

2.1 Briefly define, CPI and GDP Deflator (4 marks)

2.2 Briefly, explain the three most commonly cited weaknesses in using the CPI as a measure of the cost of living (6 marks)

2.3 Outline and briefly explain any of the five costs associated with inflation (10 marks)

[20 Marks]

Question Three – *Macroeconomics*

3.1 The aggregate demand curve slopes downward for three reasons. Briefly explain, each of the following channels in relation to the downward sloping of the aggregate demand curve

I) The wealth effect (4 marks)

II) The interest-rate effect (4 marks)

III) The exchange-rate (4 marks)

3.2 Briefly explain, how monetary policy can be used to increase aggregate demand. (4 marks)

3.3 Briefly explain, how fiscal policy can be employed to increase aggregate demand (4 marks)

[20 Marks]

SECTION C – COMPULSORY QUESTION

Question One

Number and state your main ideas/points clearly. Then, explain it in your own words and in proper context.

Steve Jobs and his friend Steve Wozniak were self-taught engineers who created one of the most popular, revolutionary, technology brand, "Apple". Steve Jobs was not the first person to have an idea to create a user-friendly computer, and he was not the first person to come up with an idea about music players or smart-phones, but he was the first person to implement them. He covered potential ideas and then implemented them in ways that no one had ever dreamed of before. Apple products, whether they be a computer, laptop, iPod, iPhone, iTunes, or otherwise, are featured everywhere. Not only Apple products are of high quality technological items, but the company also has superior branding and a strong company image making them, one of the most popular and easily recognizable brands in the world.

1.1 From this example, identify and explain any four traits/characteristics of Steve Jobs that helped him to be successful in his business. (6 mark)

1.2 Identify and explain any four characteristics that have contributed to Zambian Entrepreneurs' to fail to attain to the "apple status". (6 Marks)

1.3 Identify and explain eight typical hidden costs that an entrepreneur should know when setting up a business. (8 Marks)

[20 Marks]

ALL THE BEST

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

UNIVERSITY EXAMINATIONS

SECOND HALF EXAMINATIONS – SEPTEMBER 2016

ENG 5129

ENGINEERING, MANAGEMENT AND SOCIETY II

TIME	:	**Three (3) Hours**
INSTRUCTIONS	:	**Answer a total of Five (5) Questions**
	:	**Answer at least Two (2) Questions from Section A and Two (2) Questions from Section B**

SECTION A (Answer at least 2 Questions from this Section)

1.

(a) Planning is a process that comprises six steps. Briefly discuss these steps. **(6 Marks)**

(b) Using a diagram discuss the 5 steps of strategy management process, highlighting the main components of each step. **(6 Marks)**

(c) In their use of resources, managers are often required to possess two qualities. Discuss the two qualities. **(4 Marks)**

(d) Name and describe the two-tiers of corporate hierarchy and how they are appointed. **(4 Marks)**

2.

(a) Indicate and briefly explain the four marketing mix. **(4 Marks)**

(b) Name and discuss the three managerial skills. **(6 Marks)**

(c) Describe the major elements of strategy management process used in establishing organizational direction. **(4 Marks)**

(d) Name and briefly describe the two main areas to consider when managing Human Resource if they are to work effectively. **(2 Marks)**

(e) Why should personnel specifications be prepared when planning recruitment? **(4 Marks)**

3.

(a) Discuss the difference between strategic planning and tactical planning. **(6 Marks)**

(b) Which people in an organization typically should be included in the planning process? and explain why? **(4 Marks)**

(c) State and discuss components involved in the three environmental levels analysis in strategic planning. **(5 Marks)**

(d) Corporate governance essentially involves balancing the interests of the many stakeholders in a company. Name any 5 stakeholders that you know. **(5 Marks)**

SECTION B (Answer at least 2 Questions from this Section)

4. In the Republic of Zambia, an Employment Contract should incorporate several key features, which have to be specified as **accurately** and **unambiguously** as possible. DISCUSS FIVE features in each instance stating the actual CLAUSE and the "WOULD-BE IMPLICATION" of each clause's non-inclusion in the Employment Contract **(20 Marks)**

5. Briefly discuss the dimensions of quality for the following
   (a) Manufactured products **(10 Marks)**
   (b) Services **(10 Marks)**

6. You are working as a project manager to build an access control system for the University of Zambia.

   (a) Draw a network diagram for the project and calculate the fastest time in which the following project may be completed.

Act	Description	Duration (days)	Predecessor
A	Develop project deliverables	15	-
B	Approval from stakeholders	5	A
C	Select site	4	B
D	Evaluate and select vendor	4	B
E	Purchase hardware	3	D
F	Design software	15	B
G	Write code	30	F
H	Test software	4	G
I	Test hardware	10	E
J	Integrate hardware and software	20	H, I
K	Install and final acceptance	5	C, J

(10 Marks)

   (b) What is the end date if the start date is 25 June 2016?

(3 Marks)

   (c) What is the effect of B slipping by 3 days?

(2 Marks)

   (d) List the 10 areas of the body of knowledge.

(5 Marks)

7. You are the head of the project selection team at Zam Roots records. Your team is considering two different recording projects. Based on past history, Zam Roots expects at least a rate of return of 11 percent. Your financial advisors predict inflation to remain at 5 percent into the foreseeable future.

(a) Given the following information for each project, which one should be Zam Roots first priority? Should Zam Roots fund any of the other projects? If so, what should be the order of priority based on return on investment?

Recording Project: **Katyetye**

Year	Investment	Revenue Stream
0	K 600,000	
1		600,000
2		75,000
3		20,000
4		15,000
5		10,000

Recording Project: **Chilimwibala**

Year	Investment	Revenue Stream
0	K 400,000	0
1		400,000
2		100,000
3		25,000
4		20,000
5		10,000

(15 Marks)

(b) Explain any three items that need to be contained in the selection criteria of projects to maximize their chances of success **(5 Marks)**

END OF EXAMINATION

(Dr S. Tembo; Dr I. Banda; Dr M. Chileshe and Mr G. Ndongwe)

THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

UNIVERSITY EXAMINATIONS

END OF YEAR EXAMINATIONS, 2016

AUGUST/SEPTEMBER 2017

MEC 2309 – PROPERTIES OF ENGINEERING MATERIALS I

QUESTION PAPER

Read the following instructions carefully before you start writing:

1. *This Examination is Closed Book.*
2. *Time Allowed: Three (3) Hours.*
3. *Answer: Question 1 and one other question from Section A and any two questions from Section B.*
4. *Hand in Sections A and B in Separate Answer Books.*
5. *Question1 carries 40 marks. Other questions carry 20 marks each.*

[DO NOT TURN THE PAGE OVER UNTIL YOU ARE TOLD TO DO SO]

SECTION A: ANSWER QUESTION 1 AND ONE OTHER QUESTION

Q1. This question is compulsory and carries 40 marks

(a) Two hypothetical metals *C* and *D* are dissolved in each other and the following information is available from the experiment:

- The melting temperatures of *C* and *D* are 700 °C and 900°C, respectively.
- The metals form a eutectic at a composition of 55% *D* at 400 °C.
- The maximum solubilities possible are found to be 20% of *D* in *C* and 25% of *C* in *D*.
- At room temperature, maximum solubility of *D* in *C* is 5% and *C* in *D* is 10%.

Draw the phase diagram to scale and label the main features. All lines may be assumed to be straight. [20 marks]

(b) Describe the changes which would occur when a 60% *C* / 40% *D* alloy composition is allowed to cool slowly from the liquid state to room temperature. Mention the temperatures where the changes occur. [05 marks]

(c) For the 60% *C* / 40% *D* alloy, give the phases present, their relative proportions and their compositions at 500°C. [15 marks]

Q2.

(a) What does the term mobility mean? How does it get affected by each of the following?

(i) Temperature
(i) Cold working
(ii) Lattice Impurities
(iii) Lattice defects of the material [10 marks]

(b) Calculate the number of charge carriers in a 2mm diameter copper wire 1 metre long. For copper, take the atomic weight as 63.54, the density as 8930 kg/m^3 and a valence of 2. You may further take Avogadro's Constant to be 6.023 x 10^{23} mol^{-1}. [10 marks]

Q3.

(a) Using suitable sketches, differentiate between tetrahedral and octahedral interstitial solid solutions. [05 marks]

(b) Name the three types of intermetallic compounds. Discuss how they are formed and mention some of their important properties. [15 marks]

SECTION B – ANSWER ANY TWO QUESTIONS

Q4.

Briefly discuss the following:

(a) Annealing
(b) Hardening
(c) Thermoplastics
(d) Cyaniding [20 marks]

Q5.

In an internal combustion engine design, a cylindrical connecting rod 100 mm long and having a diameter of 10.0 mm is to support a maximum tensile load of 27,500 N. Considering that the connecting rod must not experience either plastic deformation or a diameter reduction of more than 7.5×10^{-2} mm, with clear calculations recommend the material (s) suitable for this operation from the list of materials provided below in Table Q5. [20 marks]

Table Q5: Possible connecting rod materials

Material	**Modulus of Elasticity, E (GPa)**	**Yield Strength (MPa)**	**Poisson's Ratio**
Aluminium alloy	70	200	0.33
Brass alloy	101	300	0.35
Steel Alloy	207	400	0.27
Titanium alloy	107	650	0.36

Q6.

(a) Show for the body-centred cubic crystal structure that the unit cell edge length, a, and the atomic radius, r, are related through the expression: $a = \frac{4}{\sqrt{3}} r$. [05 marks]

(b) For the unknown material having a BCC crystal structure, atomic radius of 1.24×10^{-3} mm, and an atomic weight of 5.4×10^{-11} g/atom, compute its density. [10 marks]

(c) By giving one relevant example for each, distinguish between crystalline and amorphous materials. [05 marks]

END OF MEC 2309 EXAMINATION
G M MUNAKAAMPE

UNIVERSITY OF ZAMBIA

MENG STRUCTURAL ENGINEERING

CEE6262 BRIDGE DESIGN

FINAL EXAMINATION 2016/17

Duration: Three (3) Hours
Answer: Answer All Questions
Marks are as indicated

Q1

(a)From what actions or components do the main loads that act upon bridges come from?

(b) List ten factors that may cause or enhance the deterioration of steel in a steel superstructure of a bridge?

(c) Briefly discuss the five main types bridges

(i) Girder bridges
(ii) Arch bridges
(iii)Cable-supported bridges
(iv)Rigid Frame Bridges
(v) Truss bridges

(5+10+5)

Q2 Bearings and Expansion Joints

(a) What type of reactions occur at:

(i) Roller bearings?
(ii) Fixed bearings?
(iii) Pot bearings?

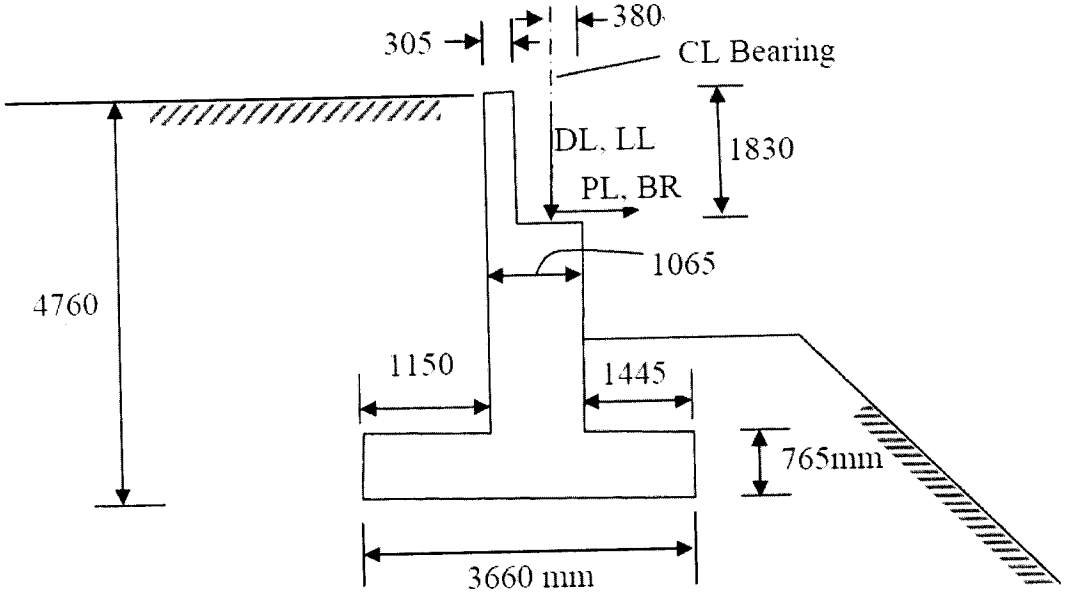
(b) What are bridge expansion joints used for on bridge decks? Give four examples of these joints.

(c) What are the advantages and disadvantages of continuous type superstructures?

(6+10+4)

Q3 Perform the necessary stability checks on the abutment shown in the Figure 3 for stability in sliding, restrictions on eccentricity and bearing pressures. Use Equivalent soil loading for the effect of induced lateral pressure on the wall (neglect DL and LL Loading) at construction stage. Clearly list all the assumptions you make and draw neat sketches to explain your calculations.

Data:
Unit weight of soil = γs = 1922 kg/ m^3
Unit weight of concrete = γc = 2400 kg/ m^3
Superstructure Dead Load, DL = 270 kPa
Live Load From Superstructure, LL = 65 kPa
Coefficient of Lateral Earth Pressure, Ka = 0.30
Angle of Friction between Wall and Foundation, $\delta = 33^o$ Degrees
Allowable Bearing Pressure, qall = 300 kPa
Braking Force at Bearing Location, BR = 5 kN/m
Longitudinal Load at Bearing Location = PL = 10% of Live Load = 6.5 kPa
Compaction Plant surcharge, w = 12 kN/m^2**n**
Surcharge Pressure, surcharge of w kN/m^2
Backfill Force, Fb = Ka $\gamma h^2/2$
Surcharge Force, Fs = Ka wh



All dimension in mm

Figure 3 Abutment Geometry and Loading

(a) Determine:
Weight of wall stem
Weight of base
Weight of backfill
Weight of surcharge

Backfill Force, Fb
Surcharge Force, Fs

Complete the Tables for Restoring and Overturning Effects

Restoring Effects:

	Weight	Lever Arm	Moment About A
Stem			
Base			
Backfill			
Surcharge			
$\sum$ =		$\sum$ =	

Oveturning Effects

	F	Lever Arm	Moment About A
Backfill			
Surcharge			
$\sum$ =		$\sum$ =	

(b) Check the abutment for:

(i) Overturning

Determine factor of Safety against overturning

(ii) Bearing

Check bearing pressure at toe and heel of base slab = $(P / A) \pm (P \times e / Z)$

Where e is eccentricity

Z is section modulus of base

(iii)Sliding

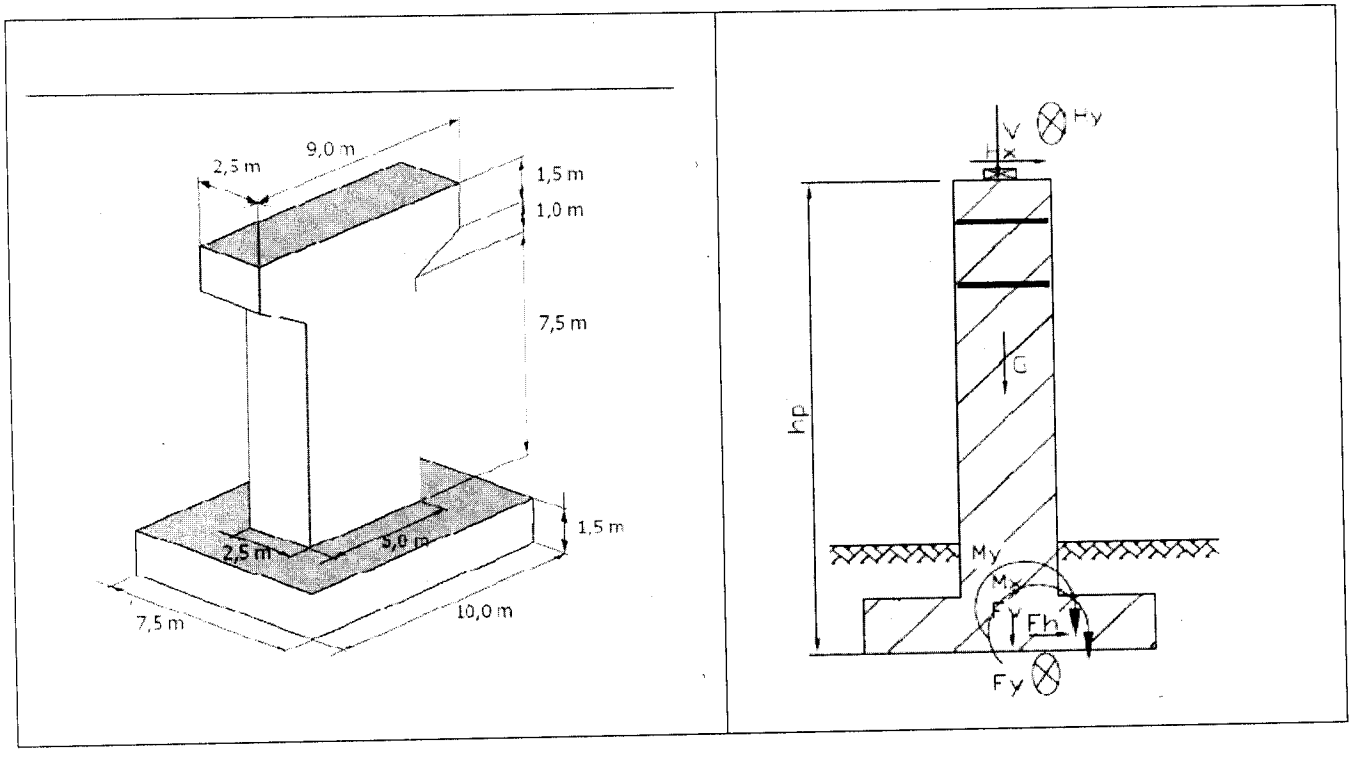
Active Sliding Force = Fb + Fs

Frictional Resistance on underside of base resisting movement = $W \tan(\varphi)$

Determine factor of Safety against sliding

(14+6)

Q4 The forces acting on a squat pier (Figure 4a) are shown in Figure 4b. The plan dimensions are shown in Figure 4c. Assume the design normal pressure at the base of the foundation 60 kPa and angle of internal friction is 30 degrees. The bearing strata is unaltered rock.



Figures 4a and b

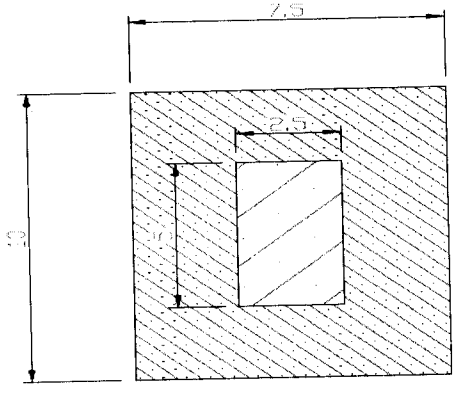


Figure 4c Plan Dimensions of Pier (m)

At the centre of the spread foundation, the resultant design actions are :

F = V + Gpier

Fx = Hx

Fy = Hy

My = Hx hp

Mx = Hy hp

Table 7.6 Partial resistance factors (γ_R) for retaining structures (table A.13 in EN 1997-1)

Resistance	Symbol	Set		
		R1	*R2*	*R3*
Bearing capacity	$\gamma_{R;v}$	1.0	1.4	1.0
Sliding resistance	$\gamma_{R;h}$	1.0	1.1	1.0
Earth resistance	$\gamma_{R;e}$	1.0	1.4	1.0

7.3.2.4 Summary for DA1, DA2 and DA3 (for "fundamental" combinations)

For **spread foundations and retaining structures**, the 3 Design Approaches, for ULS in permanent and transient design situations, can be summarised in a symbolic manner, with sets A, M and R of Tables 7.3, 7.4, 7.5 and 7.6, as follows ("+" means "to be combined with"):

Design Approach 1 (DA1)

Combination 1: *A1* "+" *M1* "+" *R1*

Combination 2: *A2* "+" *M2* "+" *R1*

Design Approach 2 (DA2)

Combination: *A1* "+" *M1* "+" *R2*

Design Approach 3 (DA3)

Combination: (*A1** or *A2*†) "+" *M2* "+" *R3*

*on structural actions, †on geotechnical actions

For the **design of axially loaded piles and anchors**, see EN 1997-1 (CEN, 2004).

Based on Design Approach , DA2:

(a) Given V_d =28.9 kN, determine the design action, Fvd, from the pier's self weight, assuming density of concrete =25 kN/m^3

Design Vertical Action, $F_{vd} = V_d + G_{pierd}$

(b) Comparing Fvd to Rd, is the foundation acceptable if based on soil condition Rk = 100.9 MN? Rd =Rk/ɣrv

(c) Determine the Moments and Eccentricities

Assuming hp =11.5m and given Fxd = 2.45 MN and Fyd =0.73 MN, Compute:

$e_B = My/Fv$

$e_L = Mx/Fv$

(d) Is the settlement acceptable based on EN 1997: (CEN 2004) E.2 (Appendix C)?

Assume

q = 0.18 MPa, E_C=7.3 MPa, Ed =6.0 MPa, σvo= q'=60 kPa, α =0.5

Appendix C

Example of a method to calculate the settlements for spread foundations - From EN 1997-2 (CEN, 2004): E.2

(1) The following is an example of a method to calculate the settlement, (s), of spread foundations using a semi-empirical method developed for MPM tests.

$$s = q - \sigma_{v0} \times \left[\frac{2B_0}{9E_d} \times \left(\frac{\lambda_d B}{B_0} \right)^{\alpha} + \frac{\alpha \lambda_c B}{9E_c} \right]$$

where

B_0 is a reference width of 0.6 m;
B is the width of the foundation;
λ_d , λ_c are shape factors given in Table E.2;
α is a rheological factor given in Table E.3;
E_c is the weighted value of E_M immediately below the foundation;
E_d is the harmonic mean of E_M in all layers up to 8 × B below the foundation;
σ_{v0} is the total (initial) vertical stress at the level of the foundation base;
q is the design normal pressure applied on the foundation.

Table E.2 — The shape coefficients, λ_c, λ_d, for settlement of spread foundations

L/B	Circle	Square	2	3	5	20
λ_d	1	1.12	1.53	1.78	2.14	2.65
λ_c	1	1.1	1.2	1.3	1.4	1.5

Table E.3 — Correlations for deriving the coefficient α for spread foundations

Type of ground	Description	E_M/p_{LM}	α
Peat			1
Clay	Over-consolidated	<16	1
	Normally consolidated	9–16	0,67
	Remoulded	7–9	0,5
Silt	Over-consolidated	>14	0,67
	Normally consolidated	5–14	0,5
Sand		>12	0,5
		5–12	0,33
Sand and gravel		>10	0,33
		6–10	0,25
Rock	Extensively fractured		0,33
	Unaltered		0,5
	Weathered		0,67

NOTE This example was published by the French Ministère de l'Equipement du Logement et des Transport (1993).

(8+2+5+5)

Q5

(a) For each of the following main construction materials for bridge superstructure, indicate the typical cross-sections, spans and construction techniques. Arrange in a table, as shown.

Superstructure Material	**Typical Sections**	**Span Range (m)**	**Construction Techniques**
Reinforced Concrete			
Prestressed Concrete Superstructures			
Composite Steel-Concrete			
Special Superstructures			

(b) With the aid of sketches, briefly explain the following Methods of construction

i. Balanced cantilever method
ii. Span by span erection with launching gantry
iii. Form traveller method
iv. Incremental launching method

(c) List eight major causes of bridge failures around the world?

(12+4+4)

END OF FINAL EXAMINATION

THE UNIVERSITY OF ZAMBIA

CIVIL & ENVIRONMENTAL ENGINEERING DEPARTMENT

MASTER OF ENGINEERING IN PROJECT MANAGEMENT
MASTER OF ENGINEERING IN CONSTRUCTION MANAGEMENT

CEE 6782 - MONITORING AND EVALUATION

FINAL EXAMINATION

MONDAY 28 AUGUST 2017

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS TO CANDIDATES:

I. CHECK THAT YOU HAVE THE CORRECT EXAMINATION IN FRONT OF YOU

II. THERE ARE SEVEN (7) QUESTIONS IN THIS EXAMINATION PAPER. **ANSWER ANY FIVE (5) QUESTIONS**

III. MARKS ARE AS ALLOCATED TO EACH QUESTION

IV. ALL QUESTIONS MUST BE ANSWERED IN THE BOOKLET PROVIDED ONLY

V. ANSWER TO EACH QUESTION TO START ON A SEPARATE PAGE

VI. THERE SHALL BE NO FORM OF COMMUNICATION BETWEEN STUDENTS DURING THE EXAMINATION. ANY STUDENT CAUGHT DOING THIS WILL BE DISQUALIFIED

Question One

Good indicators should be CREAM. Indicate which descriptions are indicators or not.

(20 marks)

Description	Yes	No
a) Mortality rate		
b) Health education materials		
c) # of clinics offering STD treatment		
d) % of clients satisfied with quality of STD treatment		
e) # of community health workers trained		
f) training for teachers		
g) % of student who score at least 90% on final exam		
h) Sexual violence counselling		
i) Years		
j) quality of learning		
k) improvements in sanitation levels		
l) gender disparities in school		
m) erratic Water supply		
n) # of doors		
o) commuters relieving themselves in the drainage and hedges		
p) frequent pump break downs		
q) Unemployment rate		
r) Ablutions used only when there is water		
s) Road length upgraded		
t) % of the toilet pans		

Question Two

Africa's rich coastal waters have long been plundered by foreign fleets, fishing illegally. Now global initiatives are gathering forces that aim to end such plunder – and protect the livelihoods of coastal communities. For these initiatives to succeed, however, many more countries around the world need to participate.

Illegal fishing is a theft from national revenues. No less than non-renewable petroleum and metals, Africa's renewable fishery resources are a potential source of wealth and opportunity. Governed wisely, they could support livelihoods, promote food security, generate export earnings and support vital ecological systems.

In the absence of effective national institutions and international cooperation, however, Africa's fishery resources have been consolidating the power and personal fortunes of ruling elites, and enriching foreign traders. West Africa alone loses $1.3 billion per year due to illegal fishing. Apart from draining the region of revenue, overfishing reduces fish stocks, lowers local catches and harms the marine environment. It destroys communities, who lose opportunities to catch, process and trade fish.

a) Identify the various stakeholders stating their categories that would influence an attitude change. (6 Marks)

b) Discuss how participatory monitoring and evaluation methods would help curb illegal fishing (8 Marks)

c) What are the three challenges of participatory monitoring (6 Marks)

Question Three

"An ex-ante evaluation is necessary for the evaluation of ongoing projects."

a) Discuss whether the foregoing statement is true. (5 Marks)

b) Discuss the significance of ex-ante evaluation with respect to funding organizations such as banks and government spending agencies like Ministry of Health and Education. (15 Marks)

Question Four

a) What are evaluation standards? (4 Marks)

b) Identify and discuss four evaluation standard variables (16 Marks)

Question Five

a) What is Results based Monitoring and Evaluation. (5 Marks)

b) Explain three limitations in using a Results based M&E framework? (6 Marks)

c) Create and describe a situation where indicators would sometimes be disaggregated? (9 Marks)

Question Six

The Zambian government launched the L-8000 project under the Road Development Agency to provide 8000km of new roads within a five year period. The Zambian government did not have enough time to plan this project. In addition, Zambia does not have adequate capacity to undertake this project. As an M&E specialist write a report advising the government:

a) on how many evaluations have to be undertaken on the project. (4 Marks)

b) describe the different types of evaluations to be undertaken. (8 Marks)

c) It is expected that things do not go as anticipated on a project. Describe four situations when an evaluation could be called for on a project. (8 Marks)

Question Seven

As an M&E specialist you have been approached by the Government of the Republic of Zambia to establish a Ministry of Monitoring and Evaluation (M&E) to monitor the implementation of the Seventh National Development Plan and any future plans. The government is concerned about sustainability of the Ministry. Describe how the new Ministry would be sustained

(20 Marks)

END

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS

5th September 2017

EEE 4352

ELECTRICAL MACHINES

TIME	:	Three (3) hours
INSTRUCTIONS	:	Answer any five (5) questions
ADDITIONAL INFORMATION	:	*All Questions Carry Equal Marks*

Question 1.

(a) What is a power transformer? Write down at least four conditions for the operation of three-phase power transformers in parallel.
(b) How do the parameters on the primary and secondary sides in a Dy11 transformer compare with each other?
(c) What is a K-factor transformer?
(d) By means of sketches describe what each of the following instrument transformers are used for: (i) Voltage transformer and (ii) Current transformer.

[6+2+4+8 Marks]

Question 2.

(a) A 200-MVA, 330-kVΔ/33-kV Y substation transformer has an 8% leakage reactance. The transformer acts as a connecting link between 330-kV transmission and 33-kV distribution. Transformer winding resistances and exciting current are neglected. The high-voltage bus connected to the transformer is assumed to be an ideal 330-kV positive-sequence source with negligible source impedance. Using the transformer ratings as base values, determine:
(i) The magnitudes of transformer voltage drop and voltage at the low-voltage terminals when the rated transformer current at 0.8 power factor lagging enters the high-voltage terminals.
(ii) The magnitude of the fault current when a three-phase-to-ground bolted short circuit occurs at the low-voltage terminals.

[12 marks]

(b) Three single-phase two-winding transformers, each rated 400 MVA, 13.8/ 199.2 kV, with leakage reactance X_{eq} =0.10 per unit, are connected to form a three-phase bank. Winding resistances and exciting current are neglected. The high-voltage windings are connected in Y. A three-phase load operating under balanced positive-sequence conditions on the high-voltage side absorbs 1000 MVA at 0.90 power factor lagging, with $V_{AN} = 199.2 \angle 0^{\circ}$ kV. Determine the voltage V_{an} at the low-voltage bus if the low-voltage windings are connected in Y.

[8 marks]

Question 3.

(a) A 230 V dc machine has an emf constant K=212.21 V.s/Wb.rad and $R_a = 0.278\ \Omega$. The field is separately excited and produces 0.01 Wb per pole. $I_a = 36$ A for all parts of the problem. (i) At what speed does the machine operate as a dc generator with rated terminal voltage? (ii) At what speed does the machine operate as a dc motor with rated terminal voltage? (iii) If an external resistance $R_x = 1\ \Omega$ is added in series with the armature circuit, at what speed does the machine operate as a dc motor with rated terminal voltage? (iv) If the motor of part (ii) is known to be supplying 10 hp to a coupled mechanical load, determine the rotational losses at the point of operation.

[12 Marks]

(b) A dc shunt motor draws a current $I_L = 75$ A at 250 V while driving a coupled mechanical load at a speed of $\omega_m = 1000\pi/30$ rad/s. Efficiency at the point of operation is known to be 92%. Also, $R_a = 0.1\ \Omega$ and $R_f = 200\ \Omega$. (i) Calculate the value of output power to the mechanical load. (ii) Determine the value of rotational losses at the point of operation. (iii) Find the value of developed torque.

[8 marks]

Question 4.

(a) Describe how a magnetization cure of a dc machine is obtained experimentally. Sketch the curve and state its importance.

(b) What is armature reaction in a dc machine?

(c) Sketch the speed-torque characteristics of the various dc motors in the same axes. State what is meant by cumulative and differential compound dc motors.

(d) Explain how speed control is achieved in dc motors.

[6+4+6+4 marks]

Question 5.

(a) A 550-V, 50-Hz, Y-connected, 6-pole synchronous generator has a per phase synchronous reactance of 1.1 Ω. Its full-load armature current is 60 A at 0.8 power factor lagging. Its friction and windage losses are 2.5 kW and core losses are 1.5 kW at 50 Hz at full-load. Assume that the armature resistance can be ignored. The field current has been adjusted such that the no-load terminal voltage is 550 V. Calculate the voltage regulation and efficiency of this generator when it is operating at rated current and 0.8 power factor lagging.

[10 Marks]

(b) At a location in our country, it is necessary to supply 300 kW of 60-Hz power. The only power sources available operate at 50 Hz. It is decided to generate the power by means of a motor-generator set consisting of a synchronous motor driving a synchronous generator. How many poles should each of the two machines have in order to convert 50-Hz power to 60-Hz power?

[5 marks]

(c) A 440-V three-phase Y-connected synchronous motor has a synchronous reactance of 1.5 Ω per phase. The field current has been adjusted so that the torque angle δ is 28° when the power supplied by the generator is 90 kW. (i) What is the magnitude of the internal generated voltage E_A in this machine? (ii) What are the magnitude and angle of the armature current in the machine?

[5 marks]

Question 6.

(a) Draw a three-phase power circuit for a direct-on-line (DOL) motor starter, including the simple control circuit showing how the motor can be started and stopped using push buttons.

[8 marks]

(b) By means of a clearly labeled diagram, explain how the speed of an induction motor can be varied using electronic methods.

[4 marks]

(c) A three-phase, 750-hp, 4160-V, Y-connected induction motor has a full-load efficiency of 90%, a lagging power factor of 0.75, and is connected to a power line. To correct the power factor of such a load to a lagging power factor of 0.85, a synchronous condenser is connected at the load. Determine the reactive power provided by the synchronous condenser.

[8 marks]

Question 7.

(a) By starting with the expression for the induced torque τ_{ind} in an induction motor, show how the derivative $\frac{d\tau_{ind}}{d\left(\frac{R_2}{s}\right)} = 0$ will lead to the maximum torque expression.

[12 marks]

(b) A 208-V, four-pole, 50-Hz, Y-connected, wound-rotor induction motor is rated at 15 hp. Its equivalent circuit components are:

$R_1 = 0.220\ \Omega \quad R_2 = 0.127\ \Omega \quad X_M = 15.0\ \Omega$

$X_1 = 0.430\ \Omega \quad X_2 = 0.430\ \Omega$

$P_{mech} = 300\ W \quad P_{misc} \approx 0 \quad P_{core} = 200\ W$

(i) What is the slip at the pullout torque?

(ii) What is the pullout torque of this motor?

[8 marks]

END OF EEE4352 EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF GEOMATIC ENGINEERING

2016 ACADEMIC YEAR END OF YEAR EXAMINATIONS

GEE 5610 - GEOGRAPHIC INFORMATION INFRASTRUCTURE

AUGUST, 2017

TIME ALLOWED: THREE HOURS (14:00 – 17:00 HOURS)

INSTRUCTIONS TO CANDIDATES

1. **This examination is Closed Book.**
2. **Calculators are permitted.**
3. **Answer: All Four (4) questions.**
4. **Show all the work leading to the solution.**
5. **All questions must be answered in the answer booklet provided only.**
6. **Write down the number of questions that you have answered on the cover of the examination answer booklet.**
7. **Begin each question on a new page.**
8. **There shall be no communication among students during the examination. Any student caught doing this will be disqualified.**
9. **Total marks for this examination paper is 100**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Question 1

a. In spatial databases we usually use two types of queries; spatial query and non-spatial query.

i. Explain the difference between a spatial query and a non-spatial query. **[4 marks]**

ii. Figure 1 and figure 2 show two relations from a spatial database. Below them are two queries. One is a non-spatial join query and the other is a spatial join query. Identify the spatial join query and the non-spatial join query. **[2 marks]**

iii. In detail explain what each of the queries is doing and why it is a join query. **[7 marks]**

senator			
name	gender	Soc_sec	district (Polygon)

Figure 1

Business			
bname	owner	soc_sec	location (Point)

Figure 2

Query 1

```
SELECT    s.name
FROM      senator AS s, business AS b
WHERE     Area(s.district)>300 AND Within(b.location, s.district)
```

Table 1

System type A	System type B
Simple system	Complex system
	Closed system
Stable system	
Adaptive system	
	Temporary system

b. What is Internet GIS? **[6 marks]**

c. Give four (4) reasons why Web servers and Map viewer clients interact in Web mapping. **[8 marks]**

Question 3

a. Explain the role of each of the following in a Spatial Data Infrastructure (SDI):

   i. Clearinghouse. **[3 marks]**

   ii. Metadata. **[3 marks]**

   iii. Geodata. **[3 marks]**

   iv. Standards. **[3 marks]**

   v. Partnerships. **[3 marks]**

b. List five (5) commonly used Unified Modelling Language (UML) diagrams. **[10 marks]**

Question 4

a. Explain what is involved in each of the following steps in building a Geodatabase:

   i. Model the User's View of Data. **[5 marks]**

   ii. Define Objects and Relationships. **[5 marks]**

   iii. Select Geographic representation. **[5 marks]**

   iv. Match to Geodatabase Elements. **[5 marks]**

   v. Organize Geodatabase Structure. **[5 marks]**

END OF EXAMINATION

The University of Zambia

School Of Engineering

Department of Geomatic Engineering

20162017 Academic Year Second Half Year

FINAL EXAMINATIONS

GEE 3622: Principles of Data Acquisition and Processing

Monday 28th August 2017

TIME:Three (3) Hours

INSTRUCTIONS:

1. This examination is Closed Book
2. Calculators are permitted
3. ANSWER **ALL** questions from **SECTION A** and one (1) question from **SECTION B**
4. Show all the work leading to the solution
5. Total marks for this examination paper is 100
6. **[ ]** indicates allocated marks for the question

Question 1 (25 marks)

a) Outline **THREE (3)** types of scattering that occur in the earth's atmosphere, giving any possible wavelength dependency of each scattering type.

b) State whether true or false:

i. Active Remote – detect only reflected sunlight or thermal IR and microwaves

ii. Passive Remote – beam own artificially produced energy to a target and record reflected component

iii. The entire range of EMR comprises the electromagnetic spectrum subdivided in divisions called wavelengths that share common characteristics.

iv. Three forms of energy transfer include: absorption, reflection and transmittance

v. The Sun is the major supplier of EM energy incident on the Earth – providing energy needed for terrestrial life and the natural processes operating in the atmosphere, water and upper layers of solid Earth.

vi. EMR travels in a straight path at the speed of light – postulated by Albert Einstein in 1905 as ~ 300,000 km/sec

vii. Electromagnetic Radiation (EMR) is light energy detected when it comes into contact with an object

viii. The visible portion of the EM Spectrum ranges from 0.4m to 0.70m

ix. The most common bands of the EM spectrum used for remote sensing are cosmic, gamma and x-rays.

x. Remote sensing depends upon operation in wavelength regions of spectrum where spectral signatures occur for identification purposes.

Question 2 (25 marks)

1. A mapping project is designed to use aerial photography at a scale of 1:10000 for a preliminary design of a development project covering an area of 20 x 15km. If a 15/23 camera is used with end and side overlaps of 60% and 30% respectively, calculate the following parameters if a flight plan along the longer side of the project boundary is to be prepared at a map scale of 1:20,000;

   i. total number of flight lines

   ii. total number of photographs to cover the project area

Question 3 (25 marks)

a. Explain the term **depth of perception** with respect to stereoscopic viewing.

b. Given that the shortest distance of clear stereoscopic depth perception for an average eye base of 65mm is 250mm, calculate the maximum Parallactic angle.

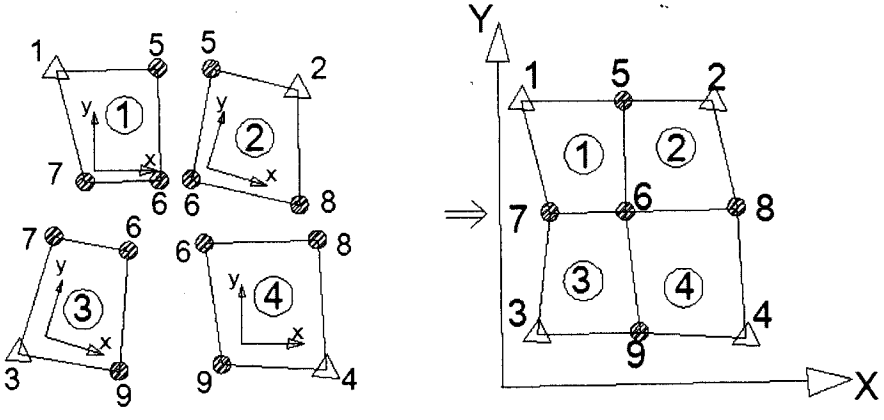
c. Given that the maximum distance at which the stereoscopic depth perception is possible is approximately 600m, calculate the minimum Parallactic angle.

d. Name **THREE (3)** instruments used to measure image coordinates and briefly outline the measurement process involved.

SECTION B

Question 4 (25 marks)

1. The figure below shows four models (1-4) which are observed independently.



a. Briefly, define the adjustment involved in these models?

b. Calculate,
   i. Total number of observation
   ii. Total number of Unknowns
   iii. Number of redundant observations
   iv. Which points represent the tie-points?
   v. Which points represent the control points?

c. Why is the similarity (conformal) transformation used in the Block adjustment by independent models?

d. Mention at least five (5) sources of errors that are normally taken into account in aerial triangulation.

Question 5 (25 marks)

The figure below shows an overlapping pair of truly vertical aerial photographs taken at equal flying height H above mean sea level (MSL) and having equal focal length f. The corresponding images of the ground point P are P_L on the left photo and P_R on the right photograph, respectively. The ground coordinate system XYZ has its origin at the MSL level location O of the left photo camera exposure station, i.e. the **X** and **Y** axes are parallel to the x and y axes of the photo system.

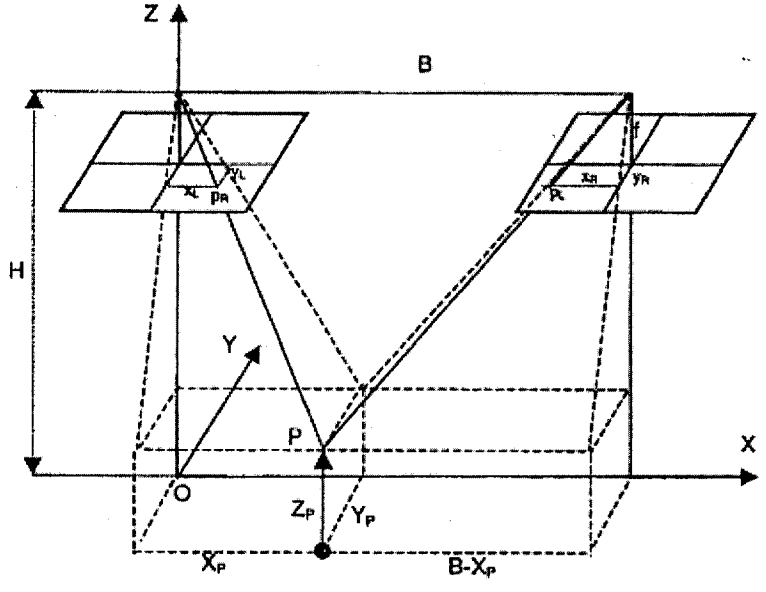
a) Derive the basic parallax equations for the ground coordinates of point P based on the illustrated geometry of the overlapping truly vertical photos.

b) Compute the ground coordinates $\mathbf{X_p Y_p Z_p}$ of point **P** using the previously derived parallax equations for the photo stereo pair, whose Focal length **f**=152mm, the air base **B**=1815m and the flying height **H**=3000m;

and the photo-coordinates of point **P** are:

for the left photo: x_L = +80.00mm y_L = -50.00mm, and

for the right photo: x_R = -20.00mm, y_R = -50.00



END OF EXAMINATION

******GOOD LUCK ******

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

2016 UNIVERSITY FINAL EXAMINATION **AUGUST/SEPTEMBER 2017**

MEC 2009 – ENGINEERING DRAWING I

TIME ALLOWED: FOUR (4) HOURS

CLOSED BOOK EXAMINATION: TEXT BOOKS AND MARKED TUTORIAL SHEETS ARE NOT ALLOWED

INSTRUCTIONS

1. Answer a total of **FOUR (4)** questions.

   a. SECTION A: Question **ONE (1)** is compulsory.
   b. SECTION B: Answer any **TWO (2)** questions from this section.
   c. SECTION C: Answer any **ONE (1)** question from this section.

2. **ONLY** question **ONE (1)** should be drawn on the drawing paper face which will bear the **Title Block**. Section B should be answered on the reverse side of the same drawing sheet

3. **SECTION C** should be answered on a **SEPARATE DRAWING ANSWER SHEET. Indicate ONLY your Computer Number on this drawing sheet.**

4. Clearly label answered questions.

5. Indicate only your computer number in the title block and on all other drawing sheets used. **DO NOT INDICATE YOUR NAME ON ANY ANSWER SHEET.**

6. Construction lines should not be erased and should be clearly visible.

7. Do not dimension your work unless otherwise stated.

8. Marks will be awarded for: correct Solution, Neatness, Layout and Good Line Work.

9. All dimensions in millimeters.

SECTION A. The question in this section is compulsory . Total Marks: 40 Marks

Question 1

Figure Q1 shows Front and end views of a Flange Coupling. Draw to full scale the front view, and in place of the full section, show the half section of the left flange of the coupling front view while the right flange should show its outside view without the section. The half section should be taken through the vertical centerline as indicated in the end view. Show hidden parts on the outer view. (Refer to Appendix A for bolts and nuts details.) **[40 Marks]**

SECTION B

Answer ANY TWO (2) Questions Total Marks: 30 Marks

Question 2

The plan and front elevation of a casting are shown in Figure Q2. Draw to scale of 1:1,

a) The given views **[2 Marks]**
b) The right end elevation **[7 Marks]**
c) A development of the curved surface. **[6 Marks]**

Question 3

Draw the spanner shown in Figure Q3 showing all construction methods used leading to the solution. **[15 Marks]**

Question 4

Figure Q4 shows the front and end views of a rod end. Draw, scale 1:1,

a) The given views, completing the front by showing the curves of intersection. **[8 Marks]**
b) An end elevation looking in the direction of the arrow. **[7 Marks]**

Question 5

Figure Q5 shows a crank-rocker mechanical linkage. Crank AB rotates around a pivot A which in turn moves a rigid link BDEF which is also connected to rocker link CD. Link CD rocks about pivot C. Portion EF makes a rigid angle of 90^{o} to portion DE of link BDEF. Using standard symbols to represent the mechanism, trace the locus of point F as the crank link makes a complete 360^{o} of rotation. **[15 Marks]**

Title block & Neatness [10 Marks]

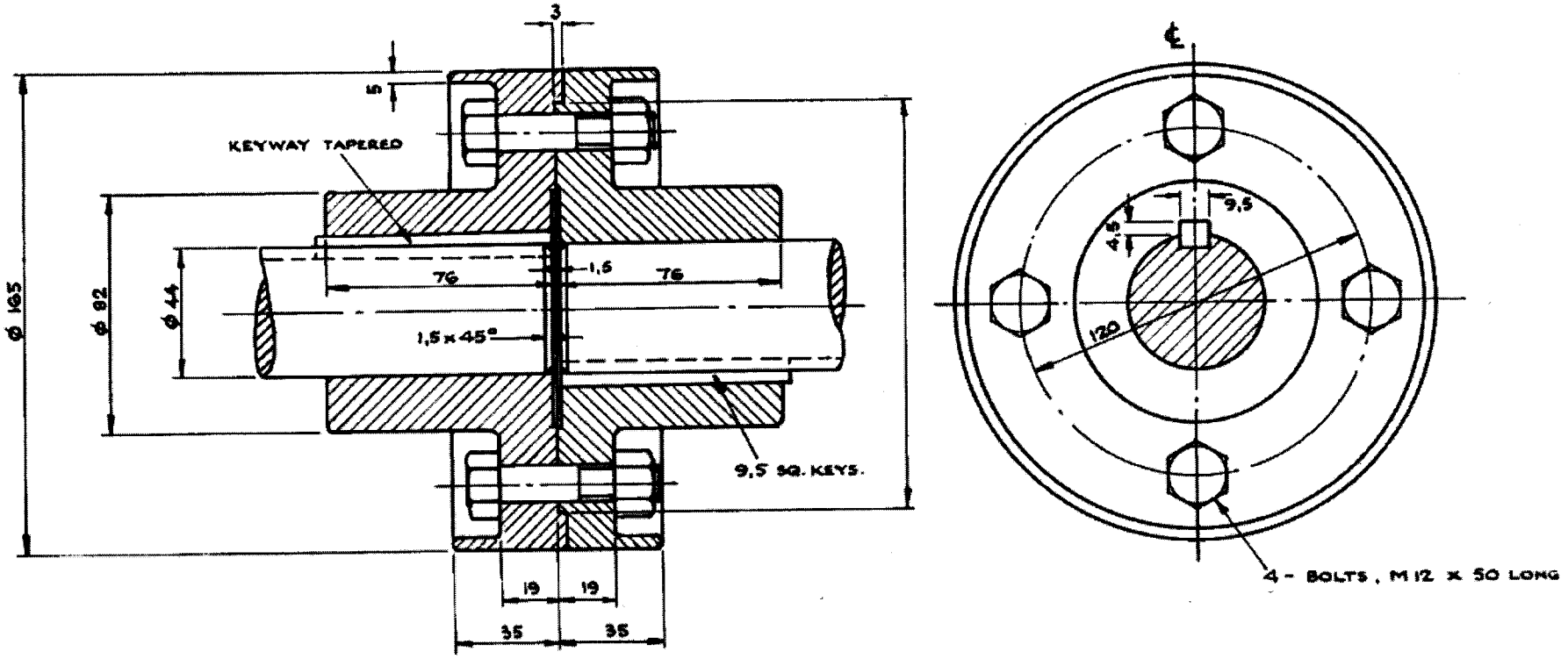


Figure Q1: Flange Coupling

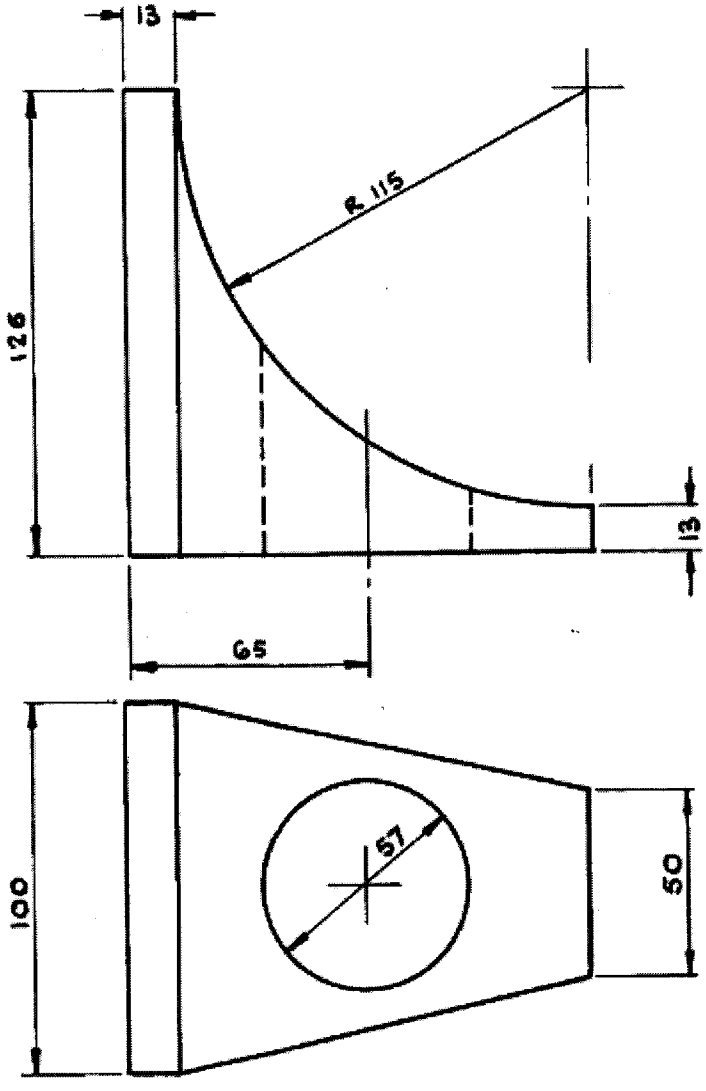


Figure Q2

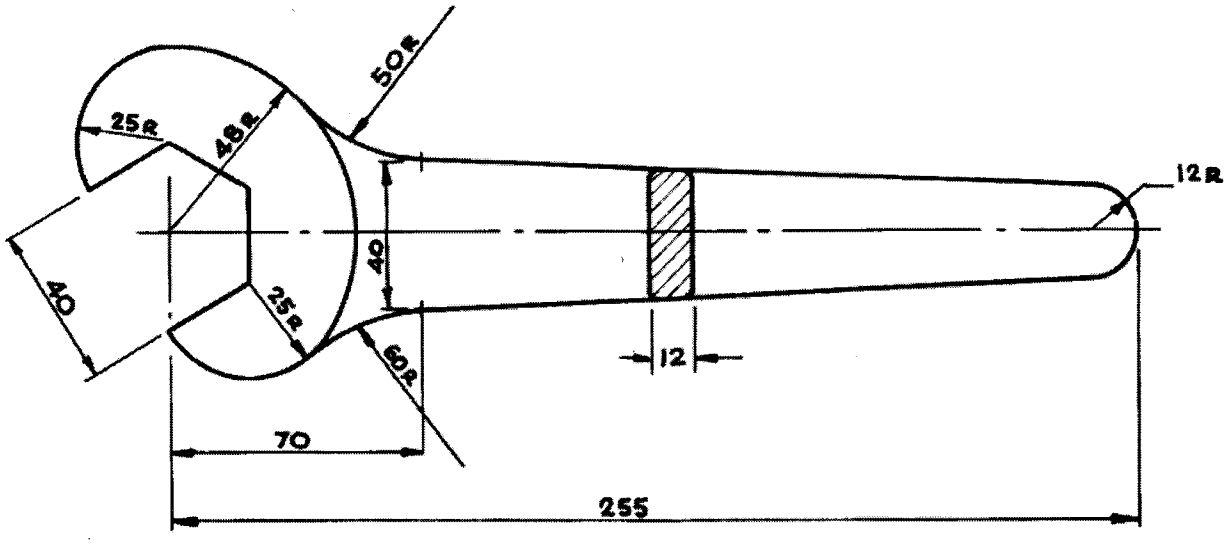


Figure Q3

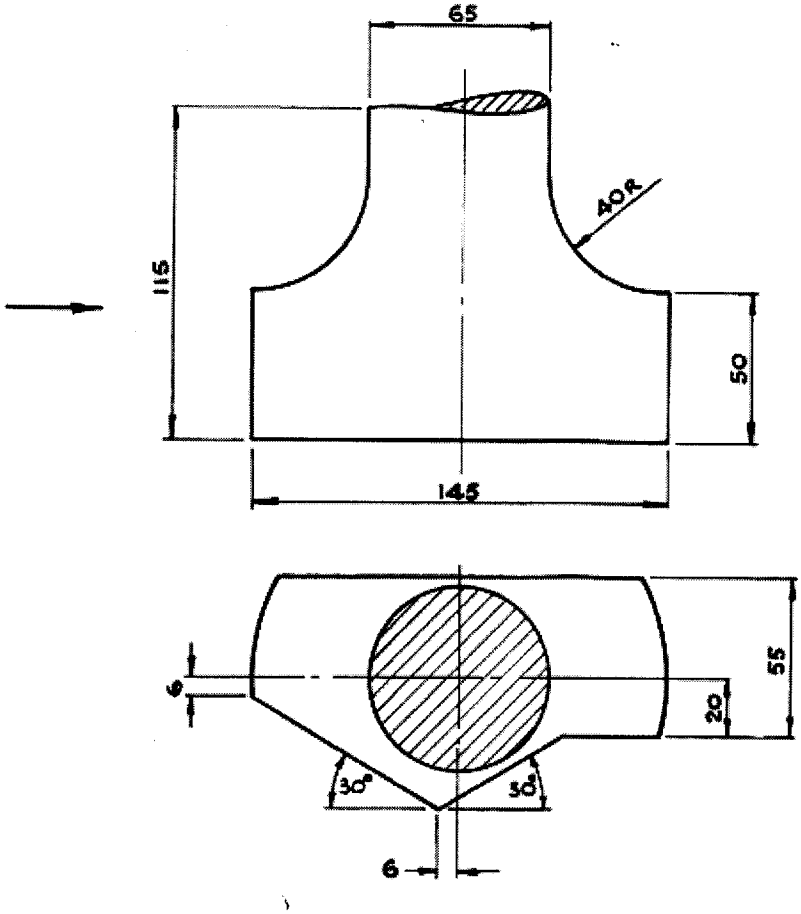


Figure Q4

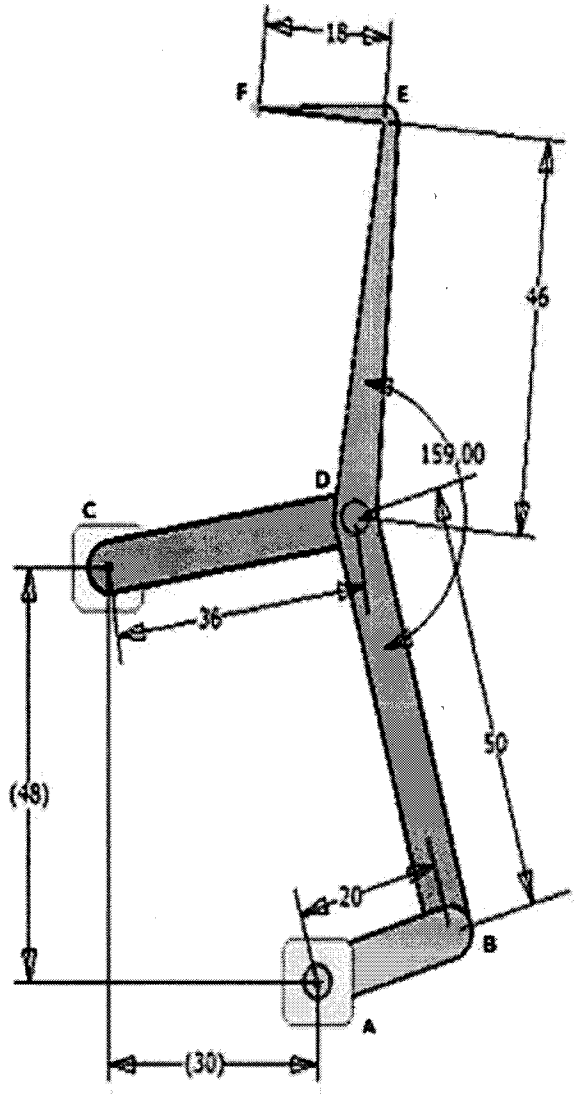


Figure Q5

SECTION C – Electrical Engineering Component
Answer ANY ONE (1) question from this section. **Total Marks: 20 Marks**

NOTE: ANSWER ON A SEPARATE SHEET OF DRAWING PAPER

NO TITLE BLOCK (Indicate Computer Number at the bottom right hand corner)
ADDITIONAL INFORMATION : Some useful information is in **Appendix B**

Question 5

Mathematically, sinusoidal waveforms can be sketched based on these three respective expressions $V_R = V_m \sin \omega t$, $V_Y = V_m \sin(\omega t - 120^o)$ and $V_B = V_m \sin(\omega t - 240^o)$ by bearing in mind their magnitude V_m and various phase shifts. These actually happen to be the voltage waveforms in the red, yellow and blue phases respectively as pictured in three-phase transmission of power. Now use your drawing instruments to draw these three waveforms in the same axes up to two cycles. Use a circle of diameter 50 mm as a guide.

[20 marks]

Question 6

(a) An **OR** logic gate can be explained by constructing a circuit consisting of a voltage source $\mathbf{V_s}$, two parallel switches $\mathbf{S_1}$ and $\mathbf{S_2}$ in series with the voltage source, and a light bulb serving as a load. Construct such a circuit and explain its operation by means of a truth table.
(Hint: Begin with a rough sketch on a piece of paper for clear realization).

(b) Construct a circuit consisting of a voltage source $\mathbf{V_s}$, three resistors $\mathbf{R_1}$, $\mathbf{R_2}$ and $\mathbf{R_3}$ in series, and clearly show how voltmeters, $\mathbf{V_1}$, $\mathbf{V_2}$, and $\mathbf{V_3}$ can be connected to measure voltage across each resistor.

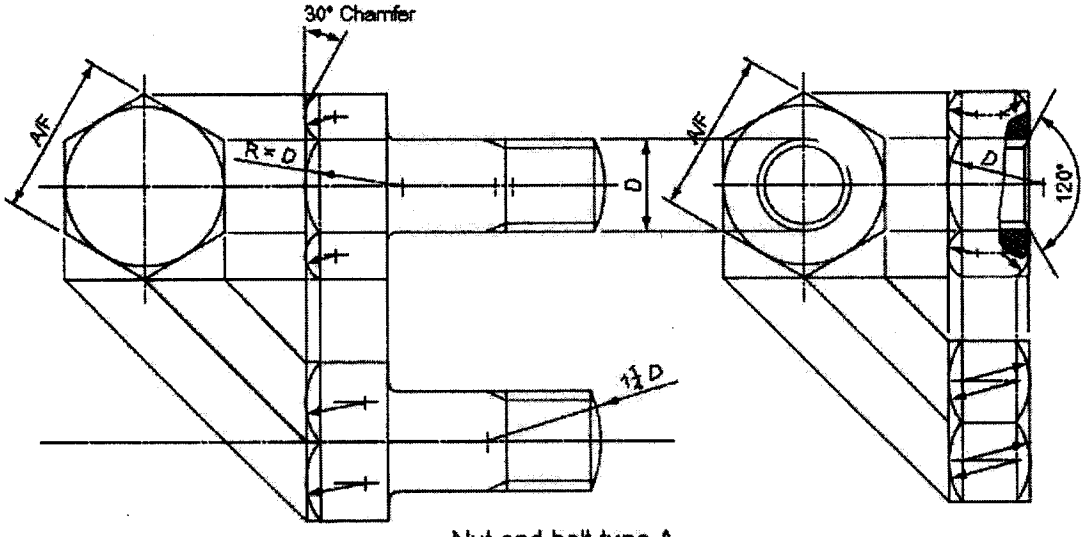
[10+10 marks]

END OF EXAMINATION

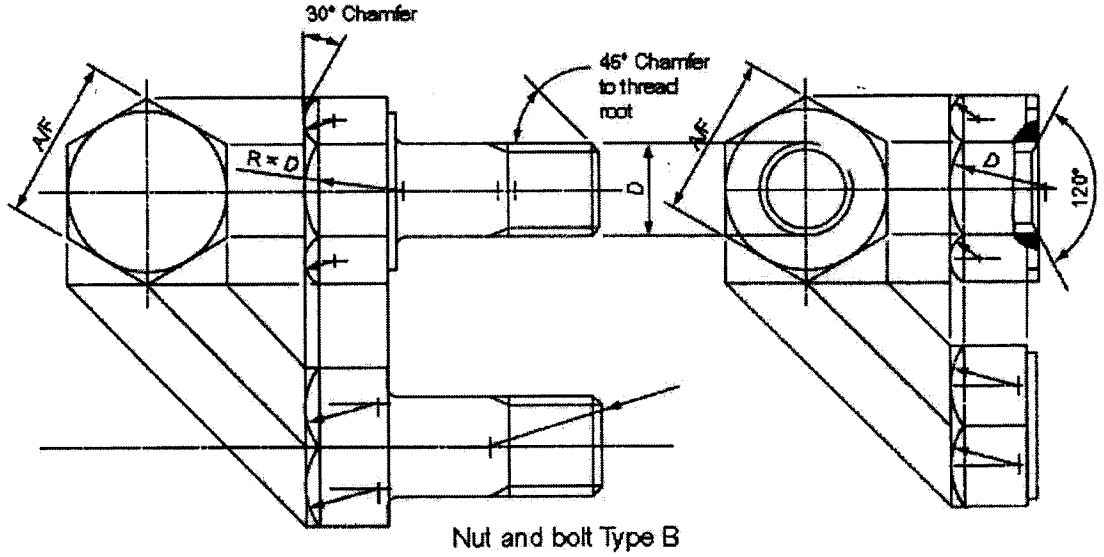
Appendix A Sizes of Isometric Precision Hexagon Nuts, Bolts and Washers

All dimensions in millimetres (maximum).

Size	Diameter of shank	Width across flats (A/F)	Height of bolt head (T) (T_B)	Radius under head (R)	Depth of washer face Washer thickness (D)	Thickness of normal nut (T_N)	Thickness of thin nut (T_{TN})	Washer inside diameter (d_1)	Washer outside diameter (d_2)
M1.6	1.6	3.2	1.125	0.2	–	1.3	–	2.0	–
M2	2.0	4.0	1.525	0.3	–	1.6	–	2.6	–
M2.5	2.5	5.0	1.825	0.3	–	2.0	–	3.1	–
M3	3.0	5.5	2.125	0.3	0.1	2.4	–	3.6	5.08
M4	4.0	7.0	2.925	0.35	0.1	3.2	–	4.7	6.55
M5	5.0	8.0	3.650	0.35	0.2	4.0	–	5.7	7.55
M6	6.0	10.0	4.15	0.4	0.3	5.0	–	6.8	9.48
M8	8.0	13.0	5.65	0.6	0.4	6.5	5.0	9.2	12.43
M10	10.0	17.0	7.18	0.6	0.4	8.0	6.0	11.2	16.43
M12	12.0	19.0	8.18	1.1	0.4	10.0	7.0	14.2	18.37
M14	14.0	22.0	9.18	1.1	0.4	11.0	8.0	16.2	21.37
M16	16.0	24.0	10.18	1.1	0.4	13.0	8.0	18.2	23.27
M18	18.0	27.0	12.215	1.1	0.4	15.0	9.0	20.2	26.27
M20	20.0	30.0	13.215	1.2	0.4	16.0	9.0	22.4	29.27
M22	22.0	32.0	14.215	1.2	0.4	18.0	10.0	24.4	31.21
M24	24.0	36.0	15.215	1.2	0.5	19.0	10.0	26.4	34.98
M27	27.0	41.0	17.215	1.7	0.5	22.0	12.0	30.4	39.98
M30	30.0	46.0	19.26	1.7	0.5	24.0	12.0	33.4	44.98
M33	33.0	50.0	21.26	1.7	0.5	26.0	14.0	36.4	48.98
M36	36.0	55.0	23.26	1.7	0.5	29.0	14.0	39.4	53.86
M39	39.0	60.0	25.26	1.7	0.6	31.0	16.0	42.4	58.86
M42	42.0	65.0	26.26	1.8	0.6	34.0	16.0	45.6	63.76
M45	45.0	70.0	28.26	1.8	0.6	36.0	18.0	48.6	68.76
M48	48.0	75.0	30.26	2.3	0.6	38.0	18.0	52.6	73.76
M52	52.0	80.0	33.31	2.3	–	42.0	20.0	56.6	–
M56	56.0	85.0	35.31	3.5	–	45.0	–	63.0	–
M60	60.0	90.0	38.31	3.5	–	48.0	–	67.0	–
M44	64.0	95.0	40.31	3.5	–	51.0	–	71.0	–
M68	68.0	100.0	43.31	3.5	–	54.0	–	75.0	–



Nut and bolt type A



Nut and bolt Type B

See Appendix A for nut, bolt and washer proportions

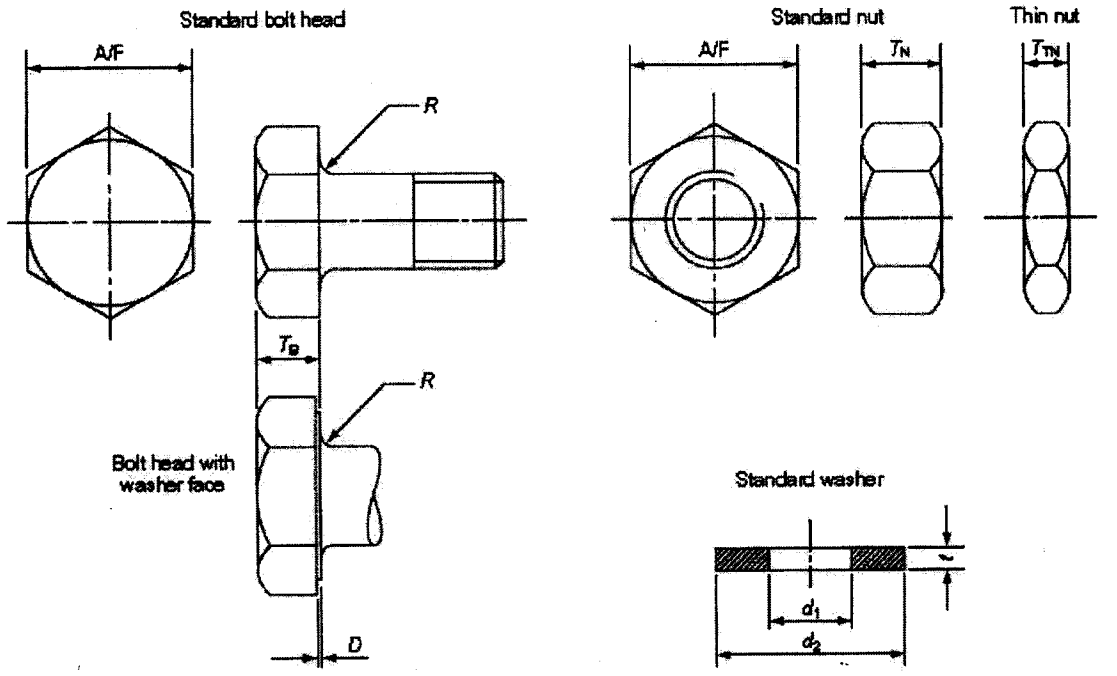


Figure A.1

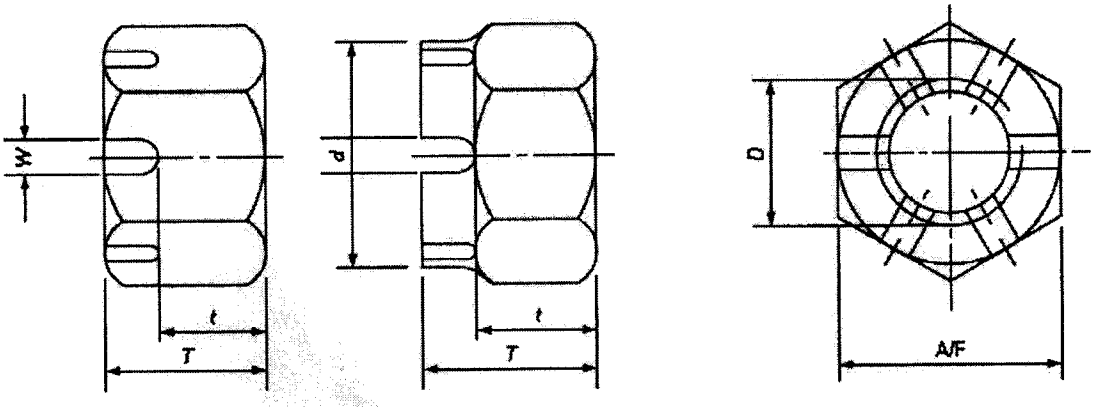
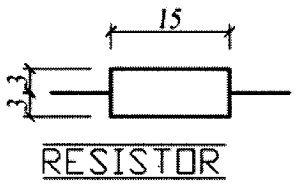


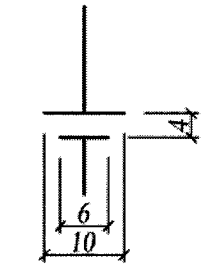
Figure A.2

APPENDIX B

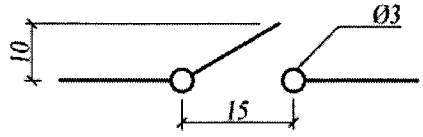
SOME USEFUL INFORMATION



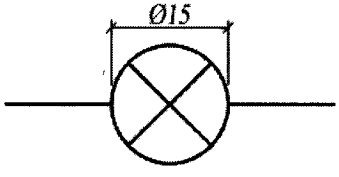
RESISTOR



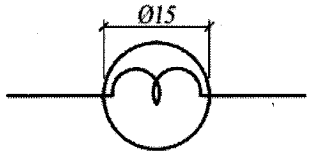
BATTERY



SWITCH 1



INDICATOR LAMP



LIGHT LAMP

THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

2016/2017 ACADEMIC YEAR FINAL EXAMINATIONS – SEPTEMBER 2017

MEC 5855 - AUTOMOBILE ENGINEERING

TIME: THREE (3) Hours **[Closed Book]**

Instructions:

1. Answer a **total of FIVE (5)** questions with a minimum of **TWO (2)** from each section.
2. All questions carry **20 MARKS**.
3. Show **ALL** your workings (sketches, graphs, etc.) and state any assumptions made.
4. Write your **computer number** on each and every sheet used.
5. All mobile phones **MUST** be switched off or put in flight mode.

SECTION A

Question 1

1.1 Discuss the various factors affecting the reliability and durability of a motor vehicle? **[8 Marks]**

1.2 Discuss the various methods used in the determination of wear on engine components of a motor vehicle (due to road conditions and otherwise). What recommendations would you make to reduce wear **[12 Marks]**

[Q1 Total: 8 + 12 = 20 Marks]

Question 2

2.1 FISCAL International (Pvt) Limited is bargaining to purchase a car for their newly appointed CEO. Apparently, there are two identical Cadillac SRX crossovers from which to make a choice. One is a rear wheel drive (RWD) and the other is a front wheel drive (FWD). Each car weighs 21336.75 N and has a static weight distribution on the axles of 50:50. The wheel base is 3000 mm and the height of the centre of gravity above the ground is 550 mm. Most critical information on the User Profile is that a road leading to his residence has an ascent of 30% with a coefficient of friction (for grip) being 0.6. Being an Automotive Expert in a Consultancy Firm, make recommendations to this company as to which of the two cars should be purchased as far as gradability is concerned, if the engine power is not a limitation.

Neglect the change in the reactions on the wheels. Support your answer with calculations.

[12 Marks]

2.2 Briefly explain various excitation sources for exciting vehicle ride vibration.

[8 Marks]

[Q2 Total: 12 + 08 = 20 Marks]

Question 3

3.1 The coefficient of rolling resistance (K) for a vehicle weighing 7.5 kN is 0.015 and the coefficient of air resistance K_a is 0.0281 in the formula $R = KW + K_a AV^2$, where R is the total resistance, A is the frontal area in m^2 and V the speed in km/h. The transmission efficiency in the top gear of 5.5:1 is 90% and that in the second gear of 11:1 is 80%. The frontal area is 5.575 m^2. If the vehicle has to have a maximum speed of 88km/h in top gear, Calculate:

(i) The engine BP required in top gear;

(ii) The engine speed if the driving wheels have an effective diameter of 0.9m in top gear;

(iii) The maximum grade the truck can negotiate at the above engine speed in second gear; and

(iv) The maximum drawbar pull available on level at the above engine speed in second gear.

[10 Marks]

3.2 Briefly explain the function of each element of a transmission system in an automobile.

[10 Marks]

[Q3 Total: 10+ 10 = 20 Marks]

SECTION B

Question 4

4.1 Briefly explain:

(i) Slip angle

(ii) Understeer

(iii) Oversteer

(iv) How is oversteer considered dangerous?

[8 Marks]

4.2 Consider a vehicle resting on a slope with an inclination angle θ to the horizontal in Figure Q4.2.

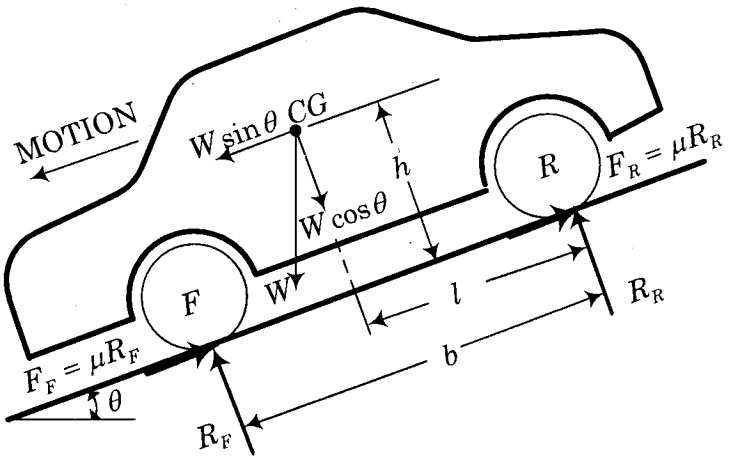


Figure Q4.2

(i) Derive the equations for normal reactions at the wheels in Figure Q4.2.

The vehicle in Figure Q4.2 has total mass of 5000 kg and is held at rest on a slope of 10°. It has a wheel base of 225 cm and its center of gravity is 100 cm in front of the rear axle and 150 cm above the ground level. Find:-

(ii) What are the normal reactions at the wheels?

(iii) Assuming that sliding does not occur first, what will be the angle of slope so that the vehicle will overturn?

(iv) Assuming all the wheels are to be braked, what will be the angle of the slope so that the vehicle will begin to slide if the co-efficient of adhesion between the tyre and the ground is 0.35?

[12 Marks]

[Q4 Total: 8 + 12 = 20 Marks]

Question 5

5.1 (i) What are the main two functions of steering gears in an automobile?
(ii) Explain the construction and working of Ackermann mechanism of steering.

[2+8=10 Marks]

5.2 Explain with neat sketch the working of a Telescopic type shock absorber.

[10 Marks]

[Q5 Total: 5+5 + 10 = 20 Marks]

Question 6

6.1 (i) Draw an automotive engine and drive train and label all the parts.
(ii) List the main components of a car electrical system.

[5+5 Marks]

6.2 Starting from first principle, show that the stopping time for a car on application of brakes varies directly as the initial speed; whereas the stopping distance varies as the square of the speed.

[Q6 Total: 5+5 + 10 = 20 Marks]

Question 7

7.1 Explain the construction of an automobile tire.
7.2 Explain how motor vehicles are classified.

[Q7 Total: 10 + 10 = 20 Marks]

END OF MEC 5855 – AUTOMOBILE ENGINEERING EXAMINATION, SEPTEMBER, 2017.

Prepared by: Mr. J.K. Musa