THE UNIVERSITY OF ZAMBIA
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
EE481 – COMPUTER ENGINEERING
SEMESTER TEST – 5th September 2011

TIME: **2 HOURS**
ANSWER: **ALL.**

Q1.

a) What is System Architecture, and how different [if at all] is it from microprocessor architecture? *[5]*

b) What is a microprocessor? Summarize the functions of a microprocessor. *[6]*

c) The registers in an 8086 microprocessor are put under specific groups: Name three groups, with examples of registers found in that group. Briefly describe [with drawings] the following four data-addressing modes available in the 8086 microprocessor: *[8]*

- Register indirect
- Register relative
- Based indexed
- Based indexed relative

d) Given that:
(BX) = 123E (SI) = 1A50 (DS) = 2010 (IP) = 4A10
Displacement = 1007
Determine the Effective address, and the resulting physical address for the addressing modes in (c) above. *[8]*

e) List the internal registers in an 8085A and their abbreviations and lengths. Describe the primary function of each register. *[6]*

Q2.

a) With regards to access time; what is the difference between RWM and ROM? *[7]*

b) What is referred to as address space, and how is the capacity of memory calculated? Briefly describe the two ways of increasing the capacity of memory. *[6]*

c) Give the number of address bits required to address any word in a memory that contains the following number of words:

i. 1024

ii. 4096

iii. 64,536 *[6]*

d) Design a memory system that provides 16K of ROM immediately followed by 8K of RWM. The ROM starts at address 0000H, and is to be constructed using 8K X 8 EPROMS. Include a memory map of the system and a rough address decoding logic as part of the design. The memory system must interface to an 8085A microprocessor system bus.

[10]

e) Describe the two types of addressing decoding highlighting their respective differences. *[4]*

Q3.

a) Show how three state buffers can be used to share a bus between several source registers and destination registers, where the bus is bi-directional.

[6]

b) Is there a difference between Data structures and Data types? If Yes, explain. *[4]*

c) Using the ASCII and Baudot Tables given in Appendix A, code the following sentence in both formats:

This September, 2011: First EE481 exam! *[6]*

d) By aid of diagram(s), describe how excess 64 is used to reduce the space required to store large real numbers. Represent the following real numbers in excess 64 notation: (i) 18472, (ii) 1024

[8]

e) What are the major differences between baudot and ASCII codes? *[6]*

f) (i) Is Multi-programming the same as Multi-processing? If No, explain.

(ii) Multi-processing is further divided into two broad categories depending on the level of resource-sharing. Briefly describe these categories.

[4]

End.

APPENDIX A: BAUDOT AND ASCII CODING TABLES

Baudot Coding

Value	LTRS shift	FIGS shift	Value	LTRS shift	FIGS shift
3	A	-	23	Q	1
25	B	?	10	R	4
14	C	:	5	S	.
9	D		16	T	5
1	E	3	7	U	7
13	F	!	30	V	;
26	G	&	19	W	2
20	H	#	29	X	/
6	I	8	21	Y	6
11	J		17	Z	"
15	K	(	0	BLANK	BLANK
18	L	)	31	LTRS	LTRS
28	M	.	27	FIGS	FIGS
12	N	,	4	SPACE	SPACE
24	O	9	8	CR	CR
22	P	0	2	LF	LF

ASCII Coding

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
00	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	TAB	LF	VT	FF	CR	SO	SI
10	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
20		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
50	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
60	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

EE481-COMPUTER ENGINEERING

TEST

Instructions: Answer all the Questions

Question 1.

- Define the following terms
  1. Private
  2. Public
  3. Contractor
- Write a sample program, which will contains the listed terms above

Question 2.

- Assembly Language can be written using Mnemonic and Operands
  1. What are the purposes of Mnemonic and Operands when coding in Assembly.
  2. With an example, show how the two components are used within a program.
  3. Is there any difference between Machine and Assembly Language? Explain.

Question 3

- Explain the Three types of statements in assembly language
  1. Executable Instructions
  2. Assembler Directives
  3. Macros

Question 4

1. With Example list in order the Levels of Programming Languages

Question 5.

1. List down the components which make up the architecture of the CPU
2. With the help of the diagram show how the components listed above are connected.

END

Add R3, R4,

And R3,

QUIZ 2-COMPUTER ENGINEERING

QUESTION 1

i. JAVA is a high-level language. Explain what this means, and how then the computer gets to understand it.
ii. Describe how an instruction cycle works.

QUESTION 2

i. Define an assembler, a compiler and an interpreter. Then highlight the differences between a compiler and an interpreter, especially the manner in which they translate.

QUESTION 3

i. Write a simple program using classes, which will help a non-programmer to calculate the value of Z ,using this equation :***Z=X/Y***. Different values of X and Y may be entered by the user to determine the value of **Z**. Use Exception Handling in your program to catch an error if zero is stored in Y.

QUESTION 4

i. The registers in various subsystems of the microprocessor system are externally interconnected by the **system bus.** With the help of a diagram, explain show how the different registers are interconnected. ***Label correctly*** the buses and explain their purposes.
ii. Accessing information either from the register or the memory can be directly or indirectly (addressing).Explain how the CPU can archive these.

THE UNIVERSITY OF ZAMBIA
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UNIVERSITY SEMESTER I EXAMINATIONS DECEMBER 2011

EE 481
COMPUTER ENGINEERING

TIME:	Three hours.
ANSWER:	Five questions – All carry equal marks
APPENDICES:	APPENDIX A: Pin configuration for 8085A microprocessor

Question One

a) What distinguishes memory-mapped I/O systems from Standard I/O systems? What kind of address decoding logic is suitable for each type of system?

[4 marks]

b) List the fundamental steps that are followed when designing memory systems. Design the memory system that meets the following requirements:

- 8-bit word length
- 16-bit address bus
- 20K ROM
- 40K RAM

[6 marks]

c) What is a microprocessor? Summarize the functions of a microprocessor, and draw a simple μP architecture.

[6 marks]

d) d) Briefly explain the three basic modes of a Programmable Peripheral Interface.

[4 marks]

Question Two

a) Appendix A shows a simplified diagram of the 8085A pin configuration. Briefly describe the $AD_0 - AD_7$, $A_8 - A_{15}$, and the ALE pins giving particular attention to their relationship (if any). **[4 marks]**

b) Briefly describe the following data-addressing modes available in the 8086 Intel microprocessor:

- Register indirect
- Register relative
- Based-indexed
- Based –indexed relative **[4 marks]**

c) Given that:

(BX) = 234C (SI) = 1A50 (DS) = 2007 (IP) = 4A10

Displacement = 1010

Determine the Effective Address, and the resulting physical address for the addressing modes in (c) above. **[8 marks]**

d) A named research company recently designed an application (program) that requires a total memory capacity of 64K x 8bits. The problem, however, is that their parts supply can only supply 16K x 1bit memory chips. What would you suggest to the company as a comprise solution? *[Use memory map].*

[4 marks]

Question Three

a) Data transfer between a given source register and a destination register employ a single shared data bus, which is used by all other pairs (source and destination registers). Design a complete register-addressing system that allows bi-directional flow of data between eight registers.

[7 marks]

b) By aid of a diagram, describe and distinguish the three broad categorizations in which programming languages are placed, and how they subsequently interact with hardware.

[6 marks]

c) Explain the differences (if any) between data structures and data types, giving examples. **[4 marks]**

d) Excess 64 and normalization is a number-type used in some computer systems. Show how it's use reduces the space required to store large numbers. Represent the following real numbers in excess 64 notation: (i) 18472, (ii) 1024

[3 marks]

Question Four

a) What is Software development, and what are the general steps required during the process. These steps of software development are made easier by other computer programs; briefly describe any two such programs. **[7 marks]**

b) List any three functions that an I/O interface is expected to perform by default.

[3 marks]

c) Briefly describe any five major components inside a Personal Computer.

[5 marks]

d) What is system software and how is it different from application software? The hosts on which software is developed are generally categorized according to their power and type. Name any three of these hosts. **[5 marks]**

Question Five

a) The effective design of microprocessor systems requires knowledge/expertise in which three areas? By aid of a diagram/flowchart, Show the general steps followed in designing microprocessor based systems. **[4 marks]**

b) The power and appeal of personal computers is multi-faceted, but includes its seeming ability to run many programs/tasks at the same time. Is this ability multi-programming or multi-processing? What is the difference between these two?

[3 marks]

c) The BIOS initiates the boot sequence from the first device using a program called bootstrap loader. Briefly describe how the bootstrap loader loads the operating system before it hands over control to the same operating system. After the operating system is loaded, it's tasks fall in six broad categories; List them.

[6 marks]

d) Explain why the desktop computer is one special purpose system also referred to as a "general" purpose system. List any three of the major considerations/goals in Operating-System Design, and what are the basic interfaces that an operating system is expected to provide.

[7 marks]

Question Six

a) Briefly describe the two fundamental (and complementary) inter-process communication schemes that are used in computers.

[4 marks]

b) Design a memory system that provides 16K of ROM immediately followed by 8K of RWM. The ROM starts at address 0000H, and is to be constructed using 8K X 8 EPROMS. Include a memory map of the system and a rough address decoding logic as part of the design. **[6 marks]**

c) An 8085A microcomputer system can be constructed with Standard ROM and RWM or with specially designed ICs that contain memory or I/O ports. Draw a microcomputer system using standard ROM and RWM, and briefly explain how it references respective memory. **[6 marks]**

d) It is imperative for a system to know the readiness of the I/O interface prior to data transfer in either direction. The system can use either one or a composite of the following modes; Programmed I/O, Interrupt-program controlled I/O and Block transfers. Briefly describe two of these modes. **[4 marks]**

Question Seven

a) Distinguish Serial communication from parallel communication. Briefly describe the two types of serial communication, citing examples where possible, and conditions where either is faster than the other.

[2 marks]

b) What is an instruction cycle and how is it different from a machine cycle? List the any four (4) machine cycles typical in an 8085A microprocessor. **[6 marks]**

c) Briefly describe the 8086 microprocessor, clearly outlining it's two broad internal units with their respective roles, and constituent registers. **[6 marks]**

d) Design an interconnected network (including IP addressing using 192.168.1.0 and 192.168.2.0 as the main network-addresses for hosts (computers, switches, and internal interface on routers) and links, respectively). The following configurations exist for the three networks:

Network A: Six (6) computers, a Switch, and a Router.

Network B: Three (3) desktops, a switch, and a Router

Network C: Twenty-six (26) desktops, two (2) switches, and a router

Note. Every link should be a distinct network with only two usable IP addresses. Also note that each router has two serial interfaces (S0 and S1) used for WAN interconnection, and an Ethernet interface E0 for the LAN. **[6 marks]**

Question Eight

a) C++ is a high-level language. Explain what this means, and how then the computer gets to understand it. **[4 marks]**

b) Determine the fraction of CPU cycles used on a floppy disk that transfers data to the microprocessor in 16-bit units and has a transfer rate of 50KB/sec. Assume the following: 400cycles for a polling operation, and a 500MHz clock speed.

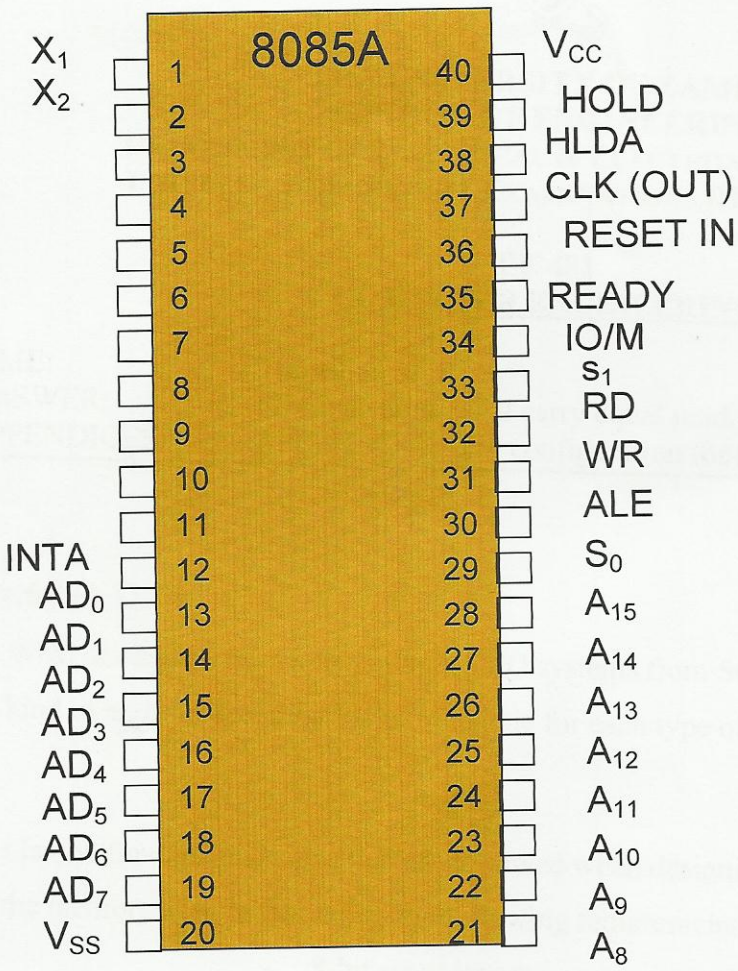
[6 marks]

c) Write a C++ program that addresses the problem below [include flowchart]:

Problem: You have recently developed a gadget that takes three SIM Cards and can operate as a phone. [You have gone ahead and acquired SIM cards for Airtel (id. 097), Zamtel (id. 096) and MTN (id. 095)]. You now want to write the code to allow the gadget to choose which SIM card to use depending on the network the destination [called] number is on. E.g. if calling 095 123456; the gadget should use the Zamtel SIM card. **[10 marks]**

End of Exam. All the best!!!

APPENDIX A: 8085A μP pin configuration



Due date : Friday, 7th Oct, 2011

EE 481 Assignment Two-Memory and Microprocessors

1.

(a) Explain the difference between memory-mapped I/O and isolated/standard I/O.

(b) Design a fully-decoded memory system for a 16-bit address bus system based on:

- 8K ROM using 4K x 1 ROMs,
- 2K RAM using 2K x 4 RAMs, and
- a 1 out-of-8 decoder.

Use a memory map to illustrate this.

2.

(a) Highlight the differences between system architecture and microprocessor architecture.

(b) Given than
(BX) = 637D (SI) = 2A9B Displacement = C237
Determine the Effective Address (if applicable) and the resultant physical address resulting from these registers and the following addressing modes:

i) Immediate
ii) Direct
iii) Register using BX
iv) Register indirect using BX
v) Register relative using BX
vi) Based indexed
vii) Based indexed relative

(c) Given that:
(IP) = 2BC0 (CS) = 0200 Displacement = 5119 (BX) = 1200
(DS) = 212A (224A0) = 0600 (275B9) = 098A
Find the branch address for the branch instruction that uses:

i) Intrasegment direct addressing
ii) Intrasegment indirect addressing which uses BX register and register addressing
iii) Intrasegment indirect addressing which uses BX register and register relative addressing.

3. What is meant by Segment overlap? Explain why each subsequent segment during segment overlap has to start at an address that is divisible by 16_{10}.

THE UNIVERSITY OF ZAMBIA
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UNIVERSITY SEMESTER I EXAMINATIONS DECEMBER 2011

EE 481
COMPUTER ENGINEERING

TIME:	Three hours.
ANSWER:	Five questions – All carry equal marks
APPENDICES:	APPENDIX A: Pin configuration for 8085A microprocessor

Question One

a) What distinguishes memory-mapped I/O systems from Standard I/O systems? What kind of address decoding logic is suitable for each type of system?

[4 marks]

b) List the fundamental steps that are followed when designing memory systems. Design the memory system that meets the following requirements:

- 8-bit word length
- 16-bit address bus
- 20K ROM
- 40K RAM

[6 marks]

c) What is a microprocessor? Summarize the functions of a microprocessor, and draw a simple μP architecture.

[6 marks]

d) d) Briefly explain the three basic modes of a Programmable Peripheral Interface.

[4 marks]

Question Two

a) Appendix A shows a simplified diagram of the 8085A pin configuration. Briefly describe the $AD_0 - AD_7$, $A_8 - A_{15}$, and the ALE pins giving particular attention to their relationship (if any). **[4 marks]**

b) Briefly describe the following data-addressing modes available in the 8086 Intel microprocessor:

- Register indirect
- Register relative
- Based-indexed
- Based –indexed relative **[4 marks]**

c) Given that:

(BX) = 234C (SI) = 1A50 (DS) = 2007 (IP) = 4A10

Displacement = 1010

Determine the Effective Address, and the resulting physical address for the addressing modes in (c) above. **[8 marks]**

d) A named research company recently designed an application (program) that requires a total memory capacity of 64K x 8bits. The problem, however, is that their parts supply can only supply 16K x 1bit memory chips. What would you suggest to the company as a comprise solution? *[Use memory map].*

[4 marks]

Question Three

a) Data transfer between a given source register and a destination register employ a single shared data bus, which is used by all other pairs (source and destination registers). Design a complete register-addressing system that allows bi-directional flow of data between eight registers.

[7 marks]

b) By aid of a diagram, describe and distinguish the three broad categorizations in which programming languages are placed, and how they subsequently interact with hardware.

[6 marks]

c) Explain the differences (if any) between data structures and data types, giving examples. **[4 marks]**

d) Excess 64 and normalization is a number-type used in some computer systems. Show how it's use reduces the space required to store large numbers. Represent the following real numbers in excess 64 notation: (i) 18472, (ii) 1024

[3 marks]

Question Four

a) What is Software development, and what are the general steps required during the process. These steps of software development are made easier by other computer programs; briefly describe any two such programs. **[7 marks]**

b) List any three functions that an I/O interface is expected to perform by default.

[3 marks]

c) Briefly describe any five major components inside a Personal Computer.

[5 marks]

d) What is system software and how is it different from application software? The hosts on which software is developed are generally categorized according to their power and type. Name any three of these hosts. **[5 marks]**

Question Five

a) The effective design of microprocessor systems requires knowledge/expertise in which three areas? By aid of a diagram/flowchart, Show the general steps followed in designing microprocessor based systems. **[4 marks]**

b) The power and appeal of personal computers is multi-faceted, but includes its seeming ability to run many programs/tasks at the same time. Is this ability multi-programming or multi-processing? What is the difference between these two?

[3 marks]

c) The BIOS initiates the boot sequence from the first device using a program called bootstrap loader. Briefly describe how the bootstrap loader loads the operating system before it hands over control to the same operating system. After the operating system is loaded, it's tasks fall in six broad categories; List them.

[6 marks]

d) Explain why the desktop computer is one special purpose system also referred to as a "general" purpose system. List any three of the major considerations/goals in Operating-System Design, and what are the basic interfaces that an operating system is expected to provide.

[7 marks]

Question Six

a) Briefly describe the two fundamental (and complementary) inter-process communication schemes that are used in computers.

[4 marks]

b) Design a memory system that provides 16K of ROM immediately followed by 8K of RWM. The ROM starts at address 0000H, and is to be constructed using 8K X 8 EPROMS. Include a memory map of the system and a rough address decoding logic as part of the design. **[6 marks]**

c) An 8085A microcomputer system can be constructed with Standard ROM and RWM or with specially designed ICs that contain memory or I/O ports. Draw a microcomputer system using standard ROM and RWM, and briefly explain how it references respective memory. **[6 marks]**

d) It is imperative for a system to know the readiness of the I/O interface prior to data transfer in either direction. The system can use either one or a composite of the following modes; Programmed I/O, Interrupt-program controlled I/O and Block transfers. Briefly describe two of these modes. **[4 marks]**

Question Seven

a) Distinguish Serial communication from parallel communication. Briefly describe the two types of serial communication, citing examples where possible, and conditions where either is faster than the other.

[2 marks]

b) What is an instruction cycle and how is it different from a machine cycle? List the any four (4) machine cycles typical in an 8085A microprocessor. **[6 marks]**

c) Briefly describe the 8086 microprocessor, clearly outlining it's two broad internal units with their respective roles, and constituent registers. **[6 marks]**

d) Design an interconnected network (including IP addressing using 192.168.1.0 and 192.168.2.0 as the main network-addresses for hosts (computers, switches, and internal interface on routers) and links, respectively). The following configurations exist for the three networks:

Network A: Six (6) computers, a Switch, and a Router.

Network B: Three (3) desktops, a switch, and a Router

Network C: Twenty-six (26) desktops, two (2) switches, and a router

Note. Every link should be a distinct network with only two usable IP addresses. Also note that each router has two serial interfaces (S0 and S1) used for WAN interconnection, and an Ethernet interface E0 for the LAN. **[6 marks]**

Question Eight

a) C++ is a high-level language. Explain what this means, and how then the computer gets to understand it. **[4 marks]**

b) Determine the fraction of CPU cycles used on a floppy disk that transfers data to the microprocessor in 16-bit units and has a transfer rate of 50KB/sec. Assume the following: 400cycles for a polling operation, and a 500MHz clock speed.

[6 marks]

16-bit 50KB/s

floppy 400cycles × 50KB/s × 1/16bit

40000 cycle × 50×1024bits/s × 1/16bits

c) Write a C++ program that addresses the problem below [include flowchart]:

Problem: You have recently developed a gadget that takes three SIM Cards and can operate as a phone. [You have gone ahead and acquired SIM cards for Airtel (id. 097), Zamtel (id. 096) and MTN (id. 095)]. You now want to write the code to allow the gadget to choose which SIM card to use depending on the network the destination [called] number is on. E.g. if calling 095 123456; the gadget should use the Zamtel SIM card. **[10 marks]**

End of Exam. All the best!!!

MWANSA MUSINDA RODRICK
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THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING
UNIVERSITY SEMESTER I EXAMINATIONS NOVEMBER 2009

EE 481
COMPUTER ENGINEERING

TIME:	Three hours.
ANSWER:	Five questions – All carry equal marks
APPENDICES:	APPENDIX A: Pin configuration for 8085A microprocessor APPENDIX B: ASCII and Baudot Codes.

Question One

a) The effective design of microprocessor systems requires knowledge/expertise in which three areas? By aid of a diagram/flowchart, Show the general steps followed in designing microprocessor based systems. **[7marks]**

b) What distinguishes memory-mapped I/O systems from Standard I/O systems? What kind of address decoding logic is suitable for each type of system? **[4marks]**

c) List the fundamental steps that are followed when designing memory systems. Design a memory system that provides 16K of ROM immediately followed by 8K of RWM. The ROM starts at address 0000H, and is to be constructed using 8K X 8 EPROMS. Include a memory map of the system and a rough address decoding logic as part of the design. **[6marks]**

d) Briefly explain the three basic modes of a Programmable Peripheral Interface. **[3marks]**

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09

Question Two

a) An 8085A microcomputer system can be constructed with Standard ROM and RWM or with specially designed ICs that contain memory or I/O ports. Draw a microcomputer system using standard ROM and RWM, and briefly explain how it references respective memory. **[8marks]**

b) It is imperative for a system to know the readiness of the I/O interface prior to data transfer in either direction. The system can use either one or a composite of the following modes; Programmed I/O, Interrupt-program controlled I/O and Block transfers. Briefly describe these modes. **[3marks]**

c) Distinguish Serial communication from parallel communication. Briefly describe the two types of serial communication, citing examples where possible, and conditions where either is faster than the other.

[4marks]

d) A fifth year project student in the School of Electrical Engineering designed an application (program) that requires a total memory capacity of 18K x 8bits. The problem, however, is that School only managed to source 4K x 8bit memory chips. If he/she asked you for assistance in this regard; what would you propose? *[Use memory map and include addresses].*

[5 marks]

Question Three

a) What is a microprocessor? Summarize the functions of a microprocessor, and draw a simple μP architecture. **[6 marks]**

b) What is an instruction cycle and how is it different from a machine cycle? List the any six (6) machine cycles typical in an 8085A microprocessor.

[6 marks]

c) Briefly describe the following data-addressing modes available in the 8086 Intel microprocessor:

- Register indirect
- Register relative

- Based-indexed
- Based –indexed relative **[4 marks]**

d) Given that:

(BX) = 234C (SI) = 1A50 (DS) = 2008 (IP) = 4A10

Displacement = 1010

Determine the Effective Address, and the resulting physical address for the addressing modes in (c) above. **[4 marks]**

Question Four

a) By aid of a diagram, describe and distinguish the three broad categorizations in which programming languages are placed, and how they subsequently interact with hardware.

[4 marks]

b) Briefly describe the 8086 microprocessor, clearly outlining it's two broad internal units with their respective roles, and constituent registers.

[8 marks]

c) Explain the major characteristics of ASCII and Baudot codes, and highlight their differences and limitations. Using the ASCII and Baudot Tables given in Appendix B, code the following sentence in both formats:

This November, 2009: Easy-going EE481 exam!

[4 marks]

d) List any four functions that an I/O interface is expected to perform by default.

[4 marks]

Question Five

a) What is Software development, and what are the general steps required during the process. These steps of software development are made easier by other computer programs; briefly describe any two such programs. **[6 marks]**

b) Is 'Handshaking' the same as a 'protocol'? If not, describe the two and explain their interaction and/or relationship. **[3 marks]**

c) Determine the fraction of CPU cycles used on a floppy disk that transfers data to the microprocessor in 16-bit units and has a transfer rate of 50KB/sec. Assume the following: 400cycles for a polling operation, and a 500MHz clock speed . **[6 marks]**

d) What is system software and how is it different from application software? The hosts on which software is developed are generally categorized according to their power and type. Name any three of these hosts. **[5 marks]**

Question Six

a) The power and appeal of personal computers is multi-dimensional, but includes it's seeming ability to run many programs/tasks at the same time. Is this ability multi-programming or multi-processing? What is the difference between these two? **[3 marks]**

b) The BIOS initiates the boot sequence from the first device using a program called bootstrap loader.

i. Briefly describe how the bootstrap loader loads the operating system before it hands over control to the same operating system. **[3 marks]**

ii. After the operating system is loaded, it's tasks fall in six broad categories; List them. **[3 marks]**

c) Explain why the desktop computer is one special purpose system also referred to as a "general" purpose system. List any four of the major considerations/goals in Operating-System Design, and what are the basic interfaces that an operating system is expected to provide. **[7 marks]**

d) State the fundamental steps that are followed when designing memory systems. What is referred to as address space, and how is the capacity of memory calculated? Briefly describe the two ways of increasing the capacity of memory. **[4 marks]**

Question Seven

a) What is DMA? DMA is commonly used for three types of data transfer: burst, cycle stealing, and transparent. Assuming a burst-type DMA system, list the steps followed in such data transfer. **[5 marks]**

b) Appendix A shows a simplified diagram of the pin configuration of an 8085A microprocessor. Briefly describe the $AD_0 - AD_7$, $A_8 - A_{15}$, and the ALE pins giving particular attention to their relationship (if any). **[4 marks]**

c) Name the algorithm that Ethernet uses to "ensure" that only one device successfully sends traffic at any given time. List the steps of this algorithm and draw a corresponding flowchart. **[3 marks]**

d) Multi-processing is further divided into two broad categories depending on the level of resource-sharing. Briefly describe these categories. **[4 marks]**

e) What is a data logger? Who uses data loggers and how do they operate? **[4 marks]**

Question Eight

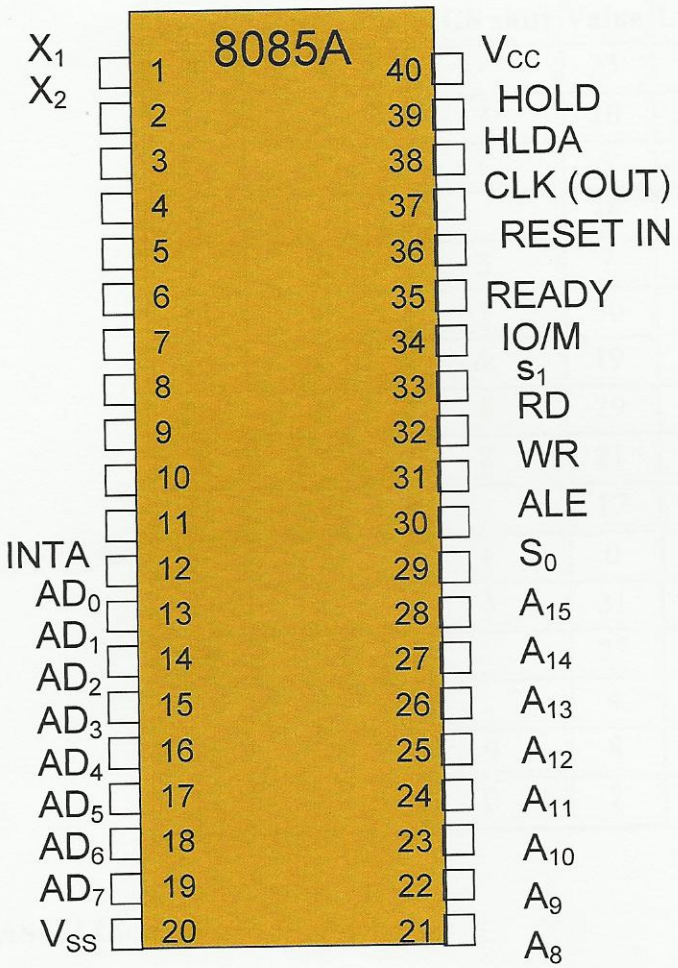
a) C++ is a high-level language. Explain what this means relative to the other types of languages. Include an explanation of how then the computer gets to understand it. **[6 marks]**

b) Write a provisional C++ program [Source code] that addresses the problem below [include flowchart]:

Problem: You have recently developed a gadget that takes three SIM Cards and can operate as a phone. [You have gone ahead and acquired SIM cards for Celtel (id. 097), Cell Z (id. 096) and MTN (id. 095)]. You now want to write the code to allow the gadget to choose which Zambian SIM card to use depending on the network the destination number is on. E.g. if calling 095 123456; the gadget should use the Cell Z SIM card. **[14 marks]**

End of Exam. All the best!!!

APPENDIX A: 8085A μP pin configuration



APPENDIX B: BAUDOT AND ASCII CODING TABLES

Baudot Coding

Value	LTRS shift	FIGS shift	Value	LTRS shift	FIGS shift
3	A	-	23	Q	1
25	B	?	10	R	4
14	C	:	5	S	.
9	D		16	T	5
1	E	3	7	U	7
13	F	!	30	V	;
26	G	&	19	W	2
20	H	#	29	X	/
6	I	8	21	Y	6
11	J		17	Z	"
15	K	(	0	BLANK	BLANK
18	L	)	31	LTRS	LTRS
28	M	.	27	FIGS	FIGS
12	N	,	4	SPACE	SPACE
24	O	9	8	CR	CR
22	P	0	2	LF	LF

ASCII Coding

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
00	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	TAB	LF	VT	FF	CR	SO	SI
10	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
20		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
50	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
60	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

Kapupo

THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Assignment NO.1

(EE431 – Electronics, EE441 - Electronic Engineering II)

16 Aug 2011

Q1

Draw the energy band diagram of a conductor, an insulator and a semiconductor. Comment on the conductivity of the 3 materials with reference to the number of free electrons in the materials at room temperature.

Q2

Find the electron concentration and the hole concentration of N-type Si

semiconductor with donor concentration of $1.2\times10^{24}m^{-3}$,

Determine the position of the Fermi level in this semiconductor from the intrinsic semiconductor Fermi level E_i at room temperature (300K),
and sketch the energy band diagram.

$$n_i = 1.5\times10^{16}m^{-3}.$$

Q3

Name two examples of the elements that can be used as donor and acceptor impurities.
Explain how the majority carriers are formed in the extrinsic semiconductors.

PLIZ GOD BLESS THEM JAH PIPO

LET THEM HERB SMOKERS FREE!

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY SEMESTER I EXAMINATIONS NOVEMBER 2010

EE431
Electronics

EE441
Electronic Engineering II

TIME : *Three (3) hours*

ANSWER : *Any FIVE (5) Questions*

Some useful constants

Boltzmann constant $k=1.38\times10^{-23}\ JK^{-1}$, electron charge $q=1.6\times10^{-19}\ C$

Silicon intrinsic carrier concentration at room temperature (300K) $n_i=1.5\times10^{16}\ m^{-3}$

QUESTION 1

(a)Explain the Fermi level and the meaning of the Fermi-Dirac distribution function.

(8marks)

(b)Determine the position of the Fermi level of N-type Si semiconductor which has donor concentration of $10^{16}cm^{-3}$ from the bottom level of the conduction band. Where Si is in the equilibrium condition at temperature of 300k, and effective density of states in the conduction band N_C is $2.8\times10^{19}\ cm^{-3}$. ***(4marks)***

(c) If the effective mass of a hole is equal to twice the effective mass of an electron, determine the position of the Fermi level in an intrinsic semiconductor from the centre of forbidden gap at room temperature of 300K. ***(3marks)***

(d) Consider the Si semiconductor with phosphorus concentration of $3\times10^{22}\ m^{-3}$. If boron is added to this semiconductor by the concentration of $10^{23}m^{-3}$.

(1)Is this semiconductor N-type or P-type? ***(1mark)***

(2)Determine the hole concentration and electron concentration in this semiconductor. ***(2marks)***

(3)Determine the position of the Fermi level in this semiconductor from the intrinsic semiconductor Fermi level E_i. Temperature is 300K. ***(2marks)***

QUESTION 2

(a) A piece of P-type silicon semiconductor with a resistivity of 0.06Ω.m has carrier drift velocity of 2×10^3 m/s in an applied electric field of 10^5 V/m. Calculate the majority carrier and minority carrier concentration in this piece of silicon at room temperature (300K). The conductivity of the minority carrier is negligible.

(3marks)

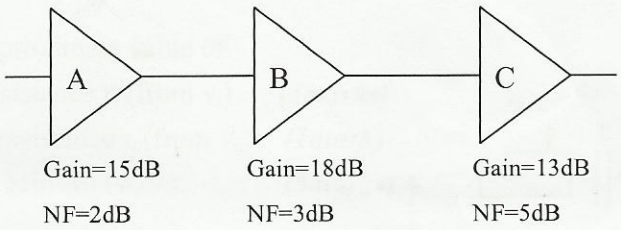
(b) The resistance of an intrinsic semiconductor at room temperature(300K) was 5.5MΩ. The resistance was reduced to 125Ω when the material was doped with acceptor impurities. If there were 10^{22} acceptor/m^3 of impurities and the mobility of the electron is 2.8 times more than the mobility of hole, calculate the concentration of the electron-hole pair in the intrinsic specimen. The conductivity of the minority carrier is negligible. ***(3marks)***

(c) Consider an intrinsic Si semiconductor that has length L=0.8cm,
Cross-section area s=15x15mm^2, DC voltage across it V=20V,
μ_n=0.14 m^2/V.s , μ_p=0.05m^2/V.s. Temperature is 300K. Calculate the,
(1) Electron and hole velocity *(2marks)*
(2) Total current flowing through the semiconductor *(1mark)*

(d) (1) Explain the working principle of light emitting diode (LED) and photo diode. *(9marks)*
(2)Give their practical applications. (giving one example for each of them) *(2marks)*

QUESTION 3

(a)Explain the built-in potential of a PN junction. *(8marks)*
(b)Calculate the built-in potential for a silicon PN junction at room temperature (300k), when P- region has an acceptor concentration of $1.2\times10^{23}m^{-3}$, and N- region has a donor concentration of $2.0\times10^{23}m^{-3}$. *(4marks)*
(c)For the three stage amplifier,
(1)Calculate the total noise figure. *(4marks)*
(2)Which stage is most critical in determining the total NF?
Explain the reason. *(4marks)*



QUESTION 4

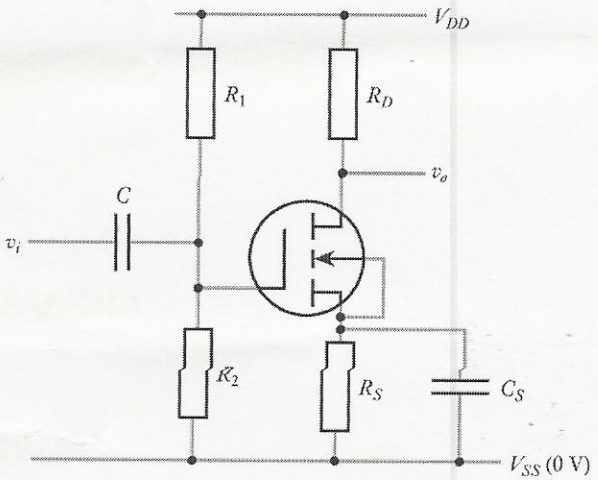
(a)Explain the early effect of BJT. *(8marks)*
(b)Explain the two methods of BJT biasing and their advantages and disadvantages. *(8marks)*
(c) Assume that mobility of hole in the semiconductor is 0.5m^2 /V.s.
Determine the average time between collisions of this hole.
Where effective mass of hole (m_p^*) is 0.55 times the rest mass of an electron in vacuum(m_o). $m_o=9.1\times10^{-31}$kg *(4marks)*

QUESTION 5

(a)N-MOS FET amplifier in the circuit has a voltage gain (v_o/v_i) of -10, input resistance of 100kΩ. Assume V_{GS}=3V, V_{DS}=5V, I_D=5mA, r_d=∞, $I_D=k(V_{GS}-V_T)^2$, k=2mA/V^2, V_{DD}=15V, $C=C_S=\infty$.

Determine the approximate value of

R_1, R_2, R_D, R_S. ***(12marks)***



(b)Explain the non-linear (harmonic) distortion.

(8marks)

QUESTION 6

(a)For the CE amplifier circuit, R_S=5kΩ, R_1=30kΩ, R_2=5kΩ, R_C=5kΩ, R_{E1}=500Ω, R_{E2}=1kΩ, $C=C_E=\infty$, V_{CC}=20V, $h_{re}=h_{oe}=0$.

The DC bias base current is negligible. Take transistor β=100.

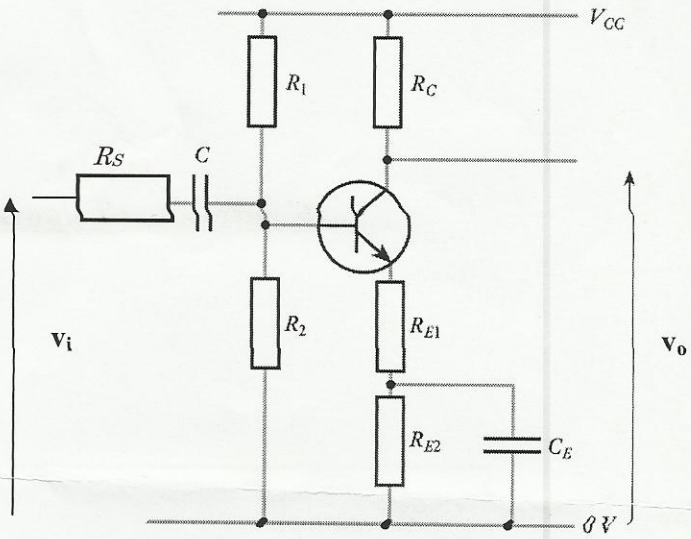
Use $r_e=0.026/I_E(\Omega)$, V_{BE}=0.7V

Find the approximate value of

(1) Input resistance r_i (from v_i) ***(4marks)***

(2) Output resistance r_o(from v_o) ***(1mark)***

(3) Voltage gain A_V (v_o/v_i) ***(5marks)***



(b)Draw the basic construction, the current-voltage characteristic curves and the equivalent circuit of SCR (silicon-controlled rectifier) and explain how it works.

(10marks)

THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING
Semester I mid-break test June 2008
EE431/441
Electronics/ Electronic Engineering III

Time: 2 Hours

Answer all questions in section A. Answer any 1 question in section B for EE431 and any 1 question in section C for EE441.

Section A

1.

a) Which are the most commonly used semiconductors and why? [12.5 marks]

b) What do you understand by intrinsic and extrinsic semiconductors? [12.5 marks]

2.

a) Using the Maxwell equations derive the continuity equation for charge conservation. **[18 marks]**

b) Explain the physical meaning of the continuity equation. [7 marks]

3.

a) Calculate the resistivity of intrinsic silicon at room temperature given the following parameters

i. $n = p = n_i = 1010/cm^3$

ii. $q = 1.60 \times 10^{-19}$.

iii. μn = 1350 $cm^2/V{\cdot}s$ and μp = 500 $cm^2/V{\cdot}s$ at room temperature.**[20 marks]**

b) Explain the conductivity of semiconductors and insulators using the energy band theory. **[5 marks]**

Section B - Optoelectronics

4.

a) Using a circuit diagram, describe the protection of LEDs against reverse bias explaining the use of every element in your circuit. [12.5 marks]

b) What value of series resistor is required to limit the current through a LED to 30mA with a forward voltage drop of 1.6V when connected to a 10V supply. **[12.5 marks]**

5.

a) Determine the resistance of a photodiode assuming a reverse biased voltage of 10V and sensitivity of $37.4\mu A/mW/cm^2$ when exposed to to light with an illumination of $2.5mW/cm^2$. **[12.5 marks]**

b) Explain the following

i. Working principle of a photodiode **[10 marks]**

ii. Dark resistance **[2.5 marks]**

Section B – Noise and distortion

6.

a) What method is used to control flicker noise. Explain your answer.[10 **marks]**

b) Show that the total average power of a resistor in a certain frequency band is $4kT\Delta f$. .**[15 marks]**

7.

a) Describe the following in detail:

i. Shot noise

ii. Thermal noise

iii. Flicker noise **[15 marks]**

b) Explain the difference between the following;

i. Noise figure and noise factor

ii. Noise power and power spectral density **[10 marks]**

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY SEMESTER I EXAMINATIONS DECEMBER, 2011

EE431 **Electronics**

EE441 **Electronic Engineering II**

Time: Three hours.
Answer: Any five questions.

Some useful constants and variables

Boltzmann constant k=1.38×10^{-23} JK^{-1}, Electron charge q=1.6×10^{-19} C,

Temperature T=300K, Silicon intrinsic carrier concentration at 300K, n_i=1.5×10^{16} m^{-3},

QUESTION 1

(a) In a intrinsic semiconductor, consider the energy level lying 0.5eV under the bottom level of the conduction band. Assume the energy band gap E_g=1.1eV. What is the probability of this level not being occupied by an electron? ***(3marks)***

(b) Consider the *Si* semiconductor with indium concentration of 3×10^{22} m^{-3}.

If arsenic is added to this semiconductor by the concentration of 10^{23}m^{-3}.

(1)Determine the hole concentration and electron concentration in this semiconductor. ***(4marks)***

(2)Determine the position of the Fermi level in this semiconductor from the intrinsic Fermi level E_i. ***(3marks)***

(c) Explain how the built-in potential is created in a PN-junction, and derive an expression for the built-in potential. ***(10marks)***

QUESTION 2

(a) Consider an intrinsic *Si* semiconductor that has length L=0.8cm,

Cross-section area S=15x15mm^2, DC voltage across it V=16V,

μ_n=0.14 m^2/V.s , μ_p=0.05m^2/V.s. Calculate the,

(1) Electron and hole velocity ***(2marks)***

(2) Total current flowing through the semiconductor ***(2marks)***

(b) The resistance of an intrinsic semiconductor was 8MΩ.

The resistance was reduced to 150Ω when the material was doped with antimony impurities. If the concentration of impurities is 10^{22} m^{-3} and the mobility of the electron is 2.5 times more than the mobility of the hole,

calculate the concentration of the electron-hole pair in the intrinsic specimen.

The conductivity of the minority carriers is negligible. ***(6marks)***

(c)Explain the Early effect of a BJT and what causes the Early effect. ***(10marks)***

QUESTION 3

(a)Determine the current density and total current of a forward biased silicon PN-junction diode which has a cross-section area S =1mm^2,

acceptor concentration N_a=2×10^{22}m^{-3}, donor concentration N_d=10^{24}m^{-3},

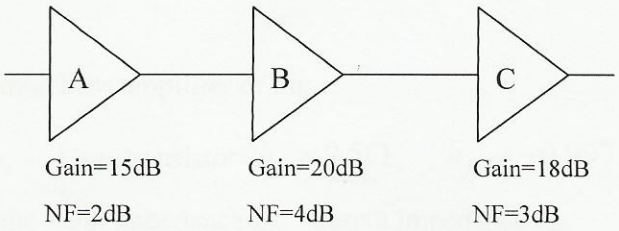
diffusion constant D_n=30cm^2/s, D_p=10cm^2/s,

diffusion length L_n=60μm, L_p=20μm, applied voltage V_D=0.6V, ***(5marks)***

(b)For the three stage amplifier,

(1)Calculate the total noise factor (F_T) and total noise figure (NF_T). ***(3marks)***

(2)Which stage is the most critical in determining the total noise figure? Explain the reason. ***(2marks)***



(c)Explain the working principle and current characteristics of a photodiode Give its practical applications (2examples) ***(10marks)***

QUESTION 4

(a) For the common emitter amplifier of Fig.

V_{BE}=0.7V. $r_o = \infty$, C=C_E=∞. $r_e = 26mV / I_E(\Omega)$

Determine: ***(10marks)***

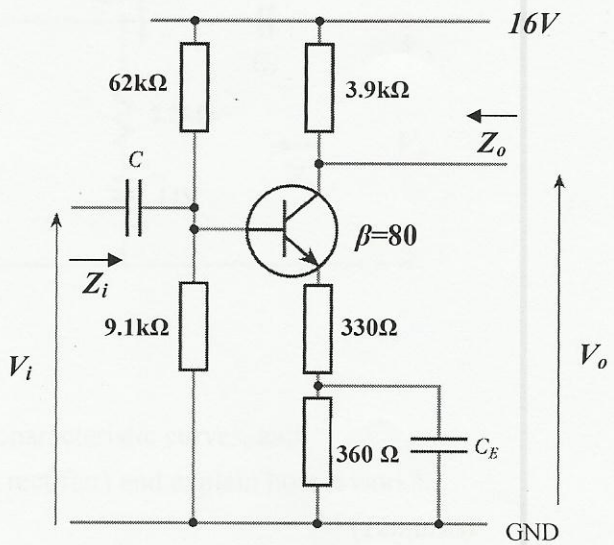
a. I_{BQ}

b. I_{CQ}

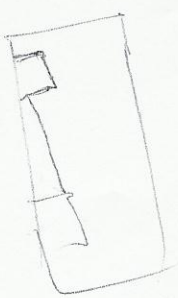
c. Z_i

d. Z_o

d. A_v (V_o /V_i)



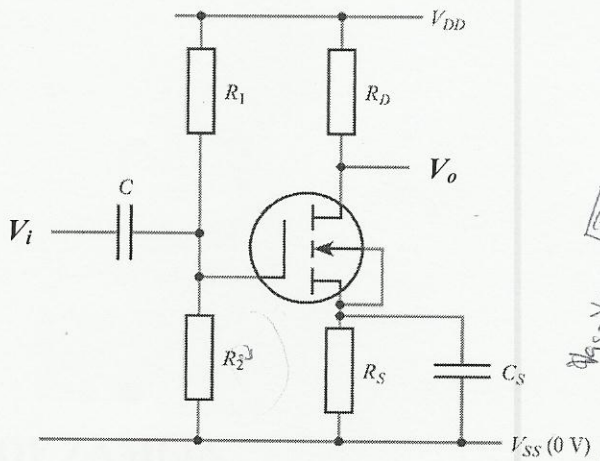
(b)Explain the structure, working principle, and pinch-off of the N-channel depletion-type MOSFET. ***(10marks)***



QUESTION 5

(a)N-MOS FET amplifier in the circuit has a voltage gain (V_o/V_i) of -10, input resistance of 100kΩ. Assume V_{GS}=3V, V_{DS}=5V, I_D=5mA, r_d=∞, I_D=k $(V_{GS}-V_T)^2$, k=2mA/V^2, V_{DD}=15V, C=C_S=∞.

Determine the approximate values of R_1, R_2, R_D, R_S. ***(12marks)***



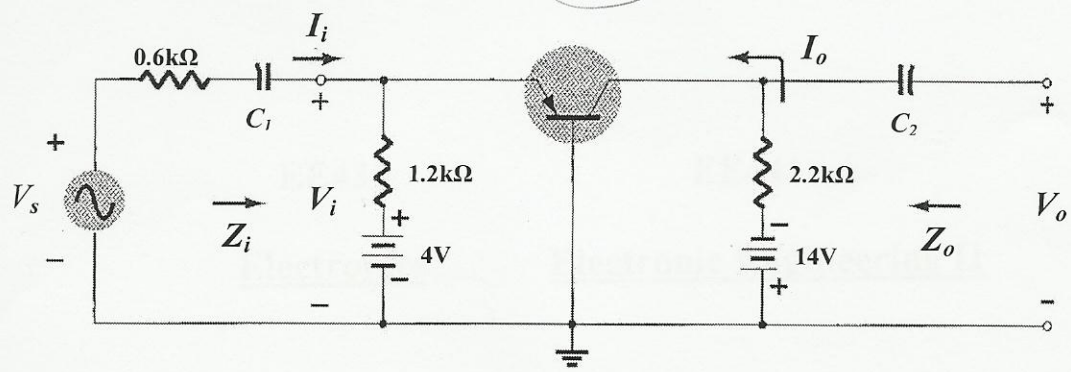
(b)Explain the harmonics and the non-linear(harmonic) distortion ***(8marks)***

QUESTION 6

(a)For the common base amplifier of Fig.

C_1=C_2=∞, Use transistor $h_{ib}=9.5\Omega$, $h_{fb}=-0.997$, $h_{rb}=h_{ob}=0$

Determine the input impedance Z_i, output impedance Z_o, voltage gain A_V (V_o/V_i), voltage gain A_{VS} (V_o/V_S), current gain A_i (I_o/I_i) ***(8marks)***



(b)Draw the basic construction, the current-voltage characteristic curves, and the equivalent circuit of SCR (silicon-controlled rectifier) and explain how it works. ***(12marks)***

END OF EXAMINATION EE431, 441

THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

EE 471 - 2010 Test

TIME: **1hr 45 mins**
Attempt **ALL** the questions.

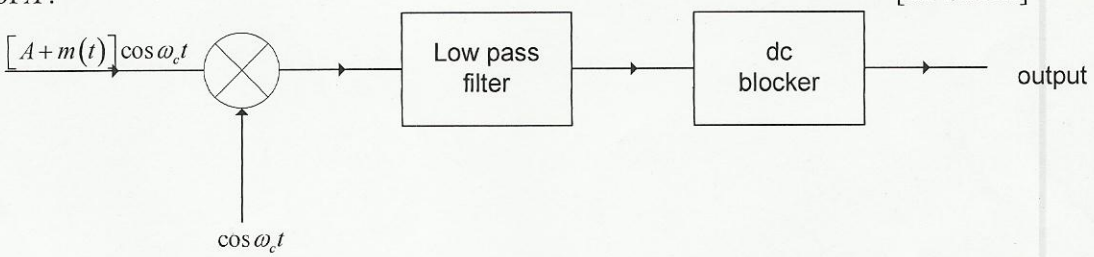
Q1.

a. With the help of a diagram and appropriate mathematical equations, describe how each of the following component works:

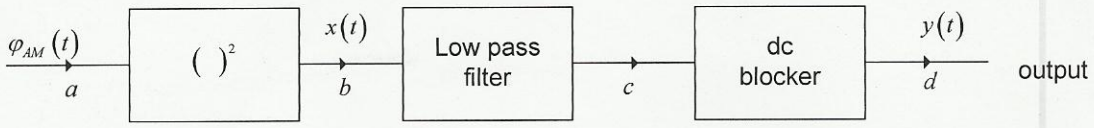
i.	Nonlinear modulator as a DSB – SC modulator	[5 Marks]
ii.	Switching modulator as a DSB – SC modulator	[5 Marks]
iii.	Switching modulators in generation of AM signals	[6 Marks]
iv.	Rectifier detector in the demodulation of AM signals	[7 Marks]
v.	Envelope detector in the demodulation of AM signals	[7 Marks]

Q2.

a. The figure below shows a scheme for synchronous demodulation. Show that this scheme can demodulate the AM signal $\left[A+m(t)\right]\cos\omega_c t$ regardless of the value of A. [12 Marks]



b. In the early days of radio, AM signals were demodulated by a crystal detector followed by a low – pass filter and a dc blocker as shown below. Assume a crystal detector to be basically a squaring device.



i.	Determine the signals at points a, b, c and d	[12 Marks]
ii.	Point out the distortion term in the output $y(t)$	[3 Marks]
iii.	Show that if A » |m(t)|, the distortion is small	[5 Marks]

c. You are asked to design a DSB – SC modulator to generate a modulated signal $km(t)\cos\omega_c t$ with the carrier frequency $f_c = 300\,kHz$ $(\omega_c = 2\pi \times 300,000)$. The following equipment is available: 1. A signal generator of frequency 100 kHz; 2. A series – bridge diode modulator; 3. A bandpass filter tuned to 300 kHz

i. Show how you can generate the desired signal [12 Marks]

ii. If the output of the modulator is $km(t)\cos\omega_c t$, find k [6 Marks]

THE UNIVERSITY OF ZAMBIA
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DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

2011/2012 ACADEMIC YEAR SEMESTER I

EE 471: TELECOMMUNICATION

INSTRUCTIONS **TIME: THREE HOURS**

1. **ANSWER ANY FIVE QUESTIONS**
2. **SHOW ALL THE WORKING LEADING TO THE SOLUTION**

1. Question One

a) Classify the following signals as energy signals or power signals and find the normalised energy or normalised power of each

i) $x(t) = 7\cos 2\pi f_0 t \ \ for -\infty < t < \infty$ [8]

ii) $\begin{cases} 16e^{(-at)} & for\ t > 0, a > 0 \\ 0 & elsewhere \end{cases}$ [8]

b) State two advantages and disadvantages of Angle Modulation. [4]

2. Question Two

a) What is the major drawback of PSK [2]

b) For the Angle Modulated signal in time domain,

i) State its general equation. [3]

iii) Derive the equation for the resulting FM wave. [3]

c) A receiver is tuned to receive the lower sideband (LSB) of a radio-frequency (RF) carrier wave with frequency, f_c=8 MHz. The bandwidth of the LSB signal is 100 kHz. The receiver employs a local oscillator (LO) with frequency, f_{lo}, for heterodyning the received signal down to a lower intermediate frequency (IF). Assume that $f_{lo} > f_c$, and that the IF is centred at 2 MHz. Draw a block diagram of the heterodyning conversion, including the RF filter and typical spectra of the signals at various points in the diagram. [12]

3. Question Three

a) Define noise in telecommunications systems. [5]

b) Given the following equation describing an arbitrary periodic waveform $x(\lambda)$ in terms of an infinite number of increasing harmonic sine and cosine components;

$$x(\lambda) = \frac{1}{2}a_0 + a_1\cos\lambda + a_2\cos 2\lambda + a_3\cos 3\lambda + \cdots + b_1\sin\lambda + b_2\sin 2\lambda + b_3\sin 3\lambda.$$

Derive the equation shown below which expresses the waveform in a more compact form;

$$x(\lambda) = \frac{1}{2}a_0 + \sum_{n=1}^{\infty}(a_n \cos n\lambda + b_n \sin n\lambda)$$ [15]

4. Question Four

a) Given a random signal represented as the sum of a Gaussian noise random variable and a dc signal as below,

$$z = a + n$$

where z is the random signal, a is the dc component, and n is the Gaussian noise random variable. State the equation expressing the probability density function p(z) of the random signal. [4]

b) Design an FDM signal set consisting of four voice channels, each in the frequency range 300 to 3400 Hz. The multiplexed composite is to be made up of inverted sidebands and is to occupy the spectral region from 30 to 50 kHz.

i) Draw the composite spectrum, indicating individual spectrum and guard band frequency locations. [8]

ii) Draw a block diagram showing the heterodyning and filtering details and the required local oscillator values. [8]

5. Question Five

a) Explain the three basic ways in which the throughput of a communication resource can be increased. [6]

b) Consider an audio signal with spectral components limited to the frequency band 300 to 3300 Hz. Assume that a sampling rate of 8000 samples/s will be used to generate a PCM signal. Assume that the ratio of peak power to average quantisation noise power at the output needs to be 30 dB.

i) What is the minimum number of uniform quantisation levels needed, and what is the minimum number of bits per sample needed? [7]

ii) Calculate the system bandwidth required for the detection of such a PCM signal [7]

6. Question Six

a) Give an explanation of thermal noise in telecommunication systems [4]

b) The information in an analog waveform, with maximum frequency $f_m = 4$ kHz, is to be transmitted over an M-ary PAM system, where the number of pulse levels is $M = 32$.

The quantisation distortion is specified not to exceed $\pm$ 1% of the peak-to-peak analog signal.

i) What is the minimum number of bits/sample, or bits/PCM word that should be used in digitising the analog wave waveform? [4]

ii) What is the minimum required sampling rate, and what is the resulting bit transmission rate? [4]

iii) What is the PAM pulse or symbol transmission rate? [4]

iv) If the transmission bandwidth (including filtering) equals 12 kHz, determine the bandwidth efficiency for this system. [4]