Wakefield College
Castleford Campus
Centre No 38210B

School of Engineering and Motor Vehicle

Programme Details

Edexcel	Programme No(s)	This student	Programme Titles
	ML041	✓	HNC Electrical Engineering

Unit Details

Unit No	Unit Title	Level
66	**Electrical, electronic and digital principles**	**5 (H2)**

Assignment Details

Original Author		M Schonborn		
Nº	**Title**	**Assessor**	**Audit Ref**	**IV Ref**
3	Analogue and Digital Ccts.	M Schonborn	**HEED003A**	

Issue Date	Hand in Date	Actual Date

This assignment should be completed within……4….weeks

Student Details

Name	
Statement	**I certify that the work carried out in this assignment is my own**
Signature	

Criteria Achieved	3.1	3.2	3.3	3.4	4.1	4.2	4.3	M2	M3	D2

Electrical, electronic and digital principles Assignment No. 3

Outcome 3	Understand the operation of electronic amplifier circuits used in electro-mechanical systems
Outcome 4	Be able to design and test digital electronic circuits used in electro-mechanical systems

To complete this assignment successfully, at least all of the **pass** criteria must be achieved. To obtain a pass grade on the complete unit, all pass criteria from all assignments from the unit must be achieved.

Assessment Criteria- Pass	**Achieved**	**Comments/feedback**
3.1 Analyse the operation of single and two stage amplifiers		
3.2 Evaluate the performance of single and two stage amplifiers		
3.3 Design and evaluate a single stage transistor amplifier		
3.4 Compare measured results with theoretical calculations		
4.1 Evaluate digital electronic device families		
4.2 Design combinational and sequential digital electronic circuits		
4.3 Test digital circuits by construction or by computer simulation		

To obtain a **merit** for the full unit, all merit criteria from all assignments from the unit must be completed successfully in addition to all of the **pass** criteria from all assignments from the unit.
To obtain a **distinction** for the full unit, all the **distinction** criteria and all the **merit** criteria from all assignments from the unit must be completed successfully in addition to all of the **pass** criteria from all assignments from the unit

Assessment Criteria	**Achieved**	**This can be achieved by:**	**Comments/feedback**
M2 Select and apply a range of information sources. The selection of methods and sources have to be justified**.**		This can be achieved in task 9 through adding relevant appendices and appropriate referencing	
M3. Present and communicate appropriate findings. Appropriate structure and approach has to be used**.**		This can be achieved in task 9 through a well presented and structured report.	
D2 Take responsibility for managing and organising activities. Show innovative ideas.		In order to achieve this grade you should show that innovative ideas have been used and that your work activities have been well structured. You can show this by using a project management tool and through innovative ideas having been applied.	

General Comments- Assessor
Suggested Action

Assessor Signature …… Date ……

Print Name: M Schonborn

Student Feedback (if any)

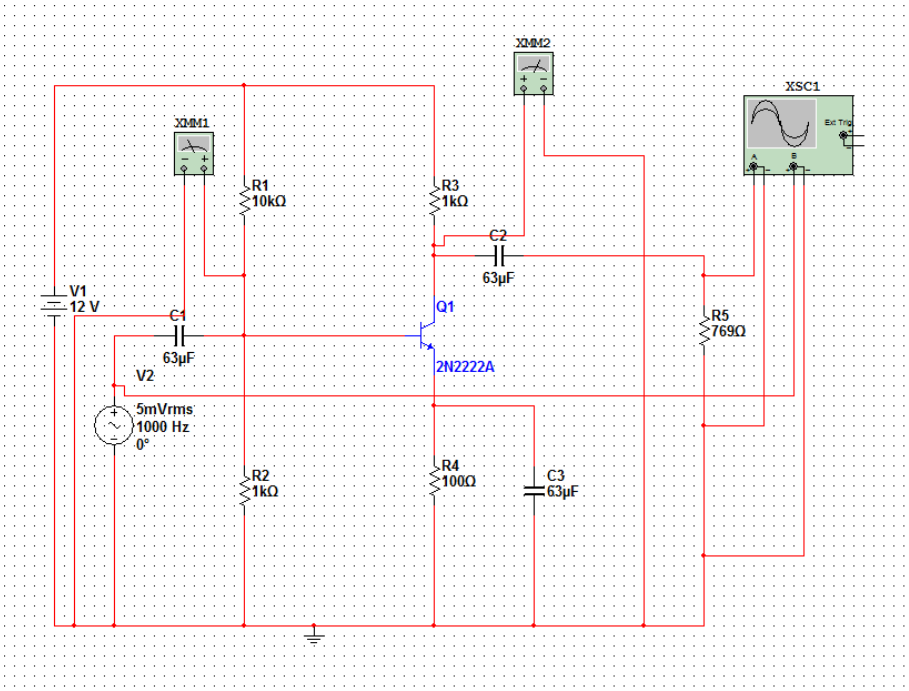
Context:
A lot of electronics engineering companies specialise in bespoke manufacture. A client has a need for a small amplifier to boost a weak audio signal sufficiently to drive a loudspeaker.

You are tasked to test existing amplifiers and to design a bespoke audio amplifier for a low voltage audio application. You will have to optimise your design.

You also have to build the logic circuit for a bespoke alarm system.

Tasks 1 to 8 will meet LO 3.1 and 3.2

Testing of a single stage amplifier circuit!



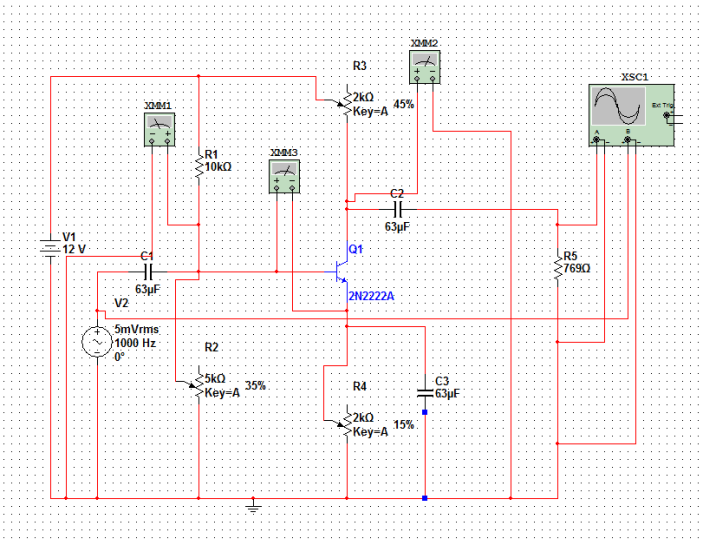
You can find the circuit on student I drive in the root folder of Michael Schonborn

1. Take voltage measurements of XMM1 and XMM2
   - what is the relevance of those voltage at XMM1?
   - what would be the ideal base biasing voltage for this circuit?
   - what is the ideal voltage dropped across R3 and why?

2. Explain the function of various components in this circuit:
   - what is the purpose of R1 and R1?
   - What is the purpose of R3?
   - what is the purpose of R4?
   - What is the purpose of each of the following components: C1, C2 and C3?

3. Using datasheets obtain the following information about the transistor:
   - What type of transistor is it?
   - what is the maximum power dissipation of the transistor?
   - what is the maximum hfe (current gain)

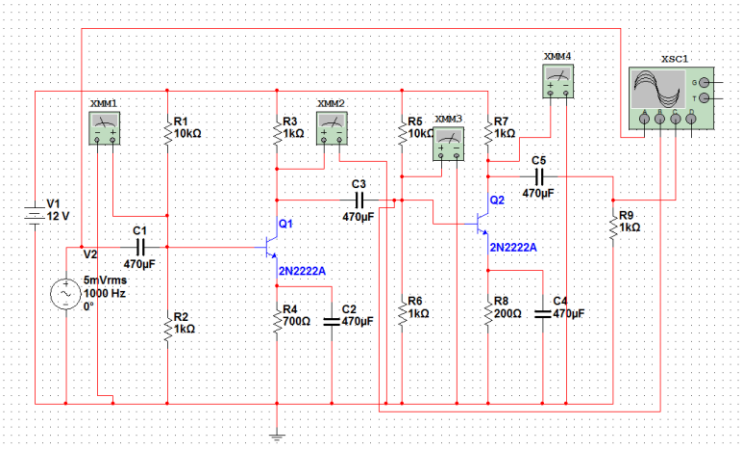
4.



The circuit is available on I drive

Analyse the circuit operation by varying the values for R2, R3 and R4!
Evaluate the circuit response and explain why the circuit behaves in the way it does.

2 Stage Amplifier Analysis

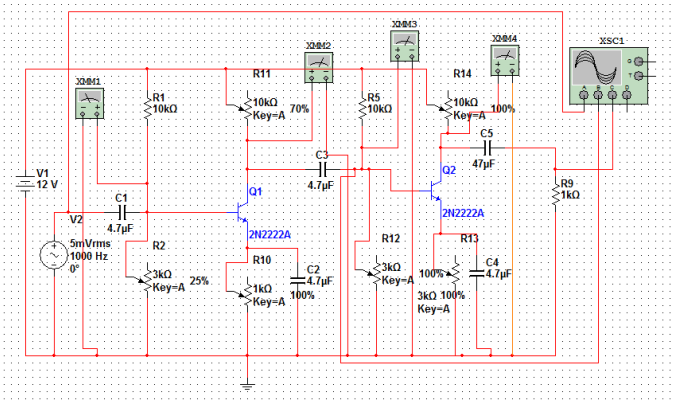


This circuit can be found on I drive

5. Take meter readings and evaluate the information you obtain

6. Take readings from the oscilloscope.
   State the following:
   - peak voltage from the amplifier input
   - peak voltage of the a.c. signal after the first stage
   - what is the voltage gain after the first stage
   - peak voltage of the a.c. signal after the second stage
   - what is the voltage gain between the output of the first stage and the output of the second stage
   - what is the total voltage gain of the amplifier

7. The output signal is slightly distorted
   - explain why the signal is distorted?
   - what can you do to eliminate the distortion?



This circuit can be found on I drive

8. Tune the amplifier for maximum output and minimise any distortion of the waveform. Print out a copy of the oscilloscope reading show all three waveforms.
   - state the gain of each stage
   - state the total gain

Task 9 will meet LO 3.3 and 3.4 (additional work on this task will lead to M2, M3 and D2)

9. Design your own single stage amplifier. You want to build a small amplifier for your smartphone. You measured a peak voltage of 100mV. You want to amplify the output by a factor of ten.
   - Produce calculations for your amplifier design!
   - design your circuit in Multisims
   - print out the completed design, show the input and output waveforms.
   - Measure the D.C. biasing for your constructed or simulated amplifier
   - Measure the a.c. signals in your amplifier
   - Compare the measured results with your calculated results
   - Comment on the differences if there are any!

   To achieve M2,M3 and D2 incorporate the following aspects into your design
   - Clearly label all components and comment on their purpose in detail
   - produce a technical diagram showing all quiescent currents for optimum bias
   - incorporate innovative ideas into your design (D2)
   - include the use of project management software to illustrate the progress of your design and report (D2)
   - produce datasheets for the transistor you have chosen
   - Compile a brief report showing clearly and orderly all calculation for your design, title page, terms of reference, project progress, data sheets for different components, simulation samples and a conclusion on difference between the calculated and actual results.
   - Clearly reference any materials used and add supporting information to the appendix

Digital Circuits

Task 10 will meet LO 4.1

10. Compare CMOS and TTL logic devices. Describe the differences and give one example where each CMOS and TTL logic devices are used.

Tasks 11 to 13 will meet LO 4.2 and 4.3

11. Describe in your own words the difference between sequential and combinational logic.

12. A warehouse needs to be secured with an alarm system. To avoid false alarms a minimum of three sensors needs to be activated. The door sensors once triggered will latch for 5 minutes.

    The warehouse has the following sensors giving the following signal when triggered:

Backdoor	1	0	1	1	0	1	0	0	1
Frontdoor	0	1	0	0	1	0	0	1	1
Loading Bay1	1	0	1	1	1	0	0	0	0
Loading Bay2	1	1	0	1	1	1	0	0	1
PIR Sensor 1	1	1	1	0	1	0	0	0	0
PIR Sensor 2	1	1	1	1	0	1	1	1	0

The following combinations should raise the Alarm either AandA or (BandB and CandC)

X = A.A + B.B.C.C

Backdoor	A	A	C	A	B	C	C	C	A
Frontdoor	B	A	B	A	B	C	C	A	B
Loading Bay1	C	C	B	B	A	A	B	B	C
Loading Bay2	B	C	A	B	A	B	B	B	A
PIR Sensor 1	C	B	A	C	C	A	A	A	B
PIR Sensor 2	B	B	C	C	C	B	A	C	C

Produce a schematic showing the logic gates used for your circuit.
Simulate the circuit on Multisims.

The circuit has been built and tested using discrete components or simulated on Multisims:

Student Name:		
Student Signature:		
Assessor Name:		
Assessor Signature:		

13. Modify the circuit design to only raise the alarm after the output has gone high three times. Provide a printout from Multisims or photographic evidence of the circuit using discrete components supported by a block diagram.