Dr R.P. Jenner, University of Greenwich

UNIVERSITY of GREENWICH

Advanced Mathematics For Engineers

Summative Assessment

Introduction

This assessment is summative which means it counts towards your overall grade for the module; this assessment is worth 40% of the available marks for the module. Under the universities assessment & feedback policy, the report for the assessment is limited to **1500 words** (+/-10%); please ensure you abide by word limit as work over this limit will not be marked as per university policy. There is no page limit so you can add as many calculations, graphs, and tables as you wish. You do not need to use an equation editor for calculations, you may complete your calculations on paper and take a picture for inclusion into your report if you wish; ensure they are fully legible.

Very long calculations and oversized diagrams can be placed at the back of the report as appendices.

You are required to place a copy of your MATLAB code at the back of the report. This does not count towards your word limit and is only there for the marking tutors' reference.

The report is required to be written in ACM conference paper format (two-column format) and an electronic ACM template file has been included in the Moodle folder for you to use. All the formatting has been set for you in the template file; please do not alter the formatting in any way. Appendices do not need to be in ACM format.

Your submission will be a single Microsoft Word document (<100MB in size) comprised of:

1. A formal technical report in ACM format up to 1500 words (+/-10%)
2. Appendices containing long calculations and/or oversized diagrams (not in ACM format)
3. A copy of your MATLAB code

The submission date for the assessment (Moodle upload only, do **not** email or share files) is:

Monday 7th April 2025, 23:30 BST

Although all students will complete the same tasks, each student has their own data to use for certain modelling processes. In the report you will be asked to complete calculations by hand and complete computer simulations. Ensure you fully explain your mathematical modelling and your computer coding; if you show complex calculations or computer code without detailed explanation you will lose very significant marks as it will be assumed you do not understand the work presented or have used Artificial Intelligence (AI) software etc. You must ensure you convince the marking tutor that you understand the work presented.

The key to success (and a high mark) is to complete all tasks, to explain your working clearly and concisely, to have consistency in quality and completeness across all tasks, and to follow the ACM template precisely. Your discussion must be fully supported by in-text citations and references.

The assessment will be graded via the following university grade boundaries:

- Exceptional (80% to 100%)
- Excellent (70% to 79%)
- Very good (60% to 69%)
- Good (50% to 59%)
- Satisfactory (40% to 49%)
- Fail (30% to 39%) (may still pass module subject to examination board approval)
- Fail (0% to 29%) (leads to module failure)

Stepped marking will be used as per university policy, this means you will receive a grade that ends in a 0, 2, 5, or an 8. For example, if your report was graded as being 'very good' the permissible grade range would be 60%, 62%, 65%, or 68%. You will not receive a grade for individual tasks, but you will receive detailed feedback for your report and there will be discussion of what you did well, where you could improve, and what you can take forward to future assessment.

The rubric (marking template) for the assessment which will be used to establish your overall grade can be seen in Appendix C and the module handbook. The rubric details what evidence must be observed to be awarded each grade boundary.

The rubric will be used to establish the academic standard of your:

- Technical discussion
- Mathematical analysis
- Computer coding
- Report writing & formatting
- Referencing

For each of the assessment domains above, you will be awarded one of the grade boundaries; your overall grade for the assessment will be established by how many of the assessment domains fall into the grade boundaries.

For example, if all five of the assessment domains for your report fell into the 'very good' category your overall grade would be 68% (possibly 70% if deemed appropriate). If four out of five assessment domains were 'very good' and one was 'good', you would be awarded 65%. If three assessment domains were 'very good' and two were 'good' you would be awarded 62% etc. The rubric is a 'guide' and not an exact science; the marking tutor will award the most appropriate grade based upon the quality of each assessment domain.

To make the marking as fair as possible, the reports will be marked anonymously. As such, please do **not** include your name, student ID number, username, or email anywhere in the report, filename, or submission title. Moodle knows your identity when you submit your work, the student identities will be hidden from the marking tutor until the reports have been marked and the grades released.

You will see that the ACM template file requires author details; you can just delete this information. You need to add a title to the report, but do **not** add any identifying information.

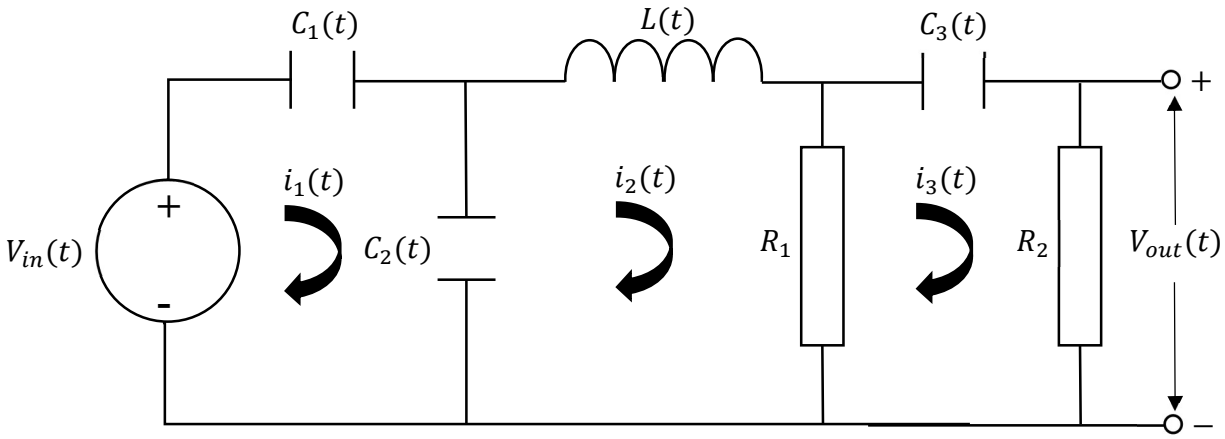
Warning:
All submitted reports will be electronically scanned for plagiarism and the use of Artificial Intelligence (AI) software.

The work that you submit must be your own; any material from other sources must be correctly cited and referenced. If unreferenced material is detected a student will be reported for plagiarism.

If AI is used in the production of a report, university regulations require that this fact is clearly stated on an AI declaration form which can be found in the Moodle folder. Use of AI which has not been acknowledged is an academic misconduct offence and again will lead to a report of plagiarism.

TASK A

Consider the following system which is initially energised at $t = 0s$ with initial conditions $v_{C1}(0)$, $v_{C2}(0)$, $v_{C3}(0)$, and $Li_L(0)$. The input to the system $V_{in}(t)$ is a step input.



Task A1
Refer to Appendix A and locate the last four digits of your student number. Observe the components values for $V_{in}(t)$, $C_1(t)$, $v_{C1}(0)$, $C_2(t)$, $v_{C2}(0)$, $C_3(t)$, $v_{C3}(0)$, $L(t)$, $Li_L(0)$, R_1, and R_2 listed against your student number. These are the values that you must use for task A, do not use any other values.

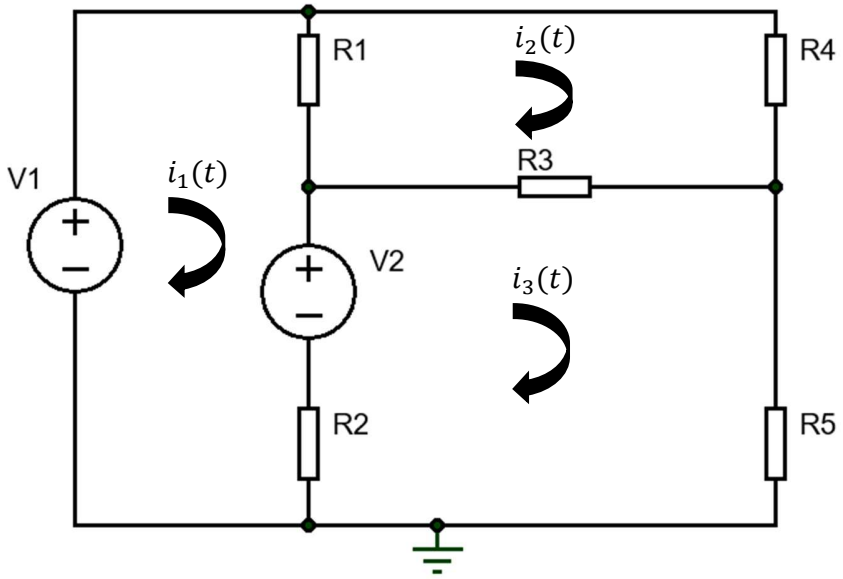
Conduct a forward Laplace transform ($\mathcal{L}$) and redraw the circuit in terms of equivalent impedance. Numerically establish the equations that describe currents $I_1(s)$, $I_2(s)$, and $I_3(s)$.

Task A2
Enter the equations developed for $I_1(s)$, $I_2(s)$, and $I_3(s)$ into MATLAB and establish the impulse response $i(t)$for each current. Plot $i_1(t)$, $i_2(t)$, and $i_3(t)$ on the same graph.

Apply an inverse Laplace transform ($\mathcal{L}^{-1}$) to current $I_2(s)$ to yield $i_2(t)$. Conduct transient analysis upon your developed time domain expression for $i_2(t)$ numerically using a suitable time base. Verify that your hand calculated transient analysis for $i_2(t)$ yields the same results as the impulse response for $i_2(t)$ as determined via MATLAB.

TASK B

Consider the following system:



Task B1:

Refer to Appendix B and locate the last four digits of your student number. Observe the components values for $V1$, $V2$, $R1$, $R2$, $R3$, $R4$, and $R5$ listed against your student number. These are the values that you must use for task B, do not use any other values.

Apply mesh analysis and Cramer's rule to numerically establish currents $i_1(t)$, $i_2(t)$, and $i_3(t)$.

Task B2:

Develop the MATLAB code that calculates currents $i_1(t)$, $i_2(t)$, and $i_3(t)$.

The developed code must:

- display the circuit diagram to the user
- allow the user to enter component values via dialogue boxes
    - all entered data must be checked for validity
- display equations employed to the user
- display all calculation steps to the user
    - numerically calculated data must be embedded within text strings

Appendix A:

Student ID	$V_{in}(V)$	$C_1(F)$	$v_{C1}(0)(V)$	$C_2(F)$	$v_{C2}(0)(V)$	$C_3(F)$	$v_{C3}(0)(V)$	$L(H)$	$Li_L(0)(V)$	$R_1(\Omega)$	$R_2(\Omega)$
xxxxx2020	2	0.1	2	0.5	6	0.8	4	0.4	3	9	6
xxxxx6881	7	0.3	3	0.4	2	0.7	5	0.6	4	5	12
xxxxx0085	3	0.6	4	0.2	3	0.4	6	0.5	4	7	2
xxxxx6710	9	0.4	5	0.8	4	0.6	2	0.3	5	4	8
xxxxx1249	5	0.7	6	0.7	5	0.5	3	0.7	6	8	5
xxxxx0369	7	0.2	2	0.4	6	0.3	4	0.2	3	10	3
xxxxx1921	4	0.8	3	0.6	2	0.7	4	0.5	4	3	8
xxxxx9284	8	0.1	4	0.5	3	0.4	5	0.9	4	5	5
xxxxx6640	10	0.9	5	0.3	4	0.6	6	0.4	5	6	3
xxxxx1711	3	0.3	6	0.6	5	0.3	2	0.8	6	12	7
xxxxx8461	6	0.5	2	0.4	6	0.9	3	0.6	3	2	2
xxxxx8165	4	0.4	3	0.7	2	0.5	4	0.8	4	8	3
xxxxx7464	8	0.2	4	0.9	3	0.1	4	0.7	4	5	7
xxxxx5970	9	0.8	5	0.8	4	0.7	5	0.4	5	3	2
xxxxx2217	4	0.7	6	0.3	5	0.5	6	0.3	6	2	8
xxxxx9735	5	0.4	2	0.2	6	0.4	2	0.9	3	8	10
xxxxx6732	6	0.6	3	0.5	2	0.2	3	0.4	4	5	3
xxxxx5500	12	0.3	4	0.9	3	0.8	4	0.9	4	3	8
xxxxx2520	2	0.9	5	0.4	4	0.7	4	0.5	5	7	5
xxxxx5971	8	0.5	6	0.8	5	0.4	5	0.1	6	2	3
xxxxx2452	5	0.1	2	0.6	6	0.3	6	0.7	3	8	7
xxxxx6869	3	0.7	3	0.3	2	0.9	2	0.2	4	10	2
xxxxx0209	7	0.2	4	0.9	3	0.4	3	0.6	4	3	8
xxxxx3087	2	0.6	5	0.5	4	0.8	4	0.4	5	6	10
xxxxx1256	8	0.9	6	0.1	5	0.6	5	0.7	6	4	3
xxxxx6505	11	0.4	2	0.7	6	0.3	6	0.9	3	8	6
xxxxx4669	4	0.8	3	0.2	2	0.9	2	0.8	4	9	5
xxxxx6526	5	0.3	4	0.4	3	0.5	3	0.3	6	5	3
xxxxx6616	2	0.1	2	0.5	6	0.8	4	0.4	3	9	6
xxxxx6711	7	0.3	3	0.4	2	0.7	5	0.6	4	5	12
xxxxx7299	3	0.6	4	0.2	3	0.4	6	0.5	4	7	2
xxxxx2329	9	0.4	5	0.8	4	0.6	2	0.3	5	4	8
xxxxx5122	5	0.7	6	0.7	5	0.5	3	0.7	6	8	5

xxxxx6430	7	0.2	2	0.4	6	0.3	4	0.2	3	10	3
xxxxx4865	4	0.8	3	0.6	2	0.7	4	0.5	4	3	8
xxxxx1738	8	0.1	4	0.5	3	0.4	5	0.9	4	5	5
xxxxx2728	10	0.9	5	0.3	4	0.6	6	0.4	5	6	3
xxxxx5485	6	0.8	4	0.4	4	0.4	3	0.7	2	6	10
xxxxx5611	2	0.7	5	0.6	8	0.2	4	0.9	3	4	3
xxxxx1205	3	0.4	6	0.5	9	0.8	5	0.8	4	8	6
xxxxx1672	4	0.6	2	0.3	4	0.7	6	0.3	5	9	5
xxxxx1852	5	0.5	3	0.7	5	0.4	2	0.2	6	5	3
xxxxx4959	6	0.3	4	0.2	6	0.6	3	0.5	2	9	6
xxxxx5071	2	0.7	4	0.5	12	0.3	4	0.9	3	8	3
xxxxx9060	3	0.4	5	0.9	2	0.9	5	0.4	4	5	7
xxxxx9461	4	0.6	6	0.4	8	0.5	6	0.8	5	3	2
xxxxx8788	5	0.3	2	0.8	5	0.1	2	0.6	6	2	8
xxxxx7338	6	0.9	3	0.6	3	0.7	3	0.3	2	5	5
xxxxx6540	2	0.5	4	0.8	7	0.2	4	0.9	3	6	3
xxxxx5903	3	0.1	4	0.7	2	0.6	5	0.5	4	12	7

Appendix B:

Student ID	V1 (V)	V2 (V)	R1 (Ω)	R2 (Ω)	R3 (Ω)	R4 (Ω)	R5 (Ω)
xxxxx2020	18	5	121	252	279	128	604
xxxxx6881	9	3	231	317	225	92	703
xxxxx0085	18	7	199	450	188	59	587
xxxxx6710	8	2	256	441	236	76	607
xxxxx1249	19	3	243	218	246	65	568
xxxxx0369	10	4	281	320	174	78	665
xxxxx1921	8	2	279	358	268	94	687
xxxxx9284	9	6	167	325	195	103	659
xxxxx6640	14	3	240	397	227	96	635
xxxxx1711	12	2	139	389	267	138	679
xxxxx8461	10	3	106	287	200	102	680
xxxxx8165	18	9	249	329	208	145	686
xxxxx7464	14	7	200	204	274	114	677
xxxxx5970	13	4	196	496	203	146	739
xxxxx2217	19	5	281	250	315	74	591
xxxxx9735	9	2	222	231	347	118	692
xxxxx6732	17	8	224	312	296	79	597
xxxxx5500	17	3	272	259	219	117	573
xxxxx2520	11	2	261	347	267	120	672
xxxxx5971	14	3	215	302	171	56	640
xxxxx2452	6	5	136	486	332	75	642
xxxxx6869	5	7	148	477	326	72	683
xxxxx0209	13	3	278	215	314	117	704
xxxxx3087	17	6	105	422	202	135	620
xxxxx1256	19	3	198	281	269	84	683
xxxxx6505	7	5	133	327	154	128	633
xxxxx4669	14	2	296	364	235	118	719
xxxxx6526	12	8	243	483	212	50	717
xxxxx6616	5	2	200	325	182	110	601
xxxxx6711	10	2	194	495	185	89	673
xxxxx7299	7	3	111	290	235	142	667
xxxxx2329	17	6	237	411	168	50	658
xxxxx5122	9	4	108	400	270	96	724

xxxxx6430	13	1	114	362	244	92	603
xxxxx4865	7	2	204	410	289	96	613
xxxxx1738	14	2	119	400	290	127	573
xxxxx2728	9	3	264	253	278	82	738
xxxxx5485	15	2	264	238	156	129	679
xxxxx5611	16	2	245	500	163	97	646
xxxxx1205	16	3	130	251	214	53	678
xxxxx1672	12	1	232	209	256	67	659
xxxxx1852	6	3	204	368	281	122	680
xxxxx4959	8	3	295	465	231	97	659
xxxxx5071	19	3	230	401	314	65	694
xxxxx9060	7	1	260	257	294	84	655
xxxxx9461	18	1	191	311	344	111	749
xxxxx8788	13	2	186	338	256	69	593
xxxxx7338	20	3	265	495	215	124	571
xxxxx6540	6	1	116	247	171	74	572
xxxxx5903	12	3	126	457	272	142	562

Appendix C: Marking Rubric

Assessment Domain	80-100 Exceptional	70-79 Excellent	60-69 Very Good	50-59 Good	40-49 Satisfactory	30-39 Fail	0-29 Fail
Technical discussion	The technical discussion is exceptionally professional being very highly accurate and which uses correct technical terminology. The discussion is almost entirely fact based and is fully supported by primary sources. The discussion of working is extremely professional and is written in an informative and instructional manner.	The technical discussion is very highly professional being highly accurate and which uses correct technical terminology. The discussion is very largely fact based and is fully supported by primary sources. The discussion of working is very highly professional and is almost entirely written in an informative and instructional manner.	The technical discussion is very professional being in the main highly accurate and which uses correct technical terminology in most of the discussion. The discussion is largely fact based and is largely supported by primary sources. The discussion of working is highly professional and is almost entirely written in an informative and instructional manner.	The technical discussion is professional and is mainly accurate although some mistakes are evident. The discussion mainly uses correct technical terminology. The discussion contains both fact-based and descriptive information. Discussion is mainly supported by primary sources, but secondary sources are also used. The discussion of working may lack some steps but is still informative and instructional	The technical discussion is mainly descriptive and is lacking in accuracy and correct terminology. Discussion is mainly supported by secondary sources; there may be errors in their application and formatting. The discussion of working is lacking in some areas meaning it is not very informative and instructional.	The technical discussion is very descriptive and is very lacking in accuracy and correct terminology. Discussion is mainly not supported by primary/secondary sources. The discussion of working is very lacking in some areas meaning it is not informative and instructional.	The technical discussion is almost entirely descriptive and lacking in accuracy and correct terminology. Discussion is not supported by primary/secondary sources. The discussion of working is very lacking or is missing entirely.
Mathematical analysis	The mathematical analysis is extremely comprehensive and fully supports and demonstrates technical discussion. All key equations, laws and theorems are shown, fully explained, and are supported by primary sources. There is an exceptionally high level of accuracy and all calculation steps are	The mathematical analysis is very highly comprehensive and almost fully supports and demonstrates technical discussion. All key equations, laws and theorems are shown, fully explained, and are supported by primary sources. There is a very high level of accuracy and all calculation steps are	The mathematical analysis is very comprehensive and supports and demonstrates technical discussion well. All key equations, laws and theorems are shown, fully explained, and are supported by primary sources. There is a high level of accuracy and all calculation steps are shown along with in-	The mathematical analysis is comprehensive and mainly supports and demonstrates technical discussion. Most key equations, laws and theorems are shown, well explained, and are mainly supported by primary sources. There is a good level of accuracy and most calculation steps are	The mathematical analysis isacceptable but may containsome errors. Analysis provides some support and demonstration of technical discussion. Few key equations, laws and theorems are shown or explained and are mainly supported by secondary sources. There is a satisfactory level of accuracy and	The mathematical analysis is unacceptable and contains multiple errors. Analysis provides little support and demonstration of technical discussion. Very few key equations, laws and theorems are shown or explained and are not supported by primary or secondary sources. Accuracy is poor and	The mathematical analysis isunacceptable and containssignificant errors. Analysis provides no support and demonstration of technical discussion. Very few key equations, laws and theorems are shown or explained or may be missing entirely. If shown, they are not supported by primary or

	shown along with in-depth discussion of the mathematical procedures used. Very significant evidence of selection of appropriate mathematical procedures to demonstrate theory. All tasks have been fully completed.	shown along with in-depth discussion of the mathematical procedures used. Very good evidence of selection of mathematical procedures to demonstrate theory. All tasks have been fully completed.	depth discussion of most of the mathematical procedures used. Good evidence of selection of mathematical procedures to demonstrate theory. The large majority of tasks have been fully completed.	shown along with good discussion of most of the mathematical procedures used. Some evidence of selection of mathematical procedures to demonstrate theory. The majority of tasks have been fully completed.	most calculation steps are shown along with some discussion of many of the mathematical procedures used. Little evidence of selection of mathematical procedures to demonstrate theory. The majority of tasks have been fully or partially completed.	few calculation steps are shown along with little discussion of the mathematical procedures used. No evidence of selection of mathematical procedures to demonstrate theory. Most tasks have not been fully or partially completed.	secondary sources. Accuracy is very poor, and few calculation steps are shown along with little/no discussion of the mathematical procedures used. No evidence of selection of mathematical procedures to demonstrate theory. Most tasks not fully or partially completed.
Computer coding	Computer files have been written in a highly professional manner. Mechanisms have been designed that support user data entry and which reject all inappropriate data. All coding is fully commented, its functionality is fully explained both textually and graphically in the report body. All figures contain correct titles and scientific units along with data identification information. Very clear evidence of selection of appropriate coding techniques to support and demonstrate theoretical discussion. All coding tasks are fully complete.	Computer files have been written in a very professional manner. Mechanisms have been designed that support user data entry and which reject almost all inappropriate data. All coding is fully commented, its functionality is fully explained both textually and graphically in the report body. All figures contain correct titles and scientific units along with data identification information. Clear evidence of selection of appropriate coding techniques to support and demonstrate theoretical discussion. All coding tasks are fully complete.	Computer files have been written in a professional manner. Mechanisms have been designed that support user data entry and which reject most inappropriate data. All coding is fully commented, its functionality is well explained both textually and graphically in the report body. All figures contain correct titles and scientific units along with data identification information. Good evidence of selection of appropriate coding techniques to support and demonstrate theoretical discussion. All coding tasks are fully/partially complete.	Computer files have been written in an acceptable manner; some information may be missing Mechanisms have been designed that support user data entry and which reject some inappropriate data. All coding is fully commented, its functionality is adequately explained. All figures contain correct titles and scientific units along with data identification information. Some evidence of selection of appropriate coding techniques to support and demonstrate theoretical discussion. Most coding tasks are fully/partially complete.	Computer files have been written in an acceptable manner; some information may be missing. Some mechanisms have been designed that support user data entry. All coding is fully commented, its functionality is adequately explained in the body of the report. Most figures contain correct titles and scientific units along with data identification information. Little evidence of selection of appropriate coding techniques to support and demonstrate theoretical discussion. Most coding tasks are fully/partially complete	Computer files have been written in a poor manner; significant information may be missing. Few mechanisms have been designed that support user data entry. Coding is not fully commented, its functionality is poorly explained in the body of the report. Few figures contain correct titles and scientific units along with data identification information. Little/no evidence of selection of appropriate coding techniques to support and demonstrate theoretical discussion. Some coding tasks are partially complete.	Computer files have been written in a poor manner; significant information may be missing. No mechanisms have been designed that support user data entry. Coding is not fully commented, its functionality has not been or poorly explained in the body of the report. Few figures contain correct titles and scientific units along with data identification information. No evidence of selection of appropriate coding techniques to support and demonstrate theoretical discussion. Most coding tasks are partially or not complete.
Report and formatting	The ACM template has been followed precisely with no formatting errors or changes. There are no spelling	The ACM template has been followed precisely with no formatting errors or changes. There are no spelling	The ACM template has been followed very closely with minimal formatting errors or changes. There are no	The ACM template has been followed closely with some formatting errors or changes. There are few spelling	The ACM template has been followed reasonably with many formatting errors or changes. There are	The ACM template has been followed poorly with multiple formatting errors or changes. There are	The ACM template has not been followed or very poorly followed with significant formatting errors. There

	mistakes, grammatical errors, or incorrect words. The report has been written in a highly professional manner with a logical structure and appropriate use of subsections. Extensive use of graphics to demonstrate theory, mathematics, and coding.	mistakes, grammatical errors, or incorrect words. The report has been written in a very professional manner with a logical structure and appropriate use of subsections. Very good use of graphics to demonstrate theory, mathematics, and coding.	spelling mistakes, grammatical errors, or incorrect words. The report has been written in a professional manner with a logical structure and appropriate use of subsections. Good use of graphics to demonstrate theory, mathematics, and coding.	mistakes, grammatical errors, or incorrect words. The report has been written in an appropriate manner with a mainly logical structure and appropriate use of subsections. Some use of graphics to demonstrate theory, mathematics, and coding.	many spelling mistakes, grammatical errors, or incorrect words. The report has been written in an acceptable manner with some structuring issues. Little use of graphics to demonstrate theory, mathematics, and coding.	many spelling mistakes, grammatical errors, or incorrect words. The report has been written in a poor manner with many structuring issues. Little/no use of graphics to demonstrate theory, mathematics, and coding.	are many spelling mistakes, grammatical errors, or incorrect words. The report has been written in a poor manner with significant structuring issues. Little/no use of graphics to demonstrate theory, mathematics, and coding.
Referencing	Sources used are, without exception, acknowledged in the text and the reference list, using correct citation – including online sources. Follows an exceptionally strong professional approach to academic practice. Primary sources are solely relied upon to support critical discussion.	Sources used are all acknowledged in the text and the reference list, using correct citation – including online sources. Follows an excellent, professional approach to academic practice. Primary sources are relied upon to support critical discussion.	Sources used are almost all acknowledged in the text and the reference list, mostly using correct citation – including most online sources. A very good approach to academic practice. Primary sources are in the main relied upon to support critical discussion in conjunction with some secondary sources	Literature is not always correctly referenced in the reference list and citations within the text is not always shown or be correct. Almost all texts are included in reference list.	The assignment includes citations within the main body and has a reference list. However, this referencing is often inaccurate and/or there are several omissions. An over reliance on secondary sources.	The reference list has many errors in its layout. Many references in the main text are incomplete or incorrect and may be missing. Citations may not have been used within the text. You need further support with this.	The assignment lacks a reference list, or it is incorrectly laid out. Referencing/citation system within the assignment has not been followed and you need further support with this.