DEPARTMENT OF ENGINEERING COURSEWORK

Term:	Academic Year:	Module Code:
Michelmas	2024-2025	ENGI 2191

Title:

Electrical Engineering 2: Coursework Report

GROUP B

Time Required:	It is expected that you should spend approximately **40** hours on this coursework assignment. This includes all learning related activities completed during the year (for example, attending lectures/workshops, completing Problem Sheets, etc).
Deadline(s) for submission:	Monday 13 January 2025 at 14:00hrs.
Date for feedback:	Monday 10 February 2025
Submission instructions:	• Your submission must be uploaded to Learn Ultra/TURNITIN in advance of the deadline. • All submissions in the Department are electronic and no hard copy is required. • The maximum file size that can be accepted is 20 MB. • All submissions must be saved using the following naming convention: SURNAME-Firstname_ENGI 2191.pdf E.g. **"BLOGGS-Joanne_ENGI 2191.pdf"**
Format:	• Reports should be submitted in PDF format. • The report submitted must be no longer than 8 pages (including diagrams and references). Appendices may be included but will not form part of the examined material nor count toward the page limit.
Penalties for non-compliance:	• All submissions must be received in the format specified by the coursework brief (this includes code files and data files). Submissions not in the correct file will not be marked.
Late submission:	In accordance with the Learning and Teaching Handbook : 6.2.5: Penalties for the Late Submission of Assessed Work - Durham University summative assessed work received late within five working days of the deadline will be capped at the module pass mark; work received more than five days of the deadline will not be marked and a mark of zero will be recorded.
Academic Integrity Guidance:	The Department of Engineering considers any attempt by a student to gain an unfair academic advantage through engaging in acts of academic misconduct ultimately diminishes the value of the degree sought and indicates a fundamental dishonestly which disrespects members of the learning community in the department. All potential incidents of suspected academic dishonesty shall be thoroughly investigated in accordance with the Learning and Teaching Handbook, Section 6.2.4: Academic Misconduct (sharepoint.com).

Use of Generative AI	Use of generative AI (gAI) and related technologies is permitted only where explicitly stated and should be compliant with our policy document entitled "Student Guidance on the Use of Generative Artificial Intelligence and Related Technology for the Department of Engineering". Note that any use of gAI or related technologies should be detailed in an acknowledgement section within your coursework submission document.
AHEP Learning Outcomes Assessed:	The Engineering Council sets the overall requirements for the Accreditation of Higher Education Programmes (AHEP) in engineering, in line with the UK Standard for Professional Engineering Competence (UK-SPEC). This assignment has been designed to assess the following AHEP Learning Outcomes: M12. Use practical laboratory and workshop skills to investigate complex problems.
Instructions to Candidates:	The assignment title and your full name must be presented at the top of the first page. Do not include your anonymous code. Your submission should be named using the following convention: SURNAME-firstname_ENGI 2191.pdf.

Revision:	

Coursework Brief:

Introduction

This coursework is a part of module ENGI 2191 (Electrical Engineering II)) and contributes 20 % of the marks towards the module. It involves analysis of a practical three-phase system with three different loads. You will be required to analyse the system in terms of current of each load, phasor diagram, active power, reactive power, power factor, voltage drop and power loss of the transmission lines. In the last session you need to install a capacitive bank at the end of the transmission line and discuss its impact on the overall performance of the system.

For theory and background reading you can refer to Michaelmas lecture notes for L2 Electromechanics as well as the recommended textbooks available in the Bill Bryson Library (reading list is outlined in the lecture notes). Please read the next section carefully first, before attempting through the tasks.

Instructions related to the use of gAI

- Use of generative AI (gAI) and related technologies is only permitted for improving the readability of text and improving the efficiency of computer code.
- Use of generative AI (gAI) and related technologies should be compliant with our policy document entitled "Student Guidance on the Use of Generative Artificial Intelligence and Related Technology for the Department of Engineering".
- Any use of gAI or related technologies should be detailed in an acknowledgement section within your coursework submission document.

Coursework Exercise

This coursework has four sections; you need to answer all sections in order to complete the coursework assignment. You will need to submit a long CW report containing theory and applications of three phase networks (no more than one page), detail of the calculations, as well as results and discussions of all sections. The suggested report length is **6 to 8 pages (excluding cover page and references)**, and the report should be in 11-point font or greater.

In order to write up your report, you will need to:

- Complete tasks in the four sections outlined in this coursework handout (in which you will use the values given in Tables 1 of this handout).
- Write up a report and discuss your results.

The final report should contain the following:

(i) A brief theory and application section, which could demonstrate your knowledge of three phase systems and the governing equations. You may refer to your lecture notes and/or recommended textbooks in the reading list (it is strongly recommended to avoid using URL addresses in the references).

(ii) Enough details of your calculations (similar to the examples in the lecture notes) and a discussion of those results.

(iii) You should begin your report with an abstract and finish it with a conclusion.

Load and Transmission Line Data:

Figure 1 shows single line diagram of a practical three-phase balanced system. This system is supplied through a three-phase generator with internal impedance of $Z_g = 0.12 + j0.036\ \Omega$, power frequency of 50 Hz and star connection. Parameters of the transmission line per unit length are $R = 0.4\ \Omega\ km^{-1}$ and $L = 3\ mH\ km^{-1}$. Total length of the transmission line between terminals T_1-T_2 is 400 m, and between terminals T_2-T_3 is 500 m. Parameters of the loads are given in Table 1.

RMS phase voltage at terminal T_3 is given as $V_{ph} = 230 < 0°\ V$.

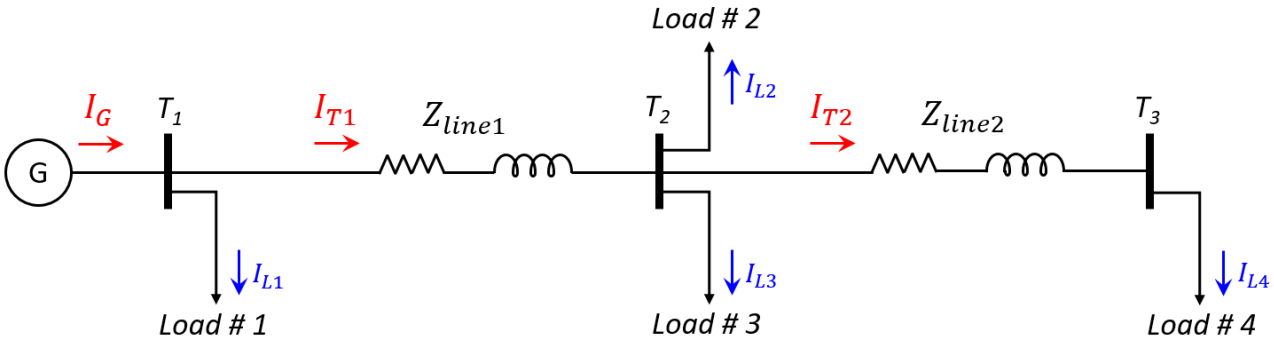

Figure 1 Single line diagram

Table 1. Loads Parameters

T1	T 2		T3
Load # 1	Load # 2	Load # 3	Load # 3
Three phase balance load $P_1 = 15.0\ kW$ $p.f. = 1.0$ $Y\ connection$	Three phase balance load with phase impedance $R_2 = 12\ \Omega, L_2 = 9\ mH$ $Y\ connection$	Three phase balance load with phase impedance $R_3 = 24\ \Omega, L_3 = 18\ mH$ $\Delta\ connection$	Three phase balance load with phase impedance $R_4 = 15\ \Omega, L_4 = 45\ mH$ $Y\ connection$

1- Coursework Details:

You will now need to read the following sections carefully in order to be able to finish this coursework element. You need to discuss your results and justify the network performance using the equations of the three phase networks, which has been outlined in the lecture notes and where possible refer to the recommended textbooks.

2- Current and voltage analysis:

In this section you need to calculate phasor of the currents and voltages of each part of the network:

- Find the line current of each load, I_{L1}, I_{L2}, I_{L3} and I_{L4}.
- Find the line current through each transmission line, I_{T1} and I_{T2}.
- Find the line current of the generator, I_G.
- Find the phase voltage (amplitude and angle) at terminals T_1 and T_2.
- Find the internal voltage of the generator (phase voltage).

3- Power and power factor analysis:

Use the results of section 2 and perform an in-depth power analysis of the network.

- Find active power, reactive power, and power factor of each load.
- Find active and reactive power through each transmission line.
- Find active and reactive power supplied by the generator.
- Find power factor of the generator.
- Plot power triangle for the generator.

4- Power losses and voltage drop analysis:

Using the results of section 2 and parameters of the transmission line, and calculate:

- Voltage drops across each transmission line.
- Power loss of each transmission line.
- Plot the voltage profile from the generator to the terminal T_3.

5- Reactive power compensation:

We want to install a capacitive bank at terminal T_3 to increase the power factor at this terminal to 0.94 lagging. Find the required capacitive reactive power Q_C in $KVAR$.

Calculate the following quantities after installing the capacitive bank:

- Active and reactive power transmitted through each transmission line.
- Active and reactive power of the power supply.
- Power factor of the generator.
- Power loss of each transmission line.

Compare the results of this section with those before the compensation in a Table. Discuss your results briefly.

Good luck

Hamed Bahmani

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MARKING AND FEEDBACK MATRIX FOR LEVEL 2 ELECTRICAL ENGINEERING COURSEWORK

Name:	
Mark:	

Honours	***Class I***		***Class II (i)***	***Class II (ii)***	***Class III***	***Not Honours Standard (Fail)***	
%	***86 - 100***	***70 - 85***	***60 – 69***	***50 - 59***	***40 - 49***	***30 – 39***	***0 – 29***
Presentation of the report 25%	*Outstanding report. Very well structured with professional quality visual presentation. Very well written in scholarly technical style. Fully referenced.*	*Excellently organised and clearly written. Excellent visual presentation. Fully referenced. Very clear direction throughout.*	*Well organised and clearly written. Good visual presentation. References included. Good direction maintained throughout.*	*Soundly written and presented. Moderate visual presentation. Direction is unclear at times. Some parts are referenced.*	*Restricted quality of organisation and presentation of material and visuals. References and/or important sections are missing.*	*Presentation of material and visuals fail to provide evidence for proper understanding of material. Difficult to read and lacks a logical train of thought or argument.*	*Presentation of material and visuals is unacceptable.*
Figures 15%	*Outstanding use of graphics to illustrate the report. Outstanding figures.*	*Excellent use of graphics to illustrate the report. Excellent figures.*	*Good use of graphics to illustrate the report. Very good figures.*	*Sound use of figures.*	*Figures show restricted evidence of understanding about the module. Some figures missing that might be expected for illustration.*	*Figures do not evidence understanding/knowledge about the module topics.*	*The Figures are unacceptable. The reader cannot extract any useful information from them.*
Results and discussions 30%	*Solutions of exemplary with outstanding discussion and in-depth engineering interpretation of results.*	*Solutions of high quality with excellent discussion and engineering interpretation of results.*	*Solutions of good quality with good discussion and engineering interpretation of results.*	*Solutions are sound with some limited discussion and engineering interpretation of results*	*Solutions demonstrate a restricted understanding of the module topic.*	*Failed to follow assignment instructions. Insufficient results were presented. No analysis or engineering judgment is evident.*	*The presented results and engineering discussion are* ***unacceptable,*** *misleading and unjustified.*
Technical content 30%	*Outstanding technical content with strong evidence of wide background reading. Superb theoretical content.*	*Excellent technical content and evidence of background reading. Excellent theoretical content.*	*Good technical content and good discussion of results. Some evidence of wider reading.*	*Sound technical content in most areas.*	*Technical content present but incorrect and/or lacking in some areas.*	*Fails to deliver technical content and/or significant incorrect content*	*Fails to present any meaningful technical content.*

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HIGHLIGHTS	*AREAS FOR IMPROVEMENT*

We hope you find this feedback useful in identifying the highlights and areas that need improvement. However, if you require further information, please contact the marker and arrange to see them during their office hours.

Please note that all marks are provisional until confirmed by the Board of Examiners.

Marker: **……**

Date: **……**