ACADEMIC CATALOG

2023/2024

ASHESI

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ASHESI UNIVERSITY 2023-2024 ACADEMIC CATALOG

1 Academic Programs, Degrees, And Degree Requirements

1.1 Mission & Vision Statements

The mission of Ashesi University is to educate a new generation of ethical, entrepreneurial leaders in Africa to cultivate within our students critical thinking skills, concern for others, and the courage it will take to transform a continent.

Our vision is an African renaissance driven by a new generation of ethical, entrepreneurial leaders. We aim to educate such leaders and to drive a movement in African higher education to scale up the education of such leaders.

1.2 Academic Message

An Ashesi student's academic purpose is striving for excellence in citizenship, leadership, and scholarship in their discipline to transform Africa.

1.3 Ashesi University Academic and Social Honour Codes

Academic Honour Code (2007): All members of each second-year class at Ashesi University vote on whether to pledge to abide by the Academic Honour Code. When a minimum of 66.7% of the class votes in favour of the pledge, the entire class is deemed committed to honouring the pledge, which simply states, "I will not cheat, and I will not allow my peers to cheat."

Social Honour Code (2018): Under the code, all members of the Ashesi community will now sign on to a new pledge of behaviour; the pledge reads, "As a member of the Ashesi Community, I will act with honesty, integrity, and respect for others, and will hold my peers accountable to abide by these principles and by the university's code of conduct."

1.4 Undergraduate Degrees Offered

1.4.1 Bachelor of Science (BSc.)

Department of Business Administration

- BSc. in Business Administration
- BSc. in Economics

Department of Computer Science and Information Systems

- BSc. in Computer Science
- BSc. in Management Information Systems

Department of Engineering

- BSc. in Computer Engineering
- BSc. in Electrical & Electronic Engineering
- BSc. in Mechanical Engineering
- BSc. in Mechatronics

1.4.2 Graduate Degrees Offered

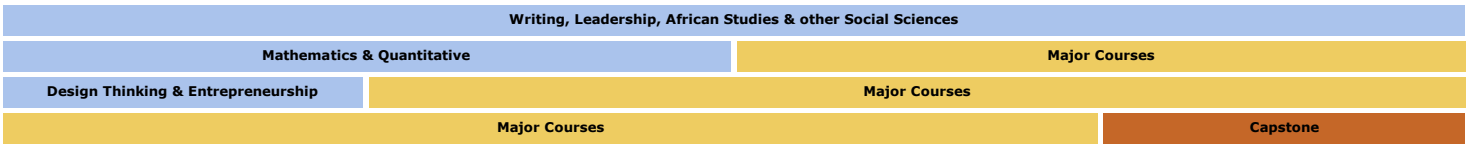
- MSc. in Mechatronics Engineering
- MAS in Mechatronics Engineering
- MPhil. in Mechatronics Engineering

1.5 Bachelor's Degree Requirements

Ashesi University offers an academic program consisting of a minimum of 134 semester hours (33.5 Ashesi ~~semester~~ units) of credit for the bachelor's degree. The degree consists of a hybrid ~~of~~ foundational liberal arts core concentrated in year one, a professional core in a major, and elective courses.

Table 1-1: Four-Year Curriculum

Year 1	Year 2	Year 3	Year 4



Ashesi's academic calendar of 32 weeks a year is divided into two semesters, e.g., 16 weeks each, or 15 and 17 weeks, or 14 and 18 weeks. Students typically take four Ashesi units per semester. An Ashesi unit is the equivalent of 4 hours a student has in contact with an instructor for instruction, discussion, or lab, or some combination of the three. Typically, a 16-week semester is 14 weeks of instruction made up of in classroom instruction and a discussion or a lab. That is, in a 16-week semester, there are 3 hours of classroom-contact instruction each week for 14 weeks (3 hrs. X 14 weeks = 42 hours) and either a one-hour discussion or a 2-3 hour lab, i.e., additional contact hours of (1hr x 14 weeks) 14 discussion hours or (2 or 3 hours X 14 weeks) range of 28 to 42 hours of lab experience.

In the European Credit Transfer and Accumulation System, ECTS, (using 1 ECTS = 25 hours) each of our degree programs is approximately 240 ECTS. (See page 75)

Students must fulfil the following minimal requirements to earn a baccalaureate degree and be eligible for graduation.

- Successful completion of at least 33.5-semester units, including all core and major requirements*
- A cumulative grade point average of 2.0 (C average) or higher
- Successful completion of the service-learning component**
- Successful completion of internship (required only for engineering students) ***
- Successful completion of writing across the curriculum course series (required pass for class of 2027 and subsequent classes) ****
- Fulfilment of all financial obligations to the University.

* Note that some Ashesi degree programs require more than 33.5 units, depending on a student's math track.

** The service-learning component is another dimension of our commitment to nurturing graduates who excel in citizenship. Service learning helps students develop a sense of citizenship by giving them an opportunity to become engaged with their surrounding community. Students must complete 40 hours of community service and fulfil this requirement in various ways. The Outreach and Experiential Learning Programs office keeps a directory of non-profit organisations students can volunteer with.

*** All Ashesi students are encouraged to take up summer internship opportunities at the end of their second and third years. To ensure some level of familiarity with the practising engineering profession, all Ashesi engineering students must either intern at an engineering firm or an engineering-related internship at a non-engineering firm, shadow a practising engineer, or engage in an engineering project for an external company.

**** Beginning with the Class of 2027, all Ashesi students should obtain a pass in the Writing Across the Curriculum Lab series as a graduation requirement.

1.6 Graduation Honours

Students with a cumulative GPA of 3.50 to 3.69 for all undergraduate work earn Cum Laude (honours). Those with a cumulative GPA of 3.70 to 3.84 for all undergraduate work earn Magna Cum Laude (high honours). Students with a cumulative GPA of 3.85 or above for all undergraduate work earn Summa Cum Laude (highest honours).

- Summa Cum Laude: 3.85-4.00 (Highest Honours)
- Magna Cum Laude: 3.70-3.84 (High Honours)
- Cum Laude: 3.50-3.69 (Honours)
- Bachelor's Degree: 2.00-3.49

Table 1-2: Cum Laude and Class Distinctions

Ashesi University Honours	GPA	Public University (University of Cape Coast Honours)	GPA
Summa Cum Laude (Highest Honours)	3.85 - 4.00	First Class	3.60 - 4.00
Magna Cum Laude (High Honours)	3.70 - 3.84		
Cum Laude (Honours)	3.50 - 3.69	Second Class (Upper)	2.95 – 3.59
Bachelor's	2.00 - 3.49	Second Class (Lower)	2.45 – 2.94
		Third Class	2.00 – 2.44

1.7 Overview of Courses Offered in Ashesi's Undergraduate Degree Programs

1.7.1 Overview of Courses Offered in the programs in the Department of Business Administration

	Business Administration	Economics
Liberal Arts & Sciences Core		
Humanities & Social Sciences	Written and Oral Comm.	Written and Oral Comm.
Humanities & Social Sciences	Text and Meaning	Text and Meaning
Humanities & Social Sciences	Ashesi Success	Ashesi Success
Humanities & Social Sciences	Leadership 1*	Leadership 1*
Humanities & Social Sciences	Leadership 2*	Leadership 2*
Humanities & Social Sciences	Leadership 3*	Leadership 3*
Humanities & Social Sciences	Leadership 4	Leadership 4
Humanities & Social Sciences	Microeconomics	Principles of Microeconomics
Humanities & Social Sciences	Macroeconomics	Principles of Macroeconomics
Ashesi Units	*6.5 Ashesi Units*	*6.5 Ashesi Units*
Business	Found. of Design & Entrepreneurship I	Found. of Design & Entrepreneurship I
Business	Found. of Design & Entrepreneurship II	Found. of Design & Entrepreneurship II
Ashesi Units	*2 Ashesi Units*	*2 Ashesi Units*
Mathematics	Pre-Calculus 1 / Calculus 1	Pre-Calculus 1 / Calculus 1
Mathematics	Pre-Calculus 2 / Calculus 2	Pre-Calculus 2 / Calculus 2
Mathematics	Applied Calculus (Pre-Calc track only)	Applied Calculus (Pre-Calc track only)
Mathematics	Statistics	Statistics
Mathematics	Quantitative Methods	
Ashesi Units	*4 Ashesi Units (5 if Pre-Calc track)*	*3 Ashesi Units (4 if Pre-Calc track)*
Computing	Intro to Computing & IS	Intro to Computing & IS
Ashesi Units	*1 Ashesi Unit*	*1 Ashesi Unit*
Research / Project Prep	Research Methods	Research Methods
Ashesi Units	*1 Ashesi Unit*	*1 Ashesi Unit*
Research / Project Prep	3 Non-Major Electives including at least 1 African studies	3 Non-Major Electives including at least 1 African studies
Ashesi Units	*3 Ashesi Units*	*3 Ashesi Units*
Total Credits – Liberal Arts & Science Core	**17.5 Ashesi Units (18.5 if Pre-Calculus)**	**16.5 Ashesi Units (17.5 if Pre-Calculus)**
MAJOR		
Required Major Class	Introduction to Finance	The Economy of Ghana
Required Major Class	Financial Accounting	Intermediate Microeconomic Theory I
Required Major Class	Marketing	Intermediate Macroeconomic Theory I
Required Major Class	Managerial Accounting	Development Economics
Required Major Class	Corporate Finance	Intermediate Microeconomic Theory II
Required Major Class	Organizational Behavior	Intermediate Macroeconomic Theory II
Required Major Class	International Trade & Policy	Econometrics I
Required Major Class	Operations Management	Introduction to Environmental Economics
Required Major Class	Business Law	Business Law
Required Major Class	Competitive Strategy	Advanced Microeconomic Theory
Required Major Class	Investments	Econometrics II
Required Major Class	Business Communication and Negotiations	Advanced Macroeconomic Theory
Required Major Class		Mathematics for Economists
Ashesi Units	*12 Ashesi Units*	*13 Ashesi Units*
Major Electives	3 BA Electives	3 Economics Electives
Ashesi Units	*3 Ashesi Units*	*3 Ashesi Units*
Capstone	Capstone 1	Capstone 1
Capstone	Capstone 2	Capstone 2
Ashesi Units	*2 Ashesi Units*	*2 Ashesi Units*
Total Credits - Major	**17 Ashesi Units**	**18 Ashesi Units**
Total Credits - Overall	**34.5 Ashesi Units (35.5 if Pre-Calc Track)**	**34.5 Ashesi Units (35.5 if Pre-Calc Track)**

1.7.2 Overview of Courses Offered in the programs in the Department of Computer Science and Information Systems

	Management Information Systems	Computer Science
Liberal Arts & Sciences Core		
Humanities & Social Sciences	Written and Oral Comm.	Written and Oral Comm.
Humanities & Social Sciences	Text and Meaning	Text and Meaning
Humanities & Social Sciences	Ashesi Success	Ashesi Success
Humanities & Social Sciences	Leadership 1*	Leadership 1*
Humanities & Social Sciences	Leadership 2*	Leadership 2*
Humanities & Social Sciences	Leadership 3*	Leadership 3*
Humanities & Social Sciences	Leadership 4	Leadership 4
Humanities & Social Sciences	Principles of Economics	Principles of Economics
Ashesi Units	***5.5 Ashesi Units***	***5.5 Ashesi Units***
Business	Found. of Design & Entrepreneurship I	Found. of Design & Entrepreneurship I
Business	Found. of Design & Entrepreneurship II	Found. of Design & Entrepreneurship II
		Finance for non-Finance Managers
Ashesi Units	***2 Ashesi Units***	***3 Ashesi Units***
Mathematics	Pre-Calculus 1 / Calculus 1	Pre-Calculus 1 / Calculus 1
Mathematics	Pre-Calculus 2 / Calculus 2	Pre-Calculus 2 / Calculus 2
Mathematics	Applied Calculus (Pre-Calc track only)	Applied Calculus (Pre-Calc track only)
Mathematics	Statistics	Statistics
Mathematics	Quantitative Methods or Linear Algebra	Linear Algebra
Ashesi Units	***4 Ashesi Units (5 if Pre-Calc track)***	***4 Ashesi Units (4 if Pre-Calc track)***
Computing	Intro to Computing & Information Systems	Intro to Computing & Information Systems
Ashesi Units	***1 Ashesi Unit***	***1 Ashesi Unit***
Research / Project Prep	Research Methods	Research Methods
Ashesi Units	***1 Ashesi Unit***	***1 Ashesi Unit***
Research / Project Prep	2 Non-Major Electives including at least 1 African Studies and 1 free elective	2 Non-Major Electives, including at least 1 African Studies
Ashesi Units	***3 Ashesi Units***	***2 Ashesi Units***
Total Credits – Liberal Arts & Science Core	**16.5 Ashesi Units (17.5 if Pre-Calculus)**	**16.5 Ashesi Units (17.5 if Pre-Calculus)**
MAJOR		
Required Major Class	Finance for Non-Finance Managers	Computer Programming for CS
Required Major Class	Object-Oriented Programming	Discrete Structures and Theory
Required Major Class	Competitive Strategy	Data Structures & Algorithms
Required Major Class	Computer Programming for CS	Computer Org. & Arch.
Required Major Class	Discrete Structures & Theory	Software Engineering
Required Major Class	Database Systems	Database Systems
Required Major Class	Web Technologies	Intermediate Comp. Prog.
Required Major Class	Systems Analysis & Design	Web Technologies
Required Major Class	Information & Systems Security	Networks & Data Comm.
Required Major Class	E-Commerce	Object-Oriented Programming
Required Major Class	IT Infrastructure & Systems Administration	Introduction to Artificial Intelligence
	Introduction to Artificial Intelligence	Introduction to Modelling and Simulation*
	IS Project Management	Algorithm Design & Analysis
		Systems Fundamentals*
		Operating Systems
Ashesi Units	***13 Ashesi Units***	***14 Ashesi Units***
Major Electives	2 MIS Electives	2 CS Electives
Ashesi Units	***2 Ashesi Units***	***2 Ashesi Units***
Capstone	Capstone 1 (could be electives)	Capstone 1 (could be electives)
Capstone	Capstone 2	Capstone 2
Ashesi Units	***2 Ashesi Units***	***2 Ashesi Units***
Total Credits - Major	**17 Ashesi Units**	**18 Ashesi Units**
Total Credits - Overall	**33.5 Ashesi Units (34.5 if Pre-Calc Track)**	**34.5 Ashesi Units (35.5 if Pre-Calc Track)**

1.7.3 Overview of Courses Offered in the programs in the Department of Engineering

	Computer Engineering	Electrical and Electronic Engineering	Mechanical Engineering	Mechatronics
Liberal Arts & Sciences Core				
Humanities & Social Sciences	Written and Oral Comm.	Written and Oral Comm.	Written and Oral Comm.	Written and Oral Comm.
Humanities & Social Sciences	Text and Meaning	Text and Meaning	Text and Meaning	Text and Meaning
Humanities & Social Sciences	Ashesi Success	Ashesi Success	Ashesi Success	Ashesi Success
Humanities & Social Sciences	Leadership 1*	Leadership 1*	Leadership 1*	Leadership 1*
Humanities & Social Sciences	Leadership 2*	Leadership 2*	Leadership 2*	Leadership 2*
Humanities & Social Sciences	Leadership 3*	Leadership 3*	Leadership 3*	Leadership 3*
Humanities & Social Sciences	Leadership 4 (for Engineers)	Leadership 4 (for Engineers)	Leadership 4 (for Engineers)	Leadership 4 (for Engineers)
Humanities & Social Sciences	Principles of Economics	Principles of Economics	Principles of Economics	Principles of Economics
Ashesi Units	***6.5 Ashesi Units***	***6.5 Ashesi Units***	***6.5 Ashesi Units***	***6.5 Ashesi Units***
Business	Found. Of Design & Entre. I	Found. Of Design & Entre. I	Found. Of Design & Entre. I	Found. Of Design & Entre. I
Business	Found. Of Design & Entre. II	Found. Of Design & Entre. II	Found. Of Design & Entre. II	Found. Of Design & Entre. II
Ashesi Units	***2 Ashesi Units***	***2 Ashesi Units***	***2 Ashesi Units***	***2 Ashesi Units***
Mathematics	Calculus for Engineering / Calculus 1	Calculus for Engineering / Calculus 1	Calculus for Engineering / Calculus 1	Calculus for Engineering / Calculus 1
Mathematics	Calculus 2 (if Calculus 1)	Calculus 2 (if Calculus 1)	Calculus 2 (if Calculus 1)	Calculus 2 (if Calculus 1)
Mathematics	Statistics for Engineering	Statistics for Engineering	Statistics for Engineering	Statistics for Engineering
Mathematics	Multivariable Calc. & Linear Algebra	Multivariable Calc. & Linear Algebra	Multivariable Calc. & Linear Algebra	Multivariable Calc. & Linear Algebra
Mathematics	Differential Equations & Numerical Methods	Differential Equations & Numerical Methods	Differential Equations & Numerical Methods	Differential Equations & Numerical Methods
Ashesi Units	***4 Ashesi Units (5 if Calculus 1 & 2 track)***	***4 Ashesi Units (5 if Calculus 1 & 2 track)***	***4 Ashesi Units (5 if Calculus 1 & 2 track)***	***4 Ashesi Units (5 if Calculus 1 & 2 track)***
Computing	Computer Programming for Engineering	Computer Programming for Engineering	Computer Programming for Engineering	Computer Programming for Engineering
Ashesi Units	***1 Ashesi Unit***	***1 Ashesi Unit***	***1 Ashesi Unit***	***1 Ashesi Unit***
Science	Engineering Mechanics	Engineering Mechanics	Engineering Mechanics	Engineering Mechanics
Science	Electromagnetism	Electromagnetism	Electromagnetism	Electromagnetism
Science	Material Science & Chemistry	Material Science & Chemistry	Material Science & Chemistry	Material Science & Chemistry
3 Ashesi Units	***3 Ashesi Units***	***3 Ashesi Units***	***3 Ashesi Units***	***3 Ashesi Units***
Research / Project Prep	3rd Yr. Grp. Project & Seminar*	3rd Yr. Grp. Project & Seminar*	3rd Yr. Grp. Project & Seminar*	3rd Yr. Grp. Project & Seminar*
Ashesi Units	***0.5 Ashesi Unit***	***0.5 Ashesi Unit***	***0.5 Ashesi Unit***	***0.5 Ashesi Unit***
Research / Project Prep	2 Non-Major Electives including at least 1 African studies	2 Non-Major Electives including at least 1 African studies	2 Non-Major Electives including at least 1 African studies	2 Non-Major Electives including at least 1 African studies
Ashesi Units	***2 Ashesi Units***	***2 Ashesi Units***	***2 Ashesi Units***	***2 Ashesi Units***
Total Credits – Liberal Arts & Science Core	**19 Ashesi Units (20 if Calc 1&2 Track)**	**19 Ashesi Units (20 if Calc 1&2 Track)**	**19 Ashesi Units (20 if Calc 1&2 Track)**	**19 Ashesi Units (20 if Calc 1&2 Track)**
MAJOR				
Required Major Class	Introduction to Engineering	Introduction to Engineering	Introduction to Engineering	Introduction to Engineering
Required Major Class	Instrumentation for Engineering*	Instrumentation for Engineering*	Instrumentation for Engineering*	Instrumentation for Engineering*
Required Major Class	Applied Programming for Eng.*	Applied Programming for Eng.*	Applied Programming for Eng.*	Applied Programming for Eng.*
Required Major Class	System Dynamics	System Dynamics	System Dynamics	System Dynamics
Required Major Class	Control Systems	Control Systems	Control Systems	Control Systems

	Computer Engineering	Electrical and Electronic Engineering	Mechanical Engineering	Mechatronics
Required Major Class	Digital Systems Design	Digital Systems Design	Fluid Dynamics & Applications	Digital Systems Design
Required Major Class	Circuits & Electronics	Circuits & Electronics	Circuits & Electronics	Circuits & Electronics
Required Major Class	Project Mgmt. & Prof. Practice	Project Mgmt. & Prof. Practice	Project Mgmt. & Prof. Practice	Project Mgmt. & Prof. Practice
Required Major Class	Embedded Systems	Embedded Systems	Mechanical machine Design	Embedded Systems
Required Major Class	Object Oriented Programming	Intro to Electrical Machines & Power Electronics	Intro to Electrical Machines & Power Electronics	Mechatronics
Required Major Class	Operating Systems	Advanced Electrical Machines & Power Electronics	CAD/CAM	CAD/CAM
Required Major Class	Discrete Math	Thermodynamics	Thermodynamics	Robotics
Required Major Class	Networks & Distr. Computing	Fundamentals of Thermal Fluid Science & Heat Transfer	Fundamentals of Thermal Fluid Science & Heat Transfer	Electrical Machines
Required Major Class	Communication Systems	Communications Systems	Mechanics of Materials / Structural Engineering	Mechanical Machine Design
Required Major Class	Computer Org. & Arch.	Power Engineering	Thermal Systems & Applications	Mechanics of Materials
Required Major Class	Signals & Systems	Signals & Systems	Manufacturing Processes	Signals & Systems
Ashesi Units	***15 Ashesi Units***	***15 Ashesi Units***	***15 Ashesi Units***	***15 Ashesi Units***
Major Electives	2 CE Electives	2 EE Electives	2 ME Electives	2 Electives
Ashesi Units	***2 Ashesi Units***	***2 Ashesi Units***	***2 Ashesi Units***	***2 Ashesi Units***
Capstone	Capstone	Capstone	Capstone	Capstone
Ashesi Units	***1 Ashesi Unit***	***1 Ashesi Unit***	***1 Ashesi Unit***	***1 Ashesi Unit***
Total Credits - Major	**18 Ashesi Units**	**18 Ashesi Units**	**18 Ashesi Units**	**18 Ashesi Units**
Total Credits - Overall	**37 Ashesi Units (38 if Calc 1 & Calc 2 Track)**	**37 Ashesi Units (38 if Calc 1 & Calc 2 Track)**	**37 Ashesi Units (38 if Calc 1 & Calc 2 Track)**	**37 Ashesi Units (38 if Calc 1 & Calc 2 Track)**

2 4-Year Curriculum

2.1 Business Administration, Economics, Management Information Systems, & Computer Science Programs: 4-Year Curriculum

Semester	Business Administration	Economics	Management Information Systems	Computer Science
Year 1				
Semester 1	Ashesi Success			
	Pre-Calculus I or Calculus I			
	Written and Oral Communication			
	Foundations of Design & Entrepreneurship 1			
	Introduction to Computing and Information Systems			
	Leadership Seminar 1 (Class of 2024)			
Semester 2	Text and Meaning			
	Precalculus 2 or Calculus 2			
	Leadership Seminar 1* (Class of 2025)			
	Foundations of Design and Entrepreneurship II			
			Computer Programming for CS	Computer Programming for CS
Summer	Applied Calculus (Pre-Calculus Students only)			
Year 2				
Semester 1	Leadership Seminar 2*	Leadership Seminar 2*	Leadership Seminar 2*	Leadership Seminar 2*
	Statistics with Probability	Statistics with Probability	Statistics with Probability	Statistics with Probability
	Principles of Microeconomics	Principles of Microeconomics	Principles of Microeconomics	Data Structures & Algorithms
	Financial Accounting	Mathematics for Economists	Discrete Structures & Theory	Discrete Structures & Theory
	Non-Major Elective[1]	Non-Major Elective[1]	Non-Major Elective[1] or Data Structures[2]	Non-Major Elective[1] or Microeconomics[3]
Semester 2	Leadership Seminar 3*	Leadership Seminar 3*	Leadership Seminar 3*	Leadership Seminar 3*
	Quantitative Methods	Introduction to Environmental Economics	Quantitative Methods	Linear Algebra
	Principles of Macroeconomics	Principles of Macroeconomics	Principles of Macroeconomics	Intermediate Computer Programming
	Marketing[1]	The Economy of Ghana	Database Systems	Database Systems
	Introduction to Finance	Non-Major Elective	Finance for non-Finance Managers	Finance for non-Finance Managers[1]
Year 3				
Semester 1	International Trade & Policy	Non-Major Elective	Managerial Accounting	Human Computer Interaction
	Operations Management	Development Economics	Web Technologies	Web Technologies
	Investments	Intermediate Microeconomic Theory I	Systems Analysis & Design	Computer Org & Architecture
		Intermediate Macroeconomic Theory I		
	Leadership Seminar 4 or Elective†	Leadership Seminar 4 or Elective†	Leadership Seminar 4 or Elective†	Leadership Seminar 4 or Elective†
Semester 2	Managerial Accounting	Intermediate Microeconomic Theory II	IT Infrastructure	Software Engineering
	Research Methods	Research Methods	Research Methods	Research Methods
	Elective†	Econometrics I	Systems Administration Lab*	Algorithm Design & Analysis
	Business Law	Business Law	IS Project Management*	
	Leadership Seminar 4 or Elective†	Intermediate Macroeconomic Theory II	Leadership Seminar 4 or Elective†	Leadership Seminar 4 or Elective†
Year 4				
Semester 1	Corporate Finance	Advanced Microeconomic Theory	E-Commerce	Operating Systems
	Competitive Strategy	Econometrics II	Information and Systems Security	Human Computer Interaction
	Elective†	Elective†	Elective†	Elective†
	Capstone 1 (Entrepreneurship 1 / Thesis 1/ Extra major elective)	Capstone 1 (Entrepreneurship 1 / Thesis 1/ Extra major elective)	Capstone 1 (Entrepreneurship 1 / Thesis 1/ Extra major elective)	Capstone 1 (Entrepreneurship 1 / Thesis 1/ Extra major elective)
Semester 2	Business Communications & Negotiations	Advanced Macroeconomic Theory	Competitive Strategy	Networks & Data Communications
	Elective†	Elective†	Elective†	Elective†
	Elective†	Elective†	Elective†	Elective†
	Capstone 2 ((Entrepreneurship 2 /	Capstone 2 ((Entrepreneurship 2 /	Capstone 2 ((Entrepreneurship 2 / Thesis 2/ Extra major elective)	Capstone 2 ((Entrepreneurship 2 /

Semester	Business Administration	Economics	Management Information Systems	Computer Science
	Thesis 2/ Extra major elective)	Thesis 2/ Extra major elective)		Thesis 2/ Extra major elective)

* Half-credit course

[1] Students who have started studying French and wish to continue will take *Beginning French 2* in Year 2 Sem 2 as a non-major elective (BA majors would need to postpone *Marketing* to the summer or to the elective slot in Year 3 Sem 2). The study of French can continue in Year 3 by taking *Professional French 1* and *Professional French 2* as course overloads. Alternatively, students can free up space for French in Year 3 by taking summer courses after Year 2.

† Students have flexibility in scheduling electives (major and non-major) in Years 3 and 4 but must ensure that they ultimately have the needed number of

major electives (3 for BA, 2 for MIS & CS) and non-major electives (3, including at least 1 Africana).

2.2 Business Administration Program Progression Plan - Jan 2022 (Class of 2026)

Semester	Business Administration	Theory (Lecture Hours)	Practice (Lab/ Discuss)	Credit Hours	Semester Credit Hours
Year 1					
Semester 1	Ashesi Success	1.5	N/A	N/A	
	CS 111 Introduction to Computing	3	1.5	4	
	MATH 142 Calculus 1 or Pre-calculus 1	4.5	1.5	4	
	ENGL 112 Written and Oral Communication	3	1	4	
	BUSA 161A Foundation of Design & Entrepreneurship 1	3	1	4	16
Semester 2	ENGL 113 Text and Meaning	3	1	4	
	SOAN 111 Leadership Seminar 1*	1.5	0	2	
	BUSA 161B Foundation of Design & Entrepreneurship 2	3	1	4	
	MATH 142B Calculus 2 or Pre-Calculus 2	4.5	1.5	4	14
Semester 3	Applied Calculus (for Pre-Calculus 1 and 2 students)	3	1.5	4	4
Year 2					
Semester 1	ECON 201 Principles of Microeconomics	3	1	4	
	STAT 151 Statistics with Probability	3	1.5	4	
	SOAN 211 Leadership Seminar 2*	1.5	0	2	
	Non-major Elective	3	1	4	
	BUSA 210 Financial Accounting	3	1	4	18
Semester 2	BUSA 332 Organizational Behaviour	3	1	4	
	SOAN 311 Leadership Seminar 3*	1.5	0	2	
	BUSA 220 Introduction to Finance	3	1	4	
	MATH143 Quantitative Methods	3	1.5	4	
	ECON 202 Principles of Macroeconomics	3	1	4	18
Year 3					
Semester 1	BUSA 350 International Trade and Policy	3	1	4	
	BUSA 304 Operations Management	3	1	4	
	BUSA 422 Corporate Finance	3	1	4	
	BUSA 341 Marketing	3	1	4	
	SOAN 411 Leadership Seminar 4 or Elective†	3	1	4	20
Semester 2	SOAN 325 Research Methods	3	1	4	
	BUSA 311 Managerial Accounting	3	1	4	
	Elective†	3	1	4	
	BUSA 402 Business Law	3	1	4	
	SOAN 411 Leadership Seminar 4 or Elective†	3	1	4	20
Year 4					
Semester 1	Business Communication and Negotiations	3	1	4	
	BUSA 321 Investments	3	1	4	
	Elective†	3	1	4	
	Thesis 1 or Applied Project/ Business Elective or Entrepreneurship 1	1.5	1.5	4	16
Semester 2	BUSA 405 Competitive Strategy	3	1	4	
	Elective†	3	1	4	
	Elective†	3	1	4	
	Thesis 2 or Applied Project or Entrepreneurship 2	3	1	4	16
Total Credit Hours					**138**

2.3 Economics Program Progression Plan - Jan 2024 (Class of 2027)

Semester	Economics	Theory (Lecture Hours)	Practice (Lab/ Discuss)	Credit Hours	Semester Credit Hours
Year 1					
Semester 1	Ashesi Success	1.5	N/A	N/A	
	CS 111 Introduction to Computing	3	1.5	4	
	MATH 142 Calculus 1 or Pre-calculus 1	4.5	1.5	4	
	ENGL 112 Written and Oral Communication	3	1	4	
	BUSA 161A Foundation of Design & Entrepreneurship 1	3	1	4	16
Semester 2	ENGL 113 Text and Meaning	3	1	4	
	SOAN 111 Leadership Seminar 1*	1.5	0	2	
	BUSA 161B Foundation of Design & Entrepreneurship 2	3	1	4	
	MATH 142B Calculus 2 or Pre-Calculus 2	4.5	1.5	4	14
Semester 3	Applied Calculus (only for students who did Pre-Calculus 1 and 2)	3	1.5	4	4
Year 2					
Semester 1	ECON 201 Principles of Microeconomics	3	1	4	
	ECON 221 Statistics with Probability for Economists	3	1.5	4	
	SOAN 211 Leadership Seminar 2*	1.5	0	2	
	Non-Major Elective	3	1	4	
	ECON 231 Mathematics for Economists	3	1	4	18
Semester 2	ECON 241 Introduction to Environmental Economics	3	1	4	
	SOAN 311 Leadership Seminar 3*	1.5	0	2	
	ECON 211 The Economy of Ghana	3	1	4	
	Non-Major Elective	3	1.5	4	
	ECON 202 Principles of Macroeconomics	3	1	4	18
Year 3					
Semester 1	ECON 301 Intermediate Microeconomic Theory I	3	1	4	
	ECON 303 Intermediate Macroeconomic Theory I	3	1	4	
	ECON 451 Development Economics	3	1	4	
	Non-Major Elective	3	1	4	
	SOAN 411 Leadership Seminar 4 or Elective†	3	1	4	20
Semester 2	SOAN 325 Research Methods	3	1	4	
	ECON 301 Intermediate Microeconomic Theory II	3	1	4	
	ECON 303 Intermediate Macroeconomic Theory II	3	1	4	
	BUSA 402 Business Law	3	1	4	
	SOAN 411 Leadership Seminar 4 or Elective†	3	1	4	20
Year 4					
Semester 1	ECON 401 Advanced Microeconomic Theory	3	1	4	
	ECON 422 Econometrics II	3	1	4	
	BUSA 402 Business Law	3	1	4	
	Thesis 1 or Applied Project/ Business Elective or Entrepreneurship 1	1.5	1.5	4	16
Semester 2	ECON 402 Advanced Macroeconomic Theory	3	1	4	
	Elective†	3	1	4	
	Elective†	3	1	4	
	Thesis 2 or Applied Project or Entrepreneurship 2	3	1	4	16
Total Credit Hours					142

2.4 Management Information Systems Program Progression Plan – Jan 2022 (Class of 26)

Semester	Management Information Systems	Theory (Lecture Hours)	Practice (Lab/ Discuss)	Credit Hours	Semester Credit Hours
Year 1					
Semester 1	Ashesi Success	1.5	N/A	N/A	
	CS 111 Introduction to Computing	3	1.5	4	
	MATH 142 Calculus 1 or Pre-calculus 1	4.5	1.5	4	
	ENGL 112 Written and Oral Communication	3	1	4	
	BUSA 161A Foundation of Design & Entrepreneurship 1	3	1	4	16
Semester 2	ENGL 113 Text and Meaning	3	1	4	
	SOAN 111 Leadership Seminar 1*	1.5	0	2	
	BUSA 161B Foundation of Design & Entrepreneurship 2	3	1	4	
	Computer Programming for CS	3	1	4	
	MATH 142B Calculus 2 or Pre-Calculus 2	4.5	1.5	4	18
Semester 3	Applied Calculus (only for students who did Pre-Calculus 1 and 2)	3	1.5	4	4
Year 2					
Semester 1	ECON 101 Microeconomics	3	1	4	
	STAT 151 Statistics with Probability	3	1.5	4	
	SOAN 211 Leadership Seminar 2*	1.5	0	2	
	Object Oriented Programming	3	1	4	
	Discrete Structures and Theory	3	1	4	18
Semester 2	Non-Major Elective or Data Structures	3	1	4	
	SOAN 311 Leadership Seminar 3*	1.5	0	2	
	Database Systems	3	1	4	
	MATH143 Quantitative Methods	3	1.5	4	
	Introduction to Artificial Intelligence	3	1	4	18
Year 3					
Semester 1	Web Technologies	3	1	4	
	Systems Analysis & Design	3	1	4	
	Finance for Non-Finance Managers	3	1	4	
	SOAN 411 Leadership Seminar 4 or Elective†	3	1	4	16
Semester 2	SOAN 325 Research Methods	3	1	4	
	IT Infrastructure and Systems Administration	3	1	4	
	IS Project Management	3	1	4	
	SOAN 411 Leadership Seminar 4 or Elective†	3	1	4	16
Year 4					
Semester 1	E-Commerce	3	1	4	
	Information and Systems Security	3	1	4	
	Elective†	3	1	4	
	Thesis 1 or Applied Project/ Business Elective or Entrepreneurship 1	1.5	1.5	4	16
Semester 2	BUSA 405 Competitive Strategy	3	1	4	
	Elective†	3	1	4	
	Elective†	3	1	4	
	Thesis 2 or Applied Project or Entrepreneurship 2	3	1	4	16
Total Credit Hours					138

2.5 Computer Science Program Progression Plan - Jan 2022 (Class of 2026)

Semester	Computer Science	Theory (Lecture Hours)	Practice (Lab/ Discuss)	Credit Hours	Semester Credit Hours
Year 1					
Semester 1	Ashesi Success	1.5	N/A	N/A	
	CS 111 Introduction to Computing	3	1.5	4	
	MATH 142 Calculus 1 or Pre-calculus 1	4.5	1.5	4	
	ENGL 112 Written and Oral Communication	3	1	4	
	BUSA 161A Foundation of Design & Entrepreneurship 1	3	1	4	16
Semester 2	ENGL 113 Text and Meaning	3	1	4	
	SOAN 111 Leadership Seminar 1*	1.5	0	2	
	BUSA 161B Foundation of Design & Entrepreneurship 2	3	1	4	
	Computer Programming for CS				
	MATH 142B Calculus 2 or Pre-Calculus 2	4.5	1.5	4	18
Semester 3	Applied Calculus (only for students who did Pre-Calculus 1 and 2)	3	1.5	4	4
Year 2					
Semester 1	Principles of Economics	3	1	4	
	STAT 151 Statistics with Probability	3	1.5	4	
	SOAN 211 Leadership Seminar 2*	1.5	0	2	
	Discrete Structures & Theory	3	1	4	
	Object Oriented Programming	3	1	4	18
Semester 2	Linear Algebra	3	1	4	
	SOAN 311 Leadership Seminar 3*	1.5	0	2	
	Data Structures & Algorithms	3	1	4	
	Database Systems	3	1.5	4	
	Introduction to Artificial Intelligence	3	1	4	18
Year 3					
Semester 1	Web Technologies	3	1	4	
	Algorithm Design & Analysis	3	1	4	
	Intermediate Computer Programming	3	1	4	
	Systems Fundamentals*	1.5	1	2	
	SOAN 411 Leadership Seminar 4 or Elective†	3	1	4	18
Semester 2	SOAN 325 Research Methods	3	1	4	
	Software Engineering	3	1	4	
	Computer Organization & Architecture	3	1	4	
	Introduction to Modelling and Simulation*	1.5	1	2	
	SOAN 411 Leadership Seminar 4 or Elective†	3	1	4	18
Year 4					
Semester 1	Operating Systems	3	1	4	
	Finance for Non-Finance Managers	3	1	4	
	Elective†	3	1	4	
	Thesis 1 or Applied Project/ Business Elective or Entrepreneurship 1	1.5	1.5	4	16
Semester 2	Networks & Data Communication	3	1	4	
	Elective†	3	1	4	
	Elective†	3	1	4	
	Thesis 2 or Applied Project or Entrepreneurship 2	3	1	4	16
Total Credit Hours					142

2.6 Computer Engineering, Electrical and Electronic Engineering, Mechanical Engineering, and Mechatronics Programs: 4-Year Curriculum

Semester	Computer Engineering	Electrical and Electronic Engineering	Mechanical Engineering	Mechatronics
Year 1				
Semester 1	Written and Oral Communication			
	Calculus for Engineers			
	Introduction to Engineering			
	Giving Voice to Values			
	Foundations Design & Entrepreneurship 1			
Semester 2	Computer Programming for Engineering			
	Multivariable Calculus & Linear Algebra			
	Engineering Mechanics			
	Foundations Design & Entrepreneurship 2			
	Leadership Seminar 1*			
Year 2				
Semester 1	Physics: Electromagnetism	Physics: Electromagnetism	Physics: Electromagnetism	Physics: Electromagnetism
	Discrete Mathematics	CAD/CAM	CAD/CAM	CAD/CAM
	Statistics for Engineering	Statistics for Engineering	Statistics for Engineering	Statistics for Engineering
	Object Oriented Programming	Thermodynamics	Thermodynamics	Robotics
	Leadership Seminar 2*	Leadership Seminar 2*	Leadership Seminar 2*	Leadership Seminar 2*
Semester 2	Circuits and Electronics	Circuits and Electronics	Circuits and Electronics	Circuits and Electronics
	Materials Science & Chemistry	Materials Science & Chemistry	Materials Science & Chemistry	Materials Science & Chemistry
	Applied Programming for Engineers	Applied Programming for Engineers	Applied Programming for Engineers	Applied Programming for Engineers
	Differential Equations & Numerical Methods	Differential Equations & Numerical Methods	Differential Equations & Numerical Methods	Differential Equations & Numerical Methods
	Text and Meaning	Text and Meaning	Text and Meaning	Text and Meaning
	Leadership Seminar 3*	Leadership Seminar 3*	Leadership Seminar 3*	Leadership Seminar 3*
Year 3				
Semester 1	Computer Organization & Architecture	Electrical Machines	Electrical Machines	Electrical Machines
	System Dynamics	System Dynamics	System Dynamics	System Dynamics
	Signals & Systems	Signals & Systems	Mechanics of Materials	Mechanics of Materials
	Leadership Seminar 4 for Engineers (Includes Year 3 Group Project)	Leadership Seminar 4 for Engineers (Includes Year 3 Group Project)	Leadership Seminar 4 for Engineers (Includes Year 3 Group Project)	Leadership Seminar 4 for Engineers (Includes Year 3 Group Project)
	Instrumentation for Engineering*	Instrumentation for Engineering*	Instrumentation for Engineering*	Instrumentation for Engineering*
Semester 2	Control Systems	Control Systems	Control Systems	Control Systems
	Networks & Data Communications	Electrical Machines & Power Elect II	Mechanical Machine Design	Mechanical Machine Design
	Digital Systems Design	Digital Systems Design	Fluid Mechanics	Digital Systems Design
	Intermediate Computer Programming	Communication Systems	Manufacturing Processes	Elective
	CE Elective	EE Elective	ME Elective	EE Elective
Year 4				
Semester 1	Operating Systems	Power Engineering	Mechanics of Machines	Mechatronics
	CE Elective	EE Elective	ME Elective	MT Elective
	Principles of Economics	Principles of Economics	Principles of Economics	Principles of Economics
	Embedded Systems	Embedded Systems	Heat Transfer	Embedded Systems
	Elective	Elective	Elective	Signals & Systems
Semester 2	Project Management and Professional Practice	Project Management and Professional Practice	Project Management and Professional Practice	Project Management and Professional Practice
	CE Elective	EE Elective	ME Elective	MT Elective
	African Studies Elective	African Studies Elective	Manufacturing Processes	African Studies Elective
	Senior Project & Seminar	Senior Project & Seminar	Senior Project & Seminar	Senior Project & Seminar

EE Year 4: students wishing to do Networks should do Africana in Sem 1 and Networks in Sem II

CE: Year 4: if desiring to do a Sem II elective, consider doing Africana in Sem 1

2.7 Computer Engineering Program Progression Plan – Jan 2022 (Class of 2026)

Semester	Computer Engineering	Theory (Lecture Hours)	Practice (Lab/ Discuss)	Credit Hours	Semester Credit Hours
Year 1					
Semester 1	Ashesi Success	1.5	N/A	N/A	
	Introduction to Engineering	3	1.5	4	
	Calculus for Engineering	4.5	1.5	4	
	ENGL 112 Written and Oral Communication	3	1	4	
	BUSA 161A Foundation of Design & Entrepreneurship 1	3	1	4	16
Semester 2	Computer Programming for Engineering	3	1	4	
	SOAN 111 Leadership Seminar 1*	1.5	0	2	
	BUSA 161B Foundation of Design & Entrepreneurship 2	3	1	4	
	Physics: Mechanics	4.5	1.5	4	
	Multivariable Calculus & Linear Algebra	4.5	1.5	4	18
Year 2					
Semester 1	Physics: Electromagnetism	3	1	4	
	Discrete Math	3	1.5	4	
	SOAN 211 Leadership Seminar 2*	1.5	0	2	
	Statistics for Engineering	3	1	4	
	Object Oriented Programming	3	1	4	18
Semester 2	ENGL 113 Text and Meaning	3	1	4	
	SOAN 311 Leadership Seminar 3*	1.5	0	2	
	Circuits and Electronics	3	1	4	
	Applied Programming for Engineers	1.5	1	2	
	Materials Science & Chemistry	3	1	4	
	Differential Equations & Numerical Methods	3	1.5	4	20
Year 3					
Semester 1	Computer Organization & Architecture	3	1	4	
	System Dynamics	3	1	4	
	Signals & Systems	3	1	4	20
	Instrumentation for Engineering*	1.5	1	2	
	SOAN 411 Leadership Seminar 4	3	1	4	
	Year 3 Group Project & Seminar*	1.5	1	2	
Semester 2	Control Systems	3	1	4	
	Data Structures & Algorithms	3	1	4	
	Elective†	3	1	4	20
	Networks & Data Communications	3	1	4	
	Digital Systems Design	3	1	4	
Year 4					
Semester 1	Operating Systems	3	1	4	
	Principles of Economics	3	1	4	
	Elective†	3	1	4	
	Embedded Systems	3	1.5	4	
	Elective†	3	1	4	20
Semester 2	Project Management and Professional Practice	3	1	4	
	Elective†	3	1	4	
	African Studies Elective	3	1	4	
	Applied Project	3	1	4	16
Total Credit Hours					**148**

2.8 Electrical and Electronic Engineering Program Progression Plan - Jan 2022 (Class of 2026)

Semester	Electrical and Electronic Engineering	Theory (Lecture Hours)	Practice (Lab/ Discuss)	Credit Hours	Semester Credit Hours
Year 1					
Semester 1	Ashesi Success	1.5	N/A	N/A	
	Introduction to Engineering	3	1.5	4	
	Calculus for Engineering	4.5	1.5	4	
	ENGL 112 Written and Oral Communication	3	1	4	
	BUSA 161A Foundation of Design & Entrepreneurship 1	3	1	4	16
Semester 2	Computer Programming for Engineering	3	1	4	
	SOAN 111 Leadership Seminar 1*	1.5	0	2	
	BUSA 161B Foundation of Design & Entrepreneurship 2	3	1	4	
	Physics: Mechanics	4.5	1.5	4	
	Multivariable Calculus & Linear Algebra	3	1.5	4	18
Year 2					
Semester 1	Physics: Electromagnetism	3	1	4	
	CAD/CAM	3	1.5	4	
	SOAN 211 Leadership Seminar 2*	1.5	0	2	
	Statistics for Engineering	3	1	4	
	Thermodynamics	3	1	4	18
Semester 2	ENGL 113 Text and Meaning	3	1	4	
	SOAN 311 Leadership Seminar 3*	1.5	0	2	
	Circuits and Electronics	3	1	4	
	Applied Programming for Engineers	1.5	1	2	
	Materials Science & Chemistry	3	1	4	
	Differential Equations & Numerical Methods	3	1.5	4	20
Year 3					
Semester 1	Electrical Machines	3	1	4	
	System Dynamics	3	1	4	
	Signals & Systems	3	1	4	
	Instrumentation for Engineering*	1.5	1.5	2	20
	SOAN 411 Leadership Seminar 4	3	1	4	
	Year 3 Group Project & Seminar*	1.5	1.5	2	
Semester 2	Control Systems	3	1	4	
	Communication Systems	3	1	4	
	Elective†	3	1	4	20
	Electrical Machines & Power Electronics II	3	1	4	
	Digital Systems Design	3	1	4	
Year 4					
Semester 1	Power Engineering	3	1	4	
	Principles of Economics	3	1	4	
	Elective†	3	1	4	
	Embedded Systems	3	1.5	4	
	Elective†	3	1	4	20
Semester 2	Elective†	3	1	4	
	Project Management and Professional Practice	3	1	4	
	African Studies Elective	3	1	4	
	Applied Project	3	1	4	16
Total Credit Hours					**148**

2.9 Mechanical Engineering Program Progression Plan - Jan 2022 (Class of 2026)

Semester	Mechanical Engineering	Theory (Lecture Hours)	Practice (Lab/ Discuss)	Credit Hours	Semester Credit Hours
Year 1					
Semester 1	Ashesi Success	1.5	N/A	N/A	
	Introduction to Engineering	3	1.5	4	
	Calculus for Engineering	4.5	1.5	4	
	ENGL 112 Written and Oral Communication	3	1	4	
	BUSA 161A Foundation of Design & Entrepreneurship 1	3	1	4	16
Semester 2	Computer Programming for Engineering	3	1	4	
	SOAN 111 Leadership Seminar 1*	1.5	0	2	
	BUSA 161B Foundation of Design & Entrepreneurship 2	3	1	4	
	Physics: Mechanics	4.5	1.5	4	
	Multivariable Calculus & Linear Algebra	3	1.5	4	18
Year 2					
Semester 1	Physics: Electromagnetism	3	1	4	
	CAD/CAM	3	1.5	4	
	SOAN 211 Leadership Seminar 2*	1.5	0	2	
	Statistics for Engineering	3	1	4	
	Thermodynamics	3	1	4	18
Semester 2	ENGL 113 Text and Meaning	3	1	4	
	SOAN 311 Leadership Seminar 3*	1.5	0	2	
	Circuits and Electronics	3	1	4	
	Applied Programming for Engineers*	1.5	1	2	
	Materials Science & Chemistry	3	1	4	
	Differential Equations & Numerical Methods	3	1.5	4	20
Year 3					
Semester 1	Electrical Machines	3	1	4	
	System Dynamics	3	1	4	
	Mechanics of Materials	3	1	4	
	Instrumentation for Engineering*	1.5	1.5	2	20
	SOAN 411 Leadership Seminar 4	3	1	4	
	Year 3 Group Project & Seminar*	1.5	1.5	2	
Semester 2	Control Systems	3	1	4	
	Manufacturing Processes	3	1	4	
	Elective†	3	1	4	20
	Mechanical Machine Design	3	1	4	
	Fluid Mechanics	3	1	4	
Year 4					
Semester 1	Mechanics of Machines	3	1	4	
	Principles of Economics	3	1	4	
	Elective†	3	1	4	
	Heat Transfer	3.5	1.5	4	
	Elective†	1.5	1.5	4	20
Semester 2	Elective†	3	1	4	
	Project Management and Professional Practice	3	1	4	
	African Studies Elective	3	1	4	
	Applied Project	3	1	4	16
Total Credit Hours					**148**

2.10 Mechatronics Program Progression Plan - Jan 2024 (Class of 2027)

Semester	Mechatronics	Theory (Lecture Hours)	Practice (Lab/ Discuss)	Credit Hours	Semester Credit Hours
Year 1					
Semester 1	Ashesi Success	1.5	N/A	N/A	
	Introduction to Engineering	3	1.5	4	
	Calculus for Engineering	4.5	1.5	4	
	ENGL 112 Written and Oral Communication	3	1	4	
	BUSA 161A Foundation of Design & Entrepreneurship 1	3	1	4	16
Semester 2	Computer Programming for Engineering	3	1	4	
	SOAN 111 Leadership Seminar 1*	1.5	0	2	
	BUSA 161B Foundation of Design & Entrepreneurship 2	3	1	4	
	Physics: Mechanics	4.5	1.5	4	
	Multivariable Calculus & Linear Algebra	3	1.5	4	18
Year 2					
Semester 1	Physics: Electromagnetism	3	1	4	
	CAD/CAM	3	1.5	4	
	SOAN 211 Leadership Seminar 2*	1.5	0	2	
	Statistics for Engineering	3	1	4	
	Robotics	3	1	4	18
Semester 2	ENGL 113 Text and Meaning	3	1	4	
	SOAN 311 Leadership Seminar 3*	1.5	0	2	
	Circuits and Electronics	3	1	4	
	Applied Programming for Engineers*	1.5	1	2	
	Materials Science & Chemistry	3	1	4	
	Differential Equations & Numerical Methods	3	1.5	4	20
Year 3					
Semester 1	Electrical Machines	3	1	4	
	System Dynamics	3	1	4	
	Mechanics of Materials	3	1	4	
	Instrumentation for Engineering*	1.5	1.5	2	
	SOAN 411 Leadership Seminar 4	3	1	4	
	Year 3 Group Project & Seminar*	1.5	1.5	2	20
Semester 2	Control Systems	3	1	4	
	Digital Systems Design	3	1	4	
	Elective†	3	1	4	
	Mechanical Machine Design	3	1	4	
	EE Electives	3	1	4	20
Year 4					
Semester 1	Mechatronics	3	1	4	
	Principles of Economics	3	1	4	
	MT Elective	3	1	4	
	Embedded Systems	3	1	4	
	Signals & Systems	3	1	4	20
Semester 2	Elective†	3	1	4	
	Project Management and Professional Practice	3	1	4	
	African Studies Elective	3	1	4	
	Applied Project	3	1	4	16
Total Credit Hours					148

3 PLANS OF STUDY PER YEAR, SEMESTER, AND PROGRAM

3.1 Plan of Study: Business Administration

ASHESI UNIVERSITY
Department of Business Administration

BSc. Business Administration

Ashesi Courses

Freshman Undergraduate	Sophomore Undergraduate	Junior Undergraduate	Senior Undergraduate
YEAR 1 **SEMESTER 1 & 2**	**YEAR 2** **SEMESTER 3 & 4**	**YEAR 3** **SEMESTER 5 & 6**	**YEAR 4** **SEMESTER 7 & 8**
SEMESTER 1	**SEMESTER 3**	**SEMESTER 5**	**SEMESTER 7**
• Ashesi Success • Pre-calculus 1 or Calculus 1 (4 credits) • Written & Oral Communication (4 credits) • Foundations of Design & Entrepreneurship 1 (4 credits) • Introduction to Computing and Information Systems (4 credits)	• Leadership Seminar 2 (2 credits) • Statistics (4 credits) • Microeconomics (4 credits) • Financial Accounting (4 credits) • Non- Major Elective (4 credits)	• Operations Management (4 credits) • International Trade & Policy (4 credits) • Leadership Seminar IV or Elective (4 credits) • Marketing (4 credits) • Corporate Finance (4 credits)	• Competitive Strategy (4 credits) • Elective (4 credits) • Investments (4 credits) • Capstone 1 (4 credits)
SEMESTER 2	**SEMESTER 4**	**SEMESTER 6**	**SEMESTER 8**
• Leadership Seminar 1 (2 credits) • Pre-calculus 2 or Calculus 2 (4 credits) • Text and Meaning (4 credits) • Foundations of Design and Entrepreneurship II (4 credits)	• Leadership Seminar 3 (2 credits) • Quantitative Methods (4 credits) • Macroeconomics (4 credits) • Introduction to Finance (4 credits) • Organizational Behaviour (4 credits)	• Research Methods (4 credits) • Managerial Accounting (4 credits) • Business Elective (4 credits) • Leadership Seminar IV or Elective (4 credits) • Business Law (4 credits)	• Business Communication and Negotiations (4 credits) • Elective (4 credits) • Elective (4 credits) • Capstone 2 (4 credits)
SUMMER			
Applied Calculus (Pre-Calculus Students only) (4 credits)			
Total Credits: 30-34	**Total Credits: 36**	**Total Credits: 40**	**Total Credits: 32**

Total Credits for BA Program = 138-142

3.2 Plan of Study: Computer Science

ASHESI UNIVERSITY
Department of Computer Science and Information Systems

BSc. Computer Science

Freshman Undergraduate	Sophomore Undergraduate	Junior Undergraduate	Senior Undergraduate
YEAR 1 **SEMESTER 1 & 2**	**YEAR 2** **SEMESTER 3 & 4**	**YEAR 3** **SEMESTER 5 & 6**	**YEAR 4** **SEMESTER 7 & 8**
SEMESTER 1	**SEMESTER 3**	**SEMESTER 5**	**SEMESTER 7**
• Ashesi Success (0 credits) • Pre-calculus 1 or Calculus 1 (4 credits) • Written & Oral Communication (4 credits) • Foundations of Design & Entrepreneurship 1 (4 credits) • Intro. To Computing & Information Systems (4 credits)	• Leadership Seminar 2 (2 credits) • Statistics (4 credits) • Principles of Economics (4 credits) • Discrete Structures & Theory (4 credits) • Object Oriented Programming (4 credits)	• Leadership Seminar 4 or Major Elective (4 credits) • Web Technologies (4 credits) • Algorithm Design & Analysis (4 credits) • Intermediate Computer Programming (4 credits) • Systems Fundamentals (2 credits)	• Operating Systems (4 credits) • Finance for non-Finance Managers (4 credits) • Elective (4 credits) • Capstone 1 (Undergraduate Thesis 1/ Entrepreneurship 1/ Extra major elective) (4 credits) • CSIS Capstone Seminar (0 credits)
SEMESTER 2	**SEMESTER 4**	**SEMESTER 6**	**SEMESTER 8**
• Leadership 1 (2 credits) • Pre-calculus 2 or Calculus 2 (4 credits) • Text & Meaning (4 credits) • Foundations of Design & Entrepreneurship 2 (4 credits) • Computer Programming for CS (4 credits)	• Leadership Seminar 3 (2 credits) • Linear Algebra (4 credits) • Data Structures & Algorithms (4 credits) • Database Systems (4 credits) • Introduction to Artificial Intelligence (4 credits)	• Leadership Seminar 4 or Elective (4 credits) • Software Engineering (4 credits) • Computer Organization & Architecture (4 credits) • Research Methods (4 credits) • Introduction to Modelling and Simulation (2 credits)	• Networks & Data Communications (4 credits) • Elective (4 credits) • Elective (4 credits) • Capstone 2 (Undergraduate Thesis 2/ Entrepreneurship 2/ Applied Project) (4 credits)
SUMMER			
Applied Calculus (Pre-Calculus Students only) (4 credits)			
Total Credits: 34-38	**Total Credits: 36**	**Total Credits: 40**	**Total Credits: 32**

Total Credits for CS Program = 142-146

3.3 Plan of Study: Management Information Systems

ASHESI UNIVERSITY
Department of Computer Science and Information Systems

BSc. Management Information Systems

Freshman Undergraduate	Sophomore Undergraduate	Junior Undergraduate	Senior Undergraduate
YEAR 1 **SEMESTER 1 & 2**	**YEAR 2** **SEMESTER 3 & 4**	**YEAR 3** **SEMESTER 5 & 6**	**YEAR 4** **SEMESTER 7 & 8**
SEMESTER 1	**SEMESTER 3**	**SEMESTER 5**	**SEMESTER 7**
• Ashesi Success (0 credit) • Pre-calculus 1 or Calculus 1 (4 credits) • Written & Oral Communication (4 credits) • Foundations of Design & Entrepreneurship 1 (4 credits) • Intro. To Computing & Information Systems (4 credits)	• Leadership Seminar 2 (2 credits) • Statistics (4 credits) • Principles of Economics (4 credits) • Discrete Structures & Theory (4 credits) • Object Oriented Programming (4 credits)	• Leadership Seminar 4 or Major Elective (4 credits) • Web Technologies (4 credits) • Systems Analysis & Design (4 credits) • Finance for non-finance managers (4 credits)	• E-Commerce (4 credits) • Information and Systems Security (4 credits) • Elective (4 credits) • Capstone 1 (Entrepreneurship 1/Thesis 1/ Extra major elective) (4 credits)
SEMESTER 2	**SEMESTER 4**	**SEMESTER 6**	**SEMESTER 8**
• Leadership Seminar 1 (2 credits) • Pre-calculus 2 or Calculus 2 (4 credits) • Text & Meaning (4 credits) • Foundations of Design & Entrepreneurship 2 (4 credits) • Computer Programming for CS (4 credits)	• Leadership Seminar 3 (2 credits) • Quantitative Methods (4 credits) • Database Systems (4 credits) • Introduction to Artificial Intelligence (4 credits) • Non-Major Elective or Data Structures (4 credits)	• Leadership Seminar 4 or Major Elective (4 credits) • Research Methods (4 credits) • IT Infrastructure and Systems Administration (4 credits) • IS Project Management (4 credits)	• Competitive Strategy (4 credits) • Elective (4 credits) • Elective (4 credits) • Capstone 2 (Entrepreneurship 2/ Thesis 2/ Applied Project) (4 credits)
SUMMER			
Applied Calculus (Pre-Calculus Students only) (4 credits)			
Total Credits: 34	**Total Credits: 36-40**	**Total Credits: 32**	**Total Credits: 32**

Total Credits for MIS Program = 134-138

3.4 Plan of Study: Computer Engineering

ASHESI UNIVERSITY
Department of Engineering

BSc. Computer Engineering

Ashesi Courses

Freshman Undergraduate	Sophomore Undergraduate	Junior Undergraduate	Senior Undergraduate
YEAR 1 **SEMESTER 1 & 2**	**YEAR 2** **SEMESTER 3 & 4**	**YEAR 3** **SEMESTER 5 & 6**	**YEAR 4** **SEMESTER 7 & 8**
SEMESTER 1	**SEMESTER 3**	**SEMESTER 5**	**SEMESTER 7**
• GVV (0 credit) • Calculus for Engineering (4 credits) • Written & Oral Communication (4 credits) • Foundations of Design & Entrepreneurship 1 (4 credits) • Introduction to Engineering (4 credits)	• Physics: Electromagnetism (4 credits) • Statistics for Engineering (4 credits) • Discrete Math (4 credits) • Object Oriented Programming (Java) (4 credits) • Leadership Seminar 2 (2 credits)	• Computer Organization & Architecture (4 credits) • System Dynamics (4 credits) • Signals & Systems (4 credits) • Leadership Seminar 4 for Engineers (4 credits) • Instrumentation for Engineering (2 credits) • Year 3 Group Project & Seminar (2 credits)	• Operating Systems (4 credits) • CE Elective (4 credits) • Principles of Economics (4 credits) • Embedded Systems (4 credits) • Elective (4 credits)
SEMESTER 2	**SEMESTER 4**	**SEMESTER 6**	**SEMESTER 8**
• Computer Programming for Engineering (4 credits) • Multivariable Calculus & Linear Algebra (4 credits) • Engineering Mechanics (4 credits) • Foundations of Design & Entrepreneurship 2 (4 credits) • Leadership Seminar 1 (2 credits)	• Leadership Seminar 3 (2 credits) • Circuits and Electronics (4 credits) • Materials Science & Chemistry (4 credits) • Differential Equations & Numerical Methods (4 credits) • Text and Meaning (4 credits) • Applied Programming for Engineers (2 credits)	• Control Systems (4 credits) • Networks & Data Communications (4 credits) • Data Structures & Algorithms (4 credits) • Digital Systems Design (4 credits) • CE Elective (4 credits)	• Project Management and Professional Practice (4 credits) • CE Elective (4 credits) • African Studies Elective (4 credits) • Senior Project & Seminar (4 credits)
Total Credits: 34	**Total Credits: 38**	**Total Credits: 40**	**Total Credits: 36**

Total Credits for Computer Engineering Program=148

3.5 Plan of Study: Electrical & Electronic Engineering

ASHESI UNIVERSITY
Department of Engineering

BSc. Electrical Engineering

Ashesi Courses

Freshman Undergraduate	Sophomore Undergraduate	Junior Undergraduate	Senior Undergraduate
YEAR 1 **SEMESTER 1 & 2**	**YEAR 2** **SEMESTER 3 & 4**	**YEAR 3** **SEMESTER 5 & 6**	**YEAR 4** **SEMESTER 7 & 8**
SEMESTER 1	**SEMESTER 3**	**SEMESTER 5**	**SEMESTER 7**
• Calculus for Engineering (4 credits) • Written & Oral Communication (4 credits) • Foundations of Design & Entrepreneurship 1 (4 credits) • Introduction to Engineering (4 credits) • GVV (0 credit)	• Physics Electromagnetism (4 credits) • CAD/CAM (4 credits) • Thermodynamics (4 credits) • Leadership Seminar 2 (2 credits) • Statistics for Engineers (4 credits)	• Electrical Machines (4 credits) • System Dynamics (4 credits) • Signals & Systems (4 credits) • Leadership 4 for Engineers (4 credits) • Instrumentation for Engineers (2 credits • Year 3 Group Project & Seminar (2 credits)	• Power Engineering (4 credits) • EE Elective (4 credits) • Principles of Economics (4 credits) • Embedded Systems (4 credits) • Elective (4 credits)
SEMESTER 2	**SEMESTER 4**	**SEMESTER 6**	**SEMESTER 8**
• Computer Programming for Engineering (4 credits) • Multivariable Calculus & Linear Algebra (4 credits) • Engineering Mechanics (4 credits) • Foundations of Design & Entrepreneurship 2 (4 credits) • Leadership Seminar 1 (2 credits)	• Leadership Seminar 3 (2 credits) • Circuits & Electronics (4 credits) • Text and Meaning (4 credits) • Material Science & Chemistry (4 credits) • Applied Programming for Engineers (2 credits) • Differential Equations & Numerical Methods (4 credits)	• Control Systems (4 credits) • Electrical Machines & Power Elect II (4 credits) • Digital Systems Design (4 credits) • Communication Systems (4 credits) • EE Elective (4 credits)	• Project Management and Professional Practice (4 credits) • EE Elective (4 credits) • African Studies Elective (4 credits) • Senior Project & Seminar (4 credits)
Total Credits: 34	**Total Credits: 38**	**Total Credits: 40**	**Total Credits: 36**

Total Credits for Electrical Engineering Program=148

3.6 Plan of Study: Mechanical Engineering

ASHESI UNIVERSITY
Department of Engineering

BSc. Mechanical Engineering

Ashesi Courses

Freshman Undergraduate	Sophomore Undergraduate	Junior Undergraduate	Senior Undergraduate
YEAR 1 **SEMESTER 1 & 2**	**YEAR 2** **SEMESTER 3 & 4**	**YEAR 3** **SEMESTER 5 & 6**	**YEAR 4** **SEMESTER 7 & 8**
SEMESTER 1	**SEMESTER 3**	**SEMESTER 5**	**SEMESTER 7**
• Calculus for Engineering 1 (4 credits) • Written & Oral Communication (4 credits) • Foundations of Design & Entrepreneurship (4 credits) • Introduction to Engineering (4 credits) • GVV (0 credit)	• Physics Electromagnetism (4 credits) • CAD/CAM (4 credits) • Thermodynamics (4 credits) • Leadership Seminar 2 (2 credits) • Statistics for Engineers (4 credits)	• Electrical Machines (4 credits) • System Dynamics (4 credits) • Mechanics of Materials (4 credits) • Leadership 4 for Engineers (4 credits) • Instrumentation for Engineering (2 credits) • Year 3 Group Project & Seminar (2 credits)	• Mechanics of Machines (4 credits) • ME Elective (4 credits) • Principles of Economics (4 credits) • Heat Transfer (4 credits) • Elective (4 units)
SEMESTER 2	**SEMESTER 4**	**SEMESTER 6**	**SEMESTER 8**
• Computer Programming for Engineering (4 credits) • Multivariable Calculus & Linear Algebra (4 credits) • Engineering Mechanics (4 Credits) • Foundations of Design & Entrepreneurship 2 (4 credits) • Leadership Seminar 1 (2 credits)	• Leadership Seminar 3 (2 credits) • Circuits & Electronics (4 credits) • Text and Meaning (4 credits) • Material Science & Chemistry (4 credits) • Applied Programming for Engineers (2 credits) • Differential Equations & Numerical Methods (4 credits)	• Control Systems (4 credits) • Mechanical Machine Design (4 credits) • Fluid Mechanics (4 credits) • Manufacturing Processes (4 credits) • ME Elective (4 credits)	• Project Management & Professional Practice (4 credits) • ME Elective (4 credits) • African Studies Elective (4 credits) • Senior Project & Seminar (4 credits)
Total Credits: 34	**Total Credits: 38**	**Total Credits: 40**	**Total Credits: 36**

Total Credits for ME Program = 148

4 Descriptions Of Courses and Prerequisites

4.1 Business Administration

4.1.1 BUSA 001 Entrepreneurship Universe

Required for Freshman Students

Prerequisite: none

Offered: Fall

Course Type: Lecture, Seminar, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Entrepreneurship Universe is a four-week introductory overview of the entrepreneurial discipline. The module will take students on an exciting journey of understanding and connecting dots in selected domains of entrepreneurship as deemed relevant. Specific aspects to be covered will include the definition and evolution of entrepreneurship, the role of entrepreneurship in economic development, forms of entrepreneurial endeavours, myths of entrepreneurship, key characteristics of entrepreneurs, and what the entrepreneurship process entails within and outside our context, among others.

4.1.2 BUSA 100 Principles of Economics

Required for all CS & ENG Majors

Prerequisite: Pre-Calculus 2 or Calculus 1

Offered: Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Welcome to Principles of Economics. This course is an exciting introduction to the field of economics, with application to the local context. Economics has two main divisions: microeconomics and macroeconomics. We will first tackle the microeconomics topics and then move on to the macroeconomics topics, but both topics are equally pertinent. After a general introduction to the field of economics and explaining the difference between microeconomics and macroeconomics, the course will start by delving into microeconomic theory before finishing up with macroeconomics theory.

Traditional microeconomic topics that will be treated include the concept of the invisible hand and the role of incentives in the market - supply and demand, international trade, elasticity, taxation, and the implications of government policy for individual firms. For the section on macroeconomics, we will discuss simple models of goods and services, assets, capital, and labour markets, which can be usefully applied to generate realistic predictions regarding the behaviour of such macroeconomic variables as output and growth, employment, inflation, the current account; as well as interest and exchange rates. The course will teach students to use these models to understand and interpret current and historical macroeconomic developments. Current macroeconomic developments and policy changes, such as the effects of the COVID-19 pandemic, global inflation related to rising oil prices and the geopolitical conflict between Russia and Ukraine, and possible impacts of national debt and corruption on macroeconomic stability and performance of African countries like Ghana, will be discussed. The role of the IMF in helping countries to manage economic challenges will be assessed.

4.1.3 BUSA 132 Organizational Behaviour

Required for all BA Majors

Prerequisite: None

Offered: Typically taught in Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

How can managers motivate employees to go above the call of duty to get the job done? How can managers be sure their decisions are not biased? What influence tactics can managers use when they do not have formal authority to tell someone what to do? This course will help students understand life in complex organisations by covering topics that span microanalysis dealing with individuals and macro analysis dealing with the organisation. The course is managerial in orientation and focuses on the processes necessary to organise, motivate, direct and control people engaged in collective activities. The emphasis is on developing concepts and strategies that will help students become more effective managers. The course uses readings, cases, exercises, and videos to illustrate the conceptual and applied aspects of individual, group and organisational behaviour.

4.1.4 BUSA 161/A Foundation of Design & Entrepreneurship I

Required for all Ashesi Students

Prerequisite: none

Offered: Fall

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This is the first part of a yearlong course on design and entrepreneurship. The goal of the course is to immerse all first-year students at the University, irrespective of major, into the world of design thinking, entrepreneurship, and business management. For this semester's work, the course will cover two main aspects: design thinking for problem-solving and entrepreneurial opportunity analysis. The two areas will involve students undertaking exercises to help hone their skills in design thinking and conduct business opportunity identification and analysis culminating in business concepts. Students will then develop and validate their business concepts and present them for evaluation. The first half of this semester will look at creativity, design thinking and innovation to position students to develop an innovative posture. Class sessions and activities will see students uncovering how the brain creates and prevents creativity, how to reframe problems, conduct research, conduct sense-making to uncover insights from research, develop a point of view, ideate, prototype, and develop solutions to the problems identified. The key focus areas teach them to deal with ambiguity and be innovative and creative amid limitations and constraints. Students will also learn how to prototype and test their ideas with users. The second half of the semester will be structured to help students evaluate their design proposals and decide how to take them further. Building on the background from the design module, students will study business opportunity analysis and business model development as entrepreneurs and intrapreneurs. They will run through the theories of business venture modelling to help them model their business concepts. This will serve as a basis for using tools like the business model canvas, which will require that students identify potential customer segments and develop and test value propositions that address their pain points, problems or needs they discovered in the first part of the course. At the end of the semester, students will reflect on the course as well as present their business concepts for evaluation and selection for the business simulation project in the second semester.

4.1.5 BUSA 162 Foundation of Design & Entrepreneurship II

Required for all Ashesi Students

Prerequisite: FDE 1

Offered: Spring

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course is a continuation of Foundations of Design and Entrepreneurship (FDE) I and aims to build on the work done through business simulations on the solution concepts developed. The venture teams will start the semester with continued prototyping, developing, and testing their Minimum Viable Products (MVP), launching their venture concept, and running post-launch promotions, all the while learning about the key entrepreneurship concepts that pertain to the various activities performed in this course. However, the venture teams will not be registered legal entities during the period of the class (perhaps afterwards). Hence, we refer to the nature of the business the venture team conducts during the semester as a business simulation. To elaborate on the process, by conducting Customer Discovery, Customer Validation and exploring Customer Creation and Company Building hypothetically, FDE II teams can test and update their business concepts into validated business ideas that can potentially be explored post-FDE.

The testing process is iterative as teams will need to incorporate new information or pivot based on outcomes from testing in the rather continuous customer development process. Such informed customer discovery, validation, and creation activities will reveal the viability of the business concept and, therefore, help the team determine if a business concept has prospects for company building or not by the end of the semester. The simulation process, therefore, provides a rigorous experiential learning corridor through which FDE teams encounter, experience, and process relevant business knowledge for business venturing in entrepreneurship (as well as in intrapreneurship at the corporate level). Towards the end of the semester, students will be guided in determining how they will transition out of the FDE program after two semesters. If they determine that their business venture should go into the company-building phase, they will have the opportunity to enrol in the student-led Ashesi Start-up Launchpad. If they decide they are not interested in pursuing the venture, the team will be assisted in exiting the simulation, resolving inventory, and closing the books.

4.1.6 BUSA 210 Financial Accounting

Required for all BA Majors

Prerequisite: none

Offered: Fall or Summer

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This is an introductory accounting course that exposes students to fundamental accounting principles, the regulatory framework of accounting practice, elements of financial statements, the mechanics of data entry, preparation of financial statements, financial statement analysis, control accounts and reconciliations, and ethics in the accounting profession. The course is designed to provide students with the requisite skills for analysing transactions, opening and maintaining proper books of accounts, doing basic reconciliations, preparing financial statements for sole proprietorships, applying fundamental accounting principles and ethical codes in solving accounting and business problems, and evaluating the financial performance of a business entity using financial statement analysis.

4.1.7 BUSA 220 Introduction to Finance

Required for all BA Majors

Prerequisite: Financial Accounting

Offered: Spring or Summer

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This is an introductory course aimed at equipping students with the basic skills of corporate finance. In this course, students will be introduced to some fundamental principles of corporate finance such as time value of money and risk. Specific areas of concentration include the time value of money, investment valuation and decision making under conditions of certainty and uncertainty, working capital management, capital budgeting, cost of capital, capital structure and dividend policy, and intermediate and long-term financing.

4.1.8 BUSA 224 Finance for non-Finance

Required for all MIS & CS Majors

Prerequisite: Pre-calculus 1 & 2 or Calculus 1; Prior or concurrent enrolment in Microeconomics

Offered: Spring & Summer

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course is designed to equip students with the necessary tools, skills and competencies required of contemporary managers of top-notch organizations to properly handle financial management and planning issues. It is a platitude that almost every activity in an organization has some monetary implications, hence may translate into numbers.

Managers must therefore be trained to know how their actions and inactions affect the numbers, which in turn affect the entity's profitability, a critical ingredient necessary for the long-term survival of the business.

The contents of the course are organized around four themes. The topics under the first theme cover the formation and organization of businesses, tax compliance and planning, and participation in the financial markets in line with statutory regulations and best practices. Topics under the second theme cover the elements and components of general-purpose financial statements and evaluation of financial performance using financial statements analysis. Topics under the third theme covers cost classification and estimation, volume planning, and profit planning. Topics under the fourth theme covers valuation concepts, risk-return profile of investments, and financial appraisal of capital projects.

The course will be delivered through lectures on key concepts, spreadsheet practicums for selected applications, and presentation of relevant cases and current developments. The last discussion introduces the students to issues in sustainable and responsible investment (SRI). This discussion will centre around the evolution of SRI, concepts, and principles. Other topics include long-term investment and corporate social responsibility, sustainable development Goals and the Millennium Development Goals.

4.1.9 BUSA 304 Operations Management

Required for all BA Majors

Prerequisite: Quantitative Methods or Statistics for Engineering & Economics

Offered: Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The study of Operations Management is an exciting area of management that has a profound effect on the productivity of both manufacturing and services. The goal of this course is to present a broad introduction in the field of operations in a realistic and practical manner.

When companies produce and deliver goods or services to meet customer demand, they do so by managing operations, in other words by executing business processes. In this course, students discover how business processes can be designed, analysed and improved to lift the performance of any organization, whether it is a bank, a hospital, a resort, or a fashion retailer. The course reveals how process management skills can be used to reduce costs, lower inventories, cut waiting times, improve quality, enhance service levels, and increase revenues and company profits. Specifically, students will gain practical knowledge of process design, demand forecasting, capacity planning, workflow planning and control, quality management, and lean operations. With a focus on the basic concepts that govern process management, the course also provides the necessary foundation to pursue further development in operations and supply chain management.

Organizations need to understand how the various processes fit together, what the implications are for the weakest part of the process, identify opportunities for continuous improvement and see from a bird’s eye view, the approach leadership must take to ensure profitability, growth, continuous improvement, development of employees and sustainability. Throughout this course, you will also see learning outcomes in each unit. You can use those learning outcomes to help organise your studies and gauge your progress.

While looking out for all the above factors, there is also the issue of ensuring that the organization, institution, or company is here for the long haul through a consistent review of sustainability requirements.

4.1.10 BUSA 311 Managerial Accounting

Required for all BA & MIS Majors

Prerequisite: Financial Accounting or Finance for non-Finance Managers

Offered: Spring or Summer

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The overall emphasis of this course is the use of accounting data within an organization by its managers. Managers need information to carry out three essential functions:

(1) Planning operations (2) controlling activities and (3) making decisions.

The purpose of this course is to show what kind of information is needed, where this information can be obtained, and how managers can use information as they carry out their planning, control, and decision-making responsibilities. The course also explains why managerial accounting is important to the future careers of all business students. It answers two questions. Topics that will be addressed in the course are cost accumulation methods for product costing; cost structure for control and motivation; cost-volume-profit relationships; profit planning and budgeting; standard costing; and relevant costs for non-routine decisions. Current and best practices will be discussed to provide you with the most recent information on how businesses accumulate and use the cost information.

4.1.11 BUSA 321 Investments

Required for all BA Majors

Prerequisite: Introduction to Finance or Finance for non-Finance Managers

Offered: Fall or Summer

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course surveys the investment media, concepts, and techniques to provide an understanding of the investment process in the economic and financial environment. The course covers the elements of investments, portfolio theory and management, security analysis, valuation of stocks and bonds, and risk-return trade-off. The course entails only the necessary mathematical and technical details which will provide the intuition that may illuminate the gliding path for students as they confront new ideas and challenges in their later lives as investment practitioners. On the conviction that theories such as the capital asset pricing model and the efficient market hypothesis are intellectually satisfying subjects of scientific research as they are important building blocks for the development of solid grounding in investments, aspects of these theories will be used generously to determine the value of real and financial assets. As the instructor tries to bridge the gap between theory and practice, several real-world examples are presented. The course will consist of lectures and discussions of contemporary investment and finance challenges and developments in Ghana and across the globe. Students will be exposed to trends in socially responsible investing around the globe and what lessons Ghanaian Fund Managers can take. A good dose of data will be used in the 'analysis' part of the course. Students will be required to use Microsoft Excel analytic tools to solve a large part of the problem sets. This is also intended to provide students with a taste of tools they will need to understand and use in their career as investment analysts.

4.1.12 BUSA 341 Marketing

Required for all BA Majors

Prerequisite: Micro-economics

Offered: Spring

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1. Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Organizations, whether private, public or non-governmental have goals and objectives they seek to achieve. The level of success of these organizations and their long-term existence depends on their ability to effectively satisfy the needs of their customers, clients or stakeholders continually. The business environment in which organizations operate is changing rapidly and especially digital technology is permeating almost every aspect of human experience. The development of the Internet, World Wide Web and other digital technologies is changing the way business is done. Customers have much wider variety and prices from many more suppliers and more convenient ways of accessing products and services. The Covid-19 pandemic of 2020 has also brought about changes in consumers' habits and attitudes in ways such as how they shop, products they prioritize and how they interact with others.

The essential or big question this course seeks to answer is: "How do organizations create value for customers, clients and stakeholders while achieving the objectives of the organizations in a dynamic business environment where digital technology is increasingly pervasive, and the Covid-19 pandemic is transforming consumer behaviour?" Students will be exposed to and have the opportunity to apply foundational knowledge of marketing concepts and

principles, and skills that thriving firms or organizations use to undertake the following critical tasks that address the essential question posed above.

4.1.13 BUSA 350 International Trade & Policy

Required for all BA Majors

Prerequisite: Pre-calculus 1; Micro-Economics; Macro-Economics; Statistics

Offered: Spring

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The course is designed to introduce students to the main concepts and methods of international trade using applications drawn from the real world. Throughout the course, we would convey the major ideas that have emerged from recent research while emphasising the continued importance of the old theories. Throughout this course, the objective is to guide students to understand how the evolution of international economic theory has helped shape our understanding of a rapidly changing global economy. Also, how can we use the knowledge about international trade to contribute to the ongoing debate about trade protection, free trade, regionalism and trade preferences, among other issues.

4.1.14 BUSA 400A_B Thesis 1 & 2

Capstone option for BA, MIS, CS

Prerequisite: 8 Credits in Major Area of Study

Offered: Fall & Spring

Course Type: Seminar

Ashesi Units: 1; Credit Hours: 3; Hours per Week in Classroom: 1.5; Hours per Week of Discussion: N/A; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 10 per week

The thesis capstone integrates the knowledge gained and skills acquired during a student's enrolment in the Business Administration department.

Students register for the thesis in both semesters of their fourth year. Each student enrolled on the thesis course will work independently on a research idea in an area of business studies. The research will be supervised by a member of the faculty. The thesis should be viewed as an opportunity to understand complex questions from diverse business perspectives. This requires using appropriate theories and research methodology to continue Ashesi's active engagement with the community (both local and global).

Send an e-mail to sagbodjah@ashesi.edu.gh if you need further information on the BA Thesis capstone process.

4.1.15 BUSA 401_A Entrepreneurship 1

Capstone option for BA, MIS, CS

Prerequisite: 8 Credits in Major Area of Study

Offered: Fall

Course Type: Seminar, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Entrepreneurship has been held by many as the key to development in the underdeveloped world. This is because it holds the potential of aiding problem-solving through the development of innovative products and services. These will also help reduce unemployment by serving as income-generation avenues for the youth. If Africa, and indeed other developing economies, can achieve the Sustainable Development Goals (SDG), there will be the need to develop profit-generating enterprises as well as social enterprises to serve as the backbone and propellant.

This capstone session, in a bid to further position Ashesi graduates to understand the nuances of start-ups and the entrepreneurial mindset to develop into entrepreneurs and intrapreneurs, integrates the skills and knowledge obtained from courses offered in the past three years of the student's education on campus. It will teach students

what a start-up is and clearly distinguish between a start-up and a small business. It will take students through opportunity analysis and the development of sustainable business models using Eric Ries' Lean Start-up, Steve Blank's Customer Development Process and Alexander Osterwalder's Business Model Canvas.

The core teaching philosophy is experiential, learner-centric, and inquiry-based to develop the mindset, reflexes, agility, and resilience an entrepreneur needs to search for certainty in the chaotic world of start-ups. This will be achieved with the adoption of several teaching aids and stress on the need to get out of the classroom to bring their businesses to life.

4.1.16 BUSA 401_B Entrepreneurship 2

Capstone option for BA, MIS, CS

Prerequisite: Entrepreneurship 1

Offered: Spring

Course Type: Seminar, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Capstone Entrepreneurship II will aim to aid venture teams in validating their business models by undertaking further customer and stakeholder engagements, as well as MVP tests. This will help the teams validate their product-market fit and gain early adopters/earlyvangelists to patronise their products/ services and pay for them. Feedback from these earlyvangelists will inform further iterations and pivots. Venture teams will then be taken through the Customer Creation and company-building aspects of the Customer Development process. These form the execution aspect of the Customer Development process. The student will look at their product/ service positioning considering the market type they are entering, plan to launch their venture or its product/ service and validate the triple bottom line of their business ventures. Due to time constraints, strategies for reaching mainstream customers and company building, with a focus on structuring fast response, departments will be put in place to aid in executing this business model but may not be executed as a requirement of this session. Specifics include venture ownership, resource management, operations, and management and cultural issues. A session will also be dedicated to family business-related conversations to get students whose families own businesses to understand the nuance and peculiarity of family businesses and how they can navigate those spaces while acting as intrapreneurs.

At the end of the semester, venture teams will feed all this information into the traditional business plan format, which will be submitted to the Department. Additionally, they will pitch their businesses to a panel of experts for evaluation and feedback. They will also write an individual reflection paper on their entrepreneurial journey to ensure that they reflect on this year-long Capstone experience. Instructors will also learn from this reflection to inform future capstone sessions.

4.1.17 BUSA 402 Business Law

Required for all BA Majors

Prerequisite: none

Offered: Fall

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The topics in this course are intended to give you an in-depth knowledge of the legal framework relevant to the business environment in Ghana. Topics in this course include an Introduction to sources of law, the law of contract, the law relating to the sale of goods, company law, torts in business, introduction aspects of employment law and dispute resolution.

The goal of this course is to familiarise you with the legal environment within which business is conducted in Ghana and Internationally. The course is not meant to train you to become a lawyer. However, the basis of all business activity is underlined by rules and regulations and, for that matter, laws.

It is, therefore, essential that as a student studying business law, you comprehend rudiments or have a basic understanding of the legal framework governing businesses in Ghana.

4.1.18 BUSA 405 Competitive Strategy

Required for all BA & MIS Majors

Prerequisite: Introduction to Finance or Finance for non-Finance Managers; Macroeconomics; Prior or concurrent enrolment in Marketing recommended but not required.

Offered: Spring

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Organisations have always had to find ways to stay in business and, more importantly, thrive in their chosen markets. This goal requires the development, implementation, and evaluation of business strategy. Competitive Strategy, also known as business strategy, is designed to establish a profitable and sustainable advantage and position for a business in a preferred marketplace. Although knowledge from such disciplines as Marketing and Human Resource Management is vital in managing a business, this course will focus on competition's role in business strategy development and implementation. Strategy development entails understanding the organisation and competitive environment in which a firm operates, formulating long-term direction, determining how to position a business unit, and creating a sustainable competitive advantage within a competitive environment. Strategy implementation or execution requires mobilising resources, developing capabilities to compete, deploying the strategy, and reviewing performance as the business pursues its aspirations.

In Competitive Strategy, the role of the Strategist is to understand and cope with competition. The overall purpose of this course is to equip students to become strategists and high-performing business executives by enhancing their ability to make and execute strategic business decisions in a competitive environment by:

*Understanding competition: acquire relevant tools to analyse the business and competitive environment

*Cope with competition: acquire knowledge, skills, traits and mindsets to craft and implement a winning strategy in a competitive environment.

Students will assume the role of general managers and business teams who have the overall responsibility for the performance of a business unit within a firm. The course is modelled around the classic work of Michael Porter and will be made relevant to modern times by using examples from recent experiences of companies. The class will also explore new thinking, ideas, and frameworks in business strategy. The course will allow students to practice and develop skills and mindsets to analyse a competitive environment (i.e., business environment, industry, and company), craft strategy and evaluate own and other practitioners' approaches to strategy and work.

The course will emphasise student-centred learning. The learning activities will include case analysis, discussions, debates, presentations, group projects, interaction with business executives and practitioners and lectures. We will use a "flipped" classroom where students will read relevant texts and prepare assigned case studies ahead of class. The class sessions will be devoted to discussing and clarifying issues and relating concepts, principles and theories to cases.

4.1.19 BUSA 410 Applied Project

Capstone option for BA, MIS, CS

Prerequisite: 8 Credits in Major Area of Study

Offered: Fall & Spring

Course Type: Seminar

Ashesi Units: 1; Credit Hours:3; Hours per Week in Classroom: 1.5; Hours per Week of Discussion: N/A; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 10 per week

The Applied Project is characterized by its engagement with a real-life organization. Ultimately, students are expected to integrate foundational knowledge and skills gained over time and use them to solve real-life challenges for existing organizations. The successful execution of an Applied Project requires skill sets including research and critical analysis, stakeholder engagement, project management, professionalism, and communication. The benefits of an Applied Project are immense. It offers students the unique opportunity to immerse themselves in an organization and gain an understanding of business problems, relationships, and solutions. It also positions students to add value to the organization in the capacity of a junior consultant. Once the project is successfully accomplished,

it becomes a strong addition to the student's personal and professional track record, and will certainly open many doors for referrals, internship, and job opportunities. It also provides the student with insights regarding what to pursue in the area of postgraduate studies. Send an email to sagbodjah@ashesi.edu.gh if you have any questions about the BA Applied Project.

4.1.20 BUSA 422 Corporate Finance

Required for all BA Majors

Prerequisite: Investments Offered: Spring & Summer

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course covers numerous issues of practical relevance to the contemporary corporate finance manager. Although the central focus will be on how corporations make investment and financing decisions, the introductory classes will discuss households' saving and investment decision-making and how securities markets and financial intermediaries complement such efforts. Topics to be covered include risk and return, asset valuation, working capital management, mergers and acquisitions, and corporate restructuring. The course focuses on the application of corporate finance concepts to solving real life problems in a typical business environment. Students will learn to appreciate how the timing of and uncertainty about future cash flows and their associated risks combine to determine the current value of those cash flows. It is expected that assignments, class projects, and discussions will provide the needed motivation and enhance students' understanding of the finance theories to be discussed. The numerous real-life examples and cases are aimed at equipping the students with skills to plug-and-play in a starting finance position in any organization in Ghana and abroad.

4.1.21 BUSA 423 International Finance

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Introduction to Finance

Offered: Typically offered in the Spring

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The course aims at providing students with a basic understanding of the international financial market, and multinational finance and investment environment. This course extends the basic principles of corporate finance to dimensions peculiar to global financial markets and multinational corporations. It is designed to cover areas of international finance such as the international financial markets, international parity conditions, foreign exchange determination and quotations, derivative securities for currency risk management, and management of the risk of multinational operations. Thus, beside the discussion of issues of corporate finance such as working capital management, capital budgeting, risk and returns, and cost of capital from the perspective of multinational enterprises, additional issues such as international monetary system, currency derivatives, exchange rate changes and regimes, and political risk are also covered.

4.1.22 BUSA 430 Human Resource Management

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Organizational behaviour

Offered: Typically offered in the Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The purpose of this course is to familiarize you with the basic principles and techniques of human resource management. The course takes a practical view that incorporates the contributions of the behavioural sciences with the technical aspects of implementing the HR function in the 'real world.'

Surely, not everyone who takes this course will become a human resource professional, although that individual will learn a great deal about those roles. However, all managers, no matter what their specializations are, play essential roles in carrying out HR policies and practices in their organizations. Consequently, a basic understanding of human resource management (HRM) is essential wherever you find yourself in your world of work. The key objective of this course is to enable you learn that HRM is more than just accepting employment applications and keeping records. It is a central and strategic organizational activity of increasing complexity and importance.

4.1.23 BUSA 431 Real Estate Development

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Quantitative Methods or Statistics for Engineering & Economics

Offered: Typically offered in the Fall

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The real estate development course aims to introduce students to what real estate development (RED) is and what the development process entails. It seeks to provide students with a good overview of what goes into the various stages of the development process with emphasis on feasibility studies, financing, and management.

The class will undertake a feasibility study for a real-life client. This client needs a feasibility study conducted for a development they want to embark on. The outputs expected are a feasibility report and recommendations for financing and property management, post development. Students in the class will be split into teams to conduct the study, going through the 8-stages of the development process. They will do this as they are taken through the various stages of development process in the class, visit the site and interact with professionals who will help them make development and investment decisions for the client. The bottom line is a development which is sustainable where its financial model is concerned, and one that is environmentally considerate.

Students will as well engage with different persons (guest lecturers) on their experiences on different developments (Public and private). As well, class tasks will have students explore developments across the continents to learn from their successes and challenges. This task will involve an assessment of the sustainability of the developments.

It is the hope of the instructors of this class that students will enjoy working on this live case, and in the process, develop skills to benefit future interest in the industry as well as in conducting marketing and feasibility studies.

4.1.24 BUSA 442 Strategic Brand Management

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Marketing and Text & Meaning; or Foundations of Design & Entrepreneurship II Offered: Typically offered in the Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The tremendous economic growth and development that the world has experienced in recent decades before the COVID-19 pandemic in 2020 have meant individuals and business managers in most countries are inundated with a wide variety of products and services from which to choose. For the individual, finding time to select from a wide variety of products and services may be challenging, but more products and services on the market mean stiffer competition for the firm. A growing number of firms and organisations have realized that one of their most valuable assets is the brand names associated with their products or services.

The exponential rate of mobile telephony growth, growing internet access, and social media use are giving greater power and voice to consumers and other stakeholders at the expense of businesses and brand managers. Brand Managers' ability to simplify the consumer decision-making process, reduce risks, set expectations, and set apart their brands from their competitors' brands is invaluable. Creating strong brands that deliver on their promise and maintaining and enhancing those brands' strength over time is imperative for business success but rather daunting.

Additionally, it has become imperative for higher education institutions that offer strategic brand management courses to include Environmental, Social, and Governance (ESG) and sustainability elements in their curriculum due to the nature of the contemporary marketplace. Firstly, ESG and sustainability are becoming increasingly important

for companies and central to brand strategy and reputation. Including these elements in brand management education ensures that students are ready for the business world's demands and the challenges they may encounter in their careers. Secondly, business practices can significantly impact society and the environment, and incorporating ESG and sustainability into brand management education allows students to understand the role of business in promoting sustainability and the importance of responsible practices. Additionally, there is growing demand from consumers, investors, and employees for companies to prioritise ESG and sustainability, so companies need employees who are trained in these considerations. By including ESG and sustainability in brand management education, students are better equipped to meet this demand and contribute to their companies' success. The business landscape is rapidly changing, and ESG and sustainability will continue to play a crucial role in shaping its future. Including these elements in brand management education ensures that students have the necessary skills and knowledge to succeed in the future. In conclusion, incorporating ESG and sustainability into a strategic brand management curriculum prepares students for the opportunities and challenges of the business world and helps them understand the role of business in promoting sustainability and responsible practices.

4.1.25 BUSA 444 Supply Chain Management

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Quantitative Methods; or Statistics for Engineering & Principles of Economics

Offered: Typically offered in the Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course presents the fundamental concepts and tools needed to understand how Supply Chains work. The content spans the typical scope of supply chains: Plan, Source, Make, Deliver and Sell set in today's global market in which there is fierce competition, more frequent innovation, and more sophisticated and demanding customers/consumers. Continuous advances in technology also provide a wide variety of continuous improvement options in supply chains. The interactions of the factors and levels of supply chains are explored for optimization and efficiency in Supply Management, Inventory Management, Product & Production Management, Distribution and Transportation Management. The Course also covers Responsible Sourcing and the Key Performance Indices that are used to determine service levels and efficiencies in supply chains.

4.1.26 BUSA 451 Development Economics

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Micro-economics or Macro-Economics or Principles of Economics; and Statistics

Offered: Typically offered in the Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Why do countries with low average incomes have peculiar and similar problems such as severe inflation, corruption, balance of payment and debt problems, overpopulation & teenage pregnancy, slums, poor governance, and weak institutions. What can be done about this? How did Singapore, Hong-Kong, South Korea, and Taiwan (the Asian Tigers), China, Qatar, Ireland etc. become so rich recently even though they were not so rich half a century ago and were in situations not too dissimilar from African countries at the time.

This course discusses the problems faced by Least Developed Countries (LDCs) and Lower Middle-Income countries (in Africa, Asia, and Latin America) and their efforts to improve the lives and well-being of their people. It incorporates different aspects of the development process including traditional development topics like economic growth, education, population studies, migration and rural-urban migration, and poverty as well as less traditional but equally pertinent topics like economic and political institutions, competition policy & antitrust laws, foreign aid, culture, leadership, and corruption. The course starts with a synthesis of the history of the models of economic development with growth models as a particular strand of the development theories and models. The course also includes activities that presents opportunities for students to delve into the inter-relationship between culture, corruption, and debt challenges both as a development challenge and to address the Ashesi Learning Goal of Ethics & Civic Engagement.

4.1.27 ECON 101 Micro-Economics

Required for all BA, MIS Majors. CS & ENG majors can substitute Principles of Economics with this course.

Prerequisite: Pre-Calculus 2 or Calculus 1

Offered: Fall or Summer

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course will cover the principles of microeconomic analysis with the aim of helping students make better business decisions in their professional careers. In addition to introducing the standard basis of economic theory such as perfect information, production theory, perfect competition and imperfect competition, the course will focus on helping students think strategically about achieving competitive advantage through the management of the firm's resources. Through this course, students will develop an understanding of basic microeconomic theory and improve their ability to make sound business decisions.

4.1.28 ECON 102 Macro-Economics

Required for all BA & MIS Majors

Prerequisite: Pre-Calculus 2 or Calculus 1

Offered: Spring or Summer

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Welcome to Principles of Macroeconomics at Ashesi University. This is an exciting time to be taking be taking this course because the course is an introduction to macroeconomics, with application to the local context. Ashesi University is in Berekuso in Ghana, West Africa, and the economies of West African countries like Ghana are in flux due to local macroeconomic management challenges at the local level and global forces both related and unrelated to the Global COVID 19 pandemic.

The Principles of Macroeconomics Course at Ashesi has two objectives. First, the course will develop simple models of goods and services, assets, capital, and labour markets which can be usefully applied to generate realistic predictions regarding the behaviour of such macroeconomic variables as: output; employment; inflation; the current account; as well as interest and exchange rates. Secondly, the course will teach students to use these models to understand and interpret contemporary and historical macroeconomic developments. Current macroeconomic developments and policy challenges such as the effects of the COVID 19 pandemic, global inflation related to geopolitical conflict between Russia and Ukraine, and rising oil global prices of oil, as well as local inflation due to global forces and possible impacts of national debt and corruption on macroeconomic stability will be discussed. The role of the IMF in helping developing countries like Ghana to manage economic challenges will be assessed.

4.1.29 ECON 452 Econometrics

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Micro-economics or Macro-Economics or Principles of Economics; and Statistics and Quantitative Methods (Multi Variable Calculus can replace Quant Methods as a prerequisite for this class)

Offered: Typically offered in the Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The objectives of the course are the following:

- Introduce students to techniques for performing statistical analysis on quantitative data focusing on the estimation of the regression model.
- Help students solve problems commonly encountered in estimating statistical models like the regression model.

- Teach students to interpret the estimates from such models.
- Enable students to be able to perform quantitative analysis using secondary data.

Please note: The course is ideal for current Ashesi seniors and juniors interested in the analysis of quantitative (as opposed to qualitative) data.

4.1.30 ECON 455 Managerial Economics

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Calculus 2 or Applied Calculus; Micro-economics; Macro-Economics; Statistics or Econometrics

Offered: Typically offered in the Spring

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Managerial Economics is the study of the different ways in which economic principles and quantitative tools can be employed to assist managers to make effective decisions. It provides principles to foster the attainment of the goals of the organization, as well as engineer a better understanding of the external business environment in which an organization operates. The course enhances students' understanding of how markets operate and develops their capability to make economic predictions about market outcomes in order to take effective decisions to maximize profit and firm value.

4.1.31 ENGR 413 Project Management & Professional Practice

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Operations Management

Offered: Typically offered in the Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Projects occur in our daily lives, whether it be a simple task of taking a shower to complex tasks, such as sending a space craft to Mars. The process, though similar, will require different degrees of planning, and resource requirements to deliver as they have different scopes and outcomes, and as well influence a different set of stakeholders with specific requirements. It is thus imperative, that every person knows the basics of project management to manage the various projects that they undertake in their daily lives. More so as students, who undertake various class and social projects, while preparing to join the world of work (filled with projects) in the very near future, acquiring good project management skills within the structured framework positions one to get certified and/or use the appropriate lingua in the line of duty in the world of projects.

This course will expose students to planning, strategizing, and executing a project in their field of study or in another field, while engaging the cross section of talent in the class: engineering, computer science, management information systems and business administration students. It will develop students' skills to manage projects and build on leadership skills and ethical reasoning they have acquired in core courses. Student will learn about organizational, environmental, safety and health issues that must be considered during the implementation of a project. Students will also learn, discuss, and reflect on professional issues such as social responsibility, ethics, licensing, and regulatory reporting. They will be introduced to Industrial Engineering, process management, work measurement, capacity utilization and constraints management.

Hinged on the PMI® Framework for Project Management and using the PMBOK® Guide as the core text, students will network and interact with members of the PMI-Ghana Chapter as they will be recognized as student members for the year. Interested students will also be supported to prep for the CAPM® Certification to enhance their employability after they graduate from Ashesi.

4.1.32 BUSA 424 Venture Capital Investment

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: TBD

Offered: Typically offered in Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The course expands on the entrepreneurial skills, cash flow appraisal techniques, investing decisions, and financing decisions learned in the prerequisite courses to the structuring of a venture capital (VC) fund, raising VC funds, appraisal of entrepreneurial ventures, allocation of funds to good entrepreneurial ventures, and support for entrepreneurs through the value generation process to the exit point. Students will learn that VC is not just another financing vehicle, but a business building endeavour pursued by the venture capitalist in strict partnership with the entrepreneur to facilitate and accelerate the success of the entrepreneur. The course asks three pertinent questions: What is an attractive sector to allocate VC funds to? Is the entrepreneurial venture a good one? Will allocation of funds to the entrepreneurial venture allow relevant stakeholders to achieve their return goals? The course will provide students with the knowledge and skills needed to answer those questions through lectures, case studies, testimonials from industry, group discussion, and role play.

4.1.33 BUSA 432 Organization Development

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: FDE 1

Offered: Spring

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

How can the outcome of capstone applied projects help organizations assess themselves and their environments, leading to the revitalization and rebuilding of their strategies, structures and processes for competitive advantage? What influence tactics can student consultants employ to gain trust from organizations for them to open their doors for them to study their systems for improvement? This course is designed to build the capacities of students who desire to undertake capstone applied projects that contribute towards the effectiveness of organizations.

The course is Organization Development (OD) Consulting in orientation, with a focus on the systematic application and transfer of behavioural science knowledge to the planned development, improvement, and reinforcement of the strategies, structures and processes that lead to organizational effectiveness. It pays attention to the practical resolution of organizations' problems systematically under changing environments, organizational behaviour which impacts on its development, techniques or tools that use authentic data to identify and address organizations' problems and obstacles that inhibit their growth.

4.1.34 BUSA 441 Service Marketing

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: Quantitative Methods; or Statistics for Engineering & Principles of Economics

Offered: Typically offered in the Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

A growing number of school graduates are recruited in service industries. This is because the service sector as a percentage of the Gross National Product is substantial and has grown significantly in most countries, including Ghana. However, teaching of Marketing in tertiary institutions tends to focus largely on manufacturing or product-based models of business practice, which are not always adequate or even, in some cases, not very useful in making decisions in a service business. The Services Marketing course seeks to teach students the concepts, frameworks and analytical procedures that are best suited to examine and resolve challenges faced by managers and as well as develop successful and coherent marketing strategy/plan for service products.

4.1.35 BUSA 471 Social Enterprise

Major Elective for BA, MIS. Non-Major Elective for ENG and CS

Prerequisite: FDE, Micro-Economics

Other courses that complement this course include Marketing, Corporate Finance, Operations Management, Competitive Strategy, Investments, Economic Development, Branding, New Product Development, Strategic Brand Management, and Service Marketing.

Offered: Typically offered in the Spring

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Social Enterprise is an exploratory business elective offered by the business administration department that challenges the student to think in ways that produce sustainable and profitable outcomes that lead to social or environmental impact. Through various team challenges, assessments, and meet the leader sessions students have the opportunity to discuss, examine, and transfer thought into action as they work together to come up with their own solutions for some of their world's toughest challenges.

4.1.36 BUSA 458 Data Analytics for Business

Major Elective for BA. Non-Major Elective for MIS, ENG and CS

Prerequisite: Statistics; Quantitative Methods

Knowledge of Research Methods will aid in appreciating the content.

Offered: Typically offered in the Fall

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Businesses must make strategic, tactical, and operational decisions to improve operational efficiency and profitability and gain a competitive advantage. Traditional, intuitive, and rule-of-thumb approaches to business decision-making are valuable. However, with vast amounts of business data, improved technology, and analytic techniques, business analytics has become invaluable for business decision-making to manage businesses more effectively and efficiently. The Business Analytics for Business course is designed to equip you, as a business professional, with the knowledge to make better decisions based on business data. It will give you the knowledge and skills to summarize, visualize, and generate insights from historical business data. You will be able to use the knowledge you have gained to forecast future outcomes and improve forecasts for planning. The course will also assist you in determining and evaluating alternative business solutions using risk and uncertainty decision models. This course will teach you how to identify business problems, patterns, and trends using data analytic technologies such as Excel, R, and Tableau. This critical skill is applicable across industries, so this course is required for all professionals.

By the end of this course, you will have a deep understanding of how to leverage data to drive business growth and be equipped with the necessary skills to tackle complex business problems through the power of data analytics. This course will provide students with practical data analytics skills and the necessary knowledge to make informed decisions across different business functions, including finance, human resource management, marketing, supply chain, and online activity.

4.2 Computer Science and Information Systems

4.2.1 CS213: Object-Oriented Programming

Prerequisites: Either Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course builds upon the programming concepts from the Computer Programming for CS course and will develop students' ability to program using the object-oriented paradigm and the Java language. It will give students an appreciation of the advantages of object-oriented programming, help them define and construct objects; and leverage abstraction, inheritance, polymorphism, and encapsulation to develop robust and maintainable applications. It will also introduce students to event-driven programming and graphical user interfaces, as well as the use of standard Java packages and the Java collections API. Good software engineering practices will be featured in various aspects of the course: characteristics of good software; documentation, testing; and coding practices which promote correctness and robustness. Also, notations like the Unified Modelling Language (UML) will be employed. Through one or more team projects, students will gain experience in designing and implementing larger applications than in their previous programming classes.

4.2.2 CS221 Discrete Structures and Theory

Prerequisites: Pre-Calculus 2 OR Calculus 1 OR Engineering Calculus, Introduction to Computing & Information Systems OR Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course is designed to give students in Computer Science the mathematical foundations they need for their future studies. Specifically, you will learn:

- Mathematical reasoning: how to think logically and mathematically? Understanding and constructing proofs.
- Combinatorial analysis: to be a problem solver, it is important to be able to count objects. We will see some basic techniques for counting.
- Discrete structures: of course, as the name of the course suggests, you will also learn how to manipulate discrete structures (sets, permutations, relations, graphs…).
- Algorithmic thinking: sometimes, we will solve a problem by specifying a list of steps to follow (an algorithm). Algorithms can be implemented through computer programs. By the end of this course, you will know how to describe algorithms (in both English and pseudocode), verify that they work properly, analyse the computer memory and time required to implement them.
- Applications and modelling: applications to show the relevance and practicality of mathematics. We will see applications of discrete mathematics to computer science, data networking and biology. An important problem-solving skill is the construction of mathematical models. We will build our own models while solving some of the exercises.

4.2.3 CS222 Data Structures & Algorithms

Prerequisites: Object Oriented Programming

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course is about data structures; that is the methods of organizing large amounts of data. It is also about algorithm analysis; that is, the estimation of the running time of algorithms. Specifically, this course will cover fundamental abstract data types and their implementations as data structures, such as lists, hash tables, trees, priority queues, and graphs, as well as asymptotic analyses of algorithms involving these data structures. Students will also learn about recursion, searching (sequential and binary); and sorting (selection sort, insertion sort, merge sort, and heap sort). The Java programming language will be used as the language of implementation in this course, and so Eclipse or IntelliJ will be the recommended development environments.

Course Objectives: At the end of this course, students will be able to:

- Analyse and compute the running time of algorithms, expressing these runtimes using asymptotic notation (Big-O).
- Explain and implement a variety of linear and non-linear data structures.
- Explain and implement fundamental algorithms for searching and sorting.
- Identify and apply appropriate data structures for the solution of practical problems.

4.2.4 CS313 Intermediate Computer Programming

Prerequisites: Either Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course is a continuation of Computer Programming for CS. It will introduce students to more details of object definition and construction and event-driven programming. It will also introduce additional standard Java packages, including the file system and graphical user interface elements. This course will also give students an introduction to C++. Good software engineering practices will be featured in various aspects of the course, and notations like the Unified Modelling Language (UML) will be employed. Through one or more team projects, students will gain experience in designing and implementing larger systems. However, the emphasis of the course will be on the use of prewritten packages and built-in language facilities, as well as design and implementation of moderately sized custom classes and algorithms, rather than on the design of whole systems.

4.2.5 CS 314 Human Computer Interaction

Prerequisites: Introduction to Computing & Information Systems OR Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course is an introduction to Human Computer Interaction (HCI), a discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. The course considers the inherently multi- and interdisciplinary nature of HCI and situates various HCI issues in the organizational and societal contexts. It introduces theories of human psychology, principles of computer systems and user interfaces designs, a methodology of developing effective HCI for information systems, and issues involved in using technologies for different purposes.

Learning Objectives: At the end of this course, the student should be able to:

- Explain HCI and interaction design to non-experts.
- Describe cognitive foundations of HCI and user-centred design process.
- Gather and understand user requirements.
- Design and evaluate UI of low and medium complexity.
- Communicate effectively about design and evaluation.
- Discuss some of the outstanding research problems in HCI.

4.2.6 CS331 Computer Organization and Architecture

Prerequisites: EITHER Computer Programming for CS OR Computer Programming for Engineering. Completion or concurrent enrolment in Discrete Structures and Theory.

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course presents the fundamental concepts of computer organization and instruction set architectures. Assembly language programming is used to present and illustrate the concepts of instruction set design. The basics of Central Processor Unit (CPU) design and implementation are covered, including some performance enhancing methods like pipelining and memory caches. The interface to the Compiler and Operating System is described in terms of the interaction between the hardware and software components of a system. The course discusses developments in modern computer system such as parallel processing, virtual computing and other new architectures.

Course Objectives:

- Learn digital system design process.

- Understanding of modern computer architecture.
- Understand Software-Hardware interface.
- Understand low level programming and program execution.

4.2.7 CS341 Web Technologies

Prerequisites: Computer Programming for CS OR Computer Programming for Engineering, Completion or concurrent enrolment in Database Systems

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course introduces the World Wide Web Consortium (W3C) standard markup language and services of the Internet. Topics covered will include basic and advanced HTML, scripting and active pages, design and active pages, design and development of Web-based applications, principles and tools for Web content creation, database fundamentals for the Web, Web management, and Web service delivery. The primary goal of this course is to introduce the relevant technologies and skills needed to design, develop, deploy and manage effective Web Applications. To achieve this goal, we will use a set of 'programming languages': HTML, CSS, JavaScript (AJAX, jQuery, Frameworks or Libraries), PHP, MySQL (relational database management system) and Content Management Systems (CMS).

4.2.8 CS353 Introduction to AI Robotics

Prerequisites: EITHER Computer Programming for CS OR Computer Programming for Engineering; EITHER Calculus II OR Applied Calculus OR Engineering Calculus

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 6-9 per week

This course gives a practical hands-on as well as theoretical introduction to robotics as a field that integrates expertise in Computer Science, Engineering, Design and Mathematics to create innovative systems that interact with and can operate autonomously or semi-autonomously in the physical world. In this course, students will work individually and in groups to implement robotics projects using robotics platforms such as the Lego EV3 kits, the TurtleBot robot, Interbotix robot arm, among others.

4.2.9 CS361: Introduction to Modelling and Simulation

Prerequisites: EITHER Computer Programming for CS OR Computer Programming for Engineering; EITHER Calculus 1 OR Applied Calculus OR Engineering Calculus; Discrete Structures & Theory

Ashesi Units: 0.5; Credit Hours: 2; Hours per Week in Classroom: 1.5; Hours per Week in Lab: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 3-4 per week

Real-world systems, such as games, communication networks or transportation systems can be modelled using statistics and a variety of modelling formalisms. This course introduces the process of designing models of existing or proposed real-world systems, and how to use the models to perform simulations that allow for predictions about the future behaviour of the system. Programming assignments provide the opportunity to construct prototype modelling tools and simulators based on the theory. In addition, applications from a variety of domains are used to illustrate the different modelling formalism.

4.2.10 CS415 Software Engineering

Prerequisites: EITHER Computer Programming for CS OR Computer Programming for Engineering, EITHER Web Technologies OR Intermediate Computer Programming OR Data Structures

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course will introduce a collection of methods which embody an "engineering" approach (i.e., scientific method) to the development of computer software. The content starts with development lifecycle models, such as waterfall, agile development, etc. and then continues to cover requirements specification, the Unified Modelling Language (UML), software architecture, object-oriented analysis and design, design patterns and testing.

Software engineering is an inherently practical subject and applying the concepts being taught is a vital component of developing expertise in this area. Consequently, students undertake a substantial group project, working through a number of stages of the development of a (larger) software application. Students will be supervised but will be expected to largely organise themselves and their work, learning key transferable skills in management and organisation.

4.2.11 CS424 Advanced Database Systems

Prerequisites: Database Systems, EITHER Discrete Structures and Theory OR Data Structures and Algorithms

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

Advanced Database Management Systems course deals with the usage as well as concepts of design and architecture of databases. In covering the concepts, theorems and algorithms, proofs relevant to different aspects (design, architecture, and implementation) are covered. The general approach is to go through design, architecture (schema, indexes, and storage), core features (transactions, concurrency), and specialized database usage (data mining & data warehousing). The practical work done in the course goes through usage of some advanced SQL features and the implementation of some algorithms and coding of internals of an actual database system.

Students should already know structured query language. The course will build further on this to include concepts such as union types and predicates. The diagram format for design may change a bit but it provides students more expressivity for their designs.

4.2.12 CS432 Networks & Data Communications

Prerequisites: EITHER Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 6-9 per week

This course introduces students to the fundamental concepts of computer networks and data communications, with practical applications; students will be able to recognize the components, relevance, advantages, and disadvantages of networking computers. Students will be introduced to the principles of data communications and transmission. Protocols employed in layers 1 to 3 will be examined in depth. Layer 4 protocols will be highlighted and compared to layer 2.

Methods and mechanisms for constructing distributed computing systems and network services are discussed in the context of common Internet systems such as electronic mail, print and file servers and Web services.

Hands-on exercises are used to help reinforce the fundamental concepts learnt. Labs will cover typical network operations tasks. Students will review hardware used in practice, common topologies and set up services on typical enterprise networks.

4.2.13 CS435 Operating Systems

Prerequisites: EITHER Computer Programming for CS OR Computer Programming for Engineering, EITHER Discrete Structures and Theory OR Data Structures and Algorithms

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This is a course on theory and practices of operating system design and implementation. Operating Systems are found in most computing devices we use (e.g., mobile phones, tablets, laptops, televisions, cloud); some are embedded, some are general purpose or specialized –anywhere you find computing, you will find an operating system. All operating systems deal in some way or another with users, security, resources, storage and memory, threads and processes, scheduling, as well as policies associated with or built on these. Our course covers an overview of operating systems, processes, memory, I/O management, file systems and some case studies.

4.2.14 CS442 E-Commerce

Required for MIS, Elective for CS

Prerequisites: Database Management Systems and Web Technologies

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 4; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This is an introduction to e-Commerce principles, technologies, and applications. This course also develops understanding of the problems and requirements of Internet business, and the corresponding solutions. Protocols to ensure secure transactions and e-commerce protocols based on encryption techniques will also be studied. Legal and ethical issues will be discussed, as well as marketing and revenue models for online businesses. Students will get hands on experience building a secure ecommerce site.

4.2.15 CS452 Machine Learning

Prerequisites: Computer Programming for CS OR Computer Programming for Engineering, Multivariable Calculus & Linear Algebra

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course introduces machine learning. Topics include supervised and unsupervised machine learning, statistical inference and prediction. A wide variety of algorithms will be presented, including logistic regression, K-nearest neighbors, naïve Bayes, decision trees, neural networks, K-means, mixtures of Gaussians, principal components analysis, Expectation Maximization. The course will also discuss modern applications of machine learning such as image segmentation and categorization, speech recognition, and text analysis.

4.2.16 CS 455 Applied Cryptography and Computer Security

Prerequisites: Data Structures OR Discrete Structures & Theory; Database Systems; Computer Programing for CS/Eng.

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 6-9 per week

Computer Security concerns the theory, concepts, techniques and tools used to ensure confidentiality, integrity, and availability. This means understanding security frameworks, threat models, security policies, and mechanisms for prevention, detection, and recovery from attacks.

4.2.17 CS458 Internet of Things

Prerequisites: Computer Programming for CS AND Database Systems (for CSIS students), Computer Programming for Engineering AND Circuits & Electronic (for Engineering students)

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

The Internet of Things (IoT) course takes an end-to-end view of IoT including the devices, networks, data analytics, programming, security, and business. It exposes the student to all aspects of a functional IoT system and how to design a secure, robust and scalable IoT network, taking on a hands-on approach. Labs and small projects will be used to gain understanding of key concepts at the various layers. Key among these are the devices, network protocols, data and programming aspects. Students will review hardware types and software tools and be introduced to IoT design principles which cover how to transition from an IoT idea to an IoT product, building of prototypes and commercializing them. Since IoT is still emerging, businesses are going to be either adopting IoT solutions or transforming their existing businesses to include IoT in a seamless and sustainable manner. The course addresses these aspects as well, in order to prepare participants to lead in this budding industry in the business segment.

4.2.18 CS459 Natural Language Processing

Prerequisites: Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 6-9 per week

This an introductory course in Natural Language Processing (NLP). NLP is a subfield of Artificial Intelligence (AI) concerned with computers' ability to process and generate text in everyday human languages. NLP may also deal with textual content in audio and other modalities. This course will seek to give students a basic understanding of what NLP is and introduce them to some state-of-the-art approaches and techniques in NLP while stirring their

imaginations to harness the power of NLP for African languages. Since the state-of-the-art for many tasks in NLP uses deep learning, the course will focus on using neural networks for NLP.

Course Objectives:

- To provide students with a basic understanding of NLP.
- To introduce students to state-of-the-art techniques in NLP
- To stir students' imagination in harnessing NLP for African languages
- To encourage students to think about and apply NLP in solving local and global problems
- To give students a foundation for understanding NLP papers

4.2.19 CS461 Data Science

Prerequisites: Linear algebra, Calculus, Statistics with Probability AND Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

Data Science is the art of creating programming code and combining it with statistical knowledge to create insights from data. This class is an introductory level undergraduate course in data science. Throughout the class, we will be covering the topics linear regression, gradient descent and cost functions, dummy variables, one hot encoding, training and testing data, logistic regression, decision trees, support vector machines, random forest, k-means clustering, naive bayes, principal component analysis, hyper parameter tuning, L1-L2 regularizations, k-fold cross validation, artificial neural networks.

4.2.20 IS333 IT Infrastructure and Systems Administration

Prerequisites: Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course introduces IT Infrastructure as a shared technology resource for students majoring in Management Information Systems. It covers topics related to both computer and systems architecture and communication networks, with an overall focus on the services and capabilities that IT Infrastructure solutions enable in an organizational context. It gives the students the knowledge and skills that they need for communicating effectively with professionals whose special focus is on hardware and systems software technology and for designing organizational processes and software solutions that require in-depth understanding of the IT Infrastructure capabilities and limitations. The course focuses strongly on Internet-based solutions, computer and network security, business continuity, and the role of Infrastructure in regulatory compliance.

4.2.21 IS451 Information and Systems Security

Prerequisites: Discrete Structures

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

Information security mechanism is one of the most crucial factors for any organization. Important assets of an organization demand a proper risk management and threat model for security hence, information and systems security concepts are gaining a lot of traction. This course will initially cover the concept of information and systems security and software installations process. It will then move on to modules such as threat modelling, risk management and mitigation.

This Course covers the network as well as web scanning. Later in the course it teaches how to use Kali Linux for ethical hacking, it will have different practical sessions on using Kali Linux such as for information gathering, vulnerability analysis, web application analysis, database assessment and password attacks and have some hands-on experience. It will also cover concepts of incident response system, information rights management and so on. It will then guide you towards building your own information security framework best fit for an organization. At the end of this course, you will be well versed in all the factors involved with information security which will help you build a security framework which will be a perfect fit for an organizational requirement.

4.2.22 CS111: Introduction to Computing and Information Systems

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course will establish basic information technology literacy, information systems and how they are used in business, including hands-on use of computer applications, principles of digital computers and the internet, data communications and problem-solving through programming. Students will learn how to construct their own websites, develop an on-line presence through LinkedIn, become adept at using Ashesi's computerized course management and grading systems, information systems, business applications, and how to design, construct and use simple databases (SQL Lite). We will use Python (IDE: Thonny) to introduce the following programming concepts:

- Simple data types and variables
- Arithmetic expressions (including precedence, the dreaded BODMAS) and assignments
- Program control flow (if, select case, and various looping constructs)
- Using pre-written functions
- Writing our own subroutines or functions
- Variables capable of storing multiple values (arrays)
- Using existing Python libraries

4.2.23 CS212: Computer Programming for Computer Science

Prerequisites: Introduction to Computing & Information Systems; Pre-Calculus I OR Calculus I

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course gives students an intensive introduction to programming as a means of problem-solving. It also introduces them to the broader fields of computer science and information systems and shows a connection between computer programming and other disciplines. Concepts will be illustrated in the Python programming language. This course will introduce the object concept, using and declaring functions (methods). Basic software engineering concepts will also be introduced and will be used to solve problems through approximation, simulations, recursive formulas, and data processing.

4.2.24 CS323: Database Systems

Prerequisites: Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course is an introduction to the design and use of database systems - systems that manage very large amounts of data. This course is an introduction to the principles, use, and applications of database systems. Students who complete the course will be able to design and create databases, be able to extract information from databases, understand in broad terms how database systems work, and understand the purposes for which databases are used. The course covers topics such as relational design using the entity-relationship model, followed by an overview of the relational model, how to convert E/R models to relations, and how one uses a relational database system to create a database. SQL (Structured Query Language), the standard query language for relational databases will be learned and experienced as well as relational algebra; normalization of relational schemes. This course will be taught using an industry-strength RDBMS like MySQL.

4.2.25 CS402: CSIS Research Seminar

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

What does it mean to do computer science research? Is it like anthropology? Do you leave your comfort zone to reside amidst processors and RAMs observing their day-to-day charade and blogging to the rest of the world? Are you more of a biologist? Do you put a motherboard under a microscope and hope that it reveals its innermost secrets to you (and only you)? Or do you put on the hat of a psychologist, designing increasingly intricate and controversial experiments in an attempt to ascertain what your machine really thinks about your data (and you)? Well, you will be able to tell by the end of this class.

We will build an understanding of research in computer science so that we can read, critique, and extend both new and old ideas. We will first discover the many joys (and the myriad tribulations) of reading a computer science

research paper: What do you look out for? What do you ignore? When someone asks you what the paper is about, what do you tell them? How to separate meaning from myth? We will then use this framework to read, assimilate, and appreciate a variety of research papers, some new some old. Throughout the semester we will read, present, and review classic research papers as well as contemporary research work from data science, machine learning, and the application of these two areas in the West African context.

4.2.26 CS413: Concepts of Programming Languages

Prerequisites: EITHER Computer Programming for CS OR Computer Programming for Engineering, EITHER Data Structures and Algorithms OR Discrete Structures and Theory.

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course examines fundamentals concepts in programming languages and major tools and techniques to implement them. The key characteristics of major programming paradigms, including the imperative programming paradigm and the functioning programming paradigm, will be studied and compared. Topics covered include specification and informal semantic models; binding and scoping; types and type systems; control structures; data abstraction; procedural abstraction and parameter passing; higher-order functions; and memory management. Programming assignments will give students the opportunity to master the course concepts.

4.2.27 CS434: Parallel & Distributed Computing

Prerequisites: Data Structures and Algorithms AND Computer Organization and Architecture

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This is an introductory course on developing and implementing efficient algorithms and applications for parallel and distributed systems. Computer systems today generally consist of either a tightly coupled or a loosely coupled network of multi-processors, e.g., MPP, cluster, grid, and peer-to-peer. Learning how to develop and program applications for such systems is a paramount skill for all Computer Scientist. This course will cover various aspects of parallel and distributed computing architectures and efficient algorithm design to harness the multi-processor configurations with emphasis on hands-on programming. It will explore and develop fundamental skills for implementing applications using various facets of networking, parallel and distributed programming techniques. Topics addressed include but not limited to: Network Interconnects; Shared-memory and Message-Passing Architectures; OpenMP, MPI and Hybrid Computational models; Basic techniques for Parallel/distributed programming and synchronization; Parallel/distributed algorithms and Applications; Graphics Processing Unit Programming using CUDA; Data Intensive Processing with MapReduce and Parallel I/O techniques.

4.2.28 CS451: Computer Graphics

Prerequisites: Computer Programming for CS OR Computer Programming for Engineering, Computer Organization, and EITHER Intermediate Computer Programming OR Data Structures.

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This is an introductory course in computer graphics, an advanced topic in the field of computer science. Computer graphics are key to many modern software applications. This is not a class in how to use existing graphics-intensive applications (such as Macromedia's Director or Flash, or Alias' Maya or Pixar's Renderman); we will learn the algorithms underlying these tools and the importance of implementing these algorithms for speed. The course introduces the basic concepts of computer graphics, including the theoretical background as well as fundamental algorithms and data structures that are used in today's interactive graphics systems. The course will cover an introduction to 2D and 3D graphics, including scan conversion, anti-aliasing schemes, clipping, OpenGL programming, 3D viewing and transformations, homogeneous coordinates, perspective and orthographic projections, illumination, shading, and some topics needed from linear algebra. The course gives the opportunity for students to develop programming skills in computer graphics through programming assignments.

4.2.29 CS 456: Algorithm Design & Analysis

Prerequisites: Discrete Structures & Theory, C or better in Data Structures

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

Algorithm design is fundamental to Computer Science, and powerful algorithms are at the heart of most of the electronic tools we use every day, from Facebook to Google Maps, to airline scheduling systems. This course focuses on learning fundamental principles of algorithm design and analyzing the time and space complexity of algorithms. We will cover algorithm design strategies such as brute-force, greedy, divide-and-conquer, recursive backtracking, dynamic programming, and heuristic strategies. We will also introduce the concept of NP completeness and tractability. This course trains you to apply powerful problem-solving techniques to the complex problems you will encounter in your career as a computer scientist.

4.2.30 CS462: Cloud Computing

Prerequisites: Database Management and Web Technologies

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

Computing in the cloud has emerged as a leading paradigm for cost-effective, scalable, well-managed computing. Users pay for services provided in a broadly shared, power efficient datacenter, enabling dynamic computing needs to be met without paying for more than is needed. Actual machines may be virtualized into machine-like services, or more abstract programming platforms, or application-specific services, with the cloud computing infrastructure managing sharing, scheduling, reliability, availability, elasticity, privacy, provisioning, and geographic replication. Cloud Computing has transformed the IT industry by opening the possibility for infinite or at least highly elastic scalability in the delivery of enterprise applications as software-as-a-service (SaaS), platform-as-a-service (PaaS)or infrastructure-as-a-service (IaaS). Amazon Elastic Cloud, Microsoft's Azure, Google Cloud, and many other Cloud offerings give software vendors and new start-ups the option to deploy their applications to systems of infinite computational power with practically no initial capital investment and with modest operating costs proportional to the actual use. The course examines the most important APIs used in Google Cloud and Amazon Web Services (and Microsoft Azure), including the techniques for building, deploying, and maintaining machine images and applications. We will learn how to use Cloud as the infrastructure for existing and new services. We will use open-source implementations of highly available clustering computational environments, as well as RESTful Web services, to build powerful and efficient applications. We also learn how to deal with non-trivial issues in the Cloud, such as load balancing, caching, distributed transactions, and identity and authorization management. In the process we will also become very familiar with Linux operating system.

4.2.31 IS371: Technology & Ethics

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

The digital world comes with it the ability for everyday activities technologically driven. Meaning: every sector of society – government, law, education, health, transport, agriculture, etc., will be affected. This means culture (the way of life for people), institutions, relationships, values and norms will be affected. Culture, as we know it, has some ethical foundations which are being threatened by the rise of technology. This course discusses ethical issues in emerging technologies. As society becomes more dependent on technology, students need the ability to critically assess issues (historical and future) from the virtual world to digital divide, artificial intelligence, machine learning, etc., evaluating alternative strategies or approaches and recommending policies. This course introduces and builds on theoretical and empirical understanding of how information technology shapes and is shaped by society(policies). Areas such as social media, privacy, security and surveillance will be discussed.

4.2.32 IS 361: IS Project Management

Prerequisites: Introduction to Computing and Information Systems, Prior or concurrent enrolment in Systems Analysis and Design

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course comprehensively introduces project management in an information technology/systems context. It will explain the need for project management and the issues associated with managing projects in the IS/IT context. The critical phases of the project management cycle and various tools, techniques, and methods used in each project phase are also discussed. The course will consider theoretical and practical perspectives and equip students with the

necessary skills to better manage or participate in projects. The course is designed in line with the Project Management Body of Knowledge (PMBoK) from the Project Management Institute.

4.2.33 CS112: Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course gives students an intensive introduction to programming as a means of problem-solving. It also introduces them to the broader fields of computer science and information systems and shows a connection between computer programming and other disciplines. Concepts will be illustrated in the Python programming language. This course will introduce the object concept, using and declaring functions (methods). Basic software engineering concepts will also be introduced and will be used to solve problems through approximation, simulations, recursive formulas, and data processing. Finally, Computer Science and Programming will be applied to various engineering disciplines throughout the class. During the course, students will learn some fundamentals such as variables, decisions, loops, and functions in Python. This course is aimed at students with little or no prior programming experience but a desire to understand computational approaches to problem solving. It emphasizes applying problem solving skills; directed toward technical careers in fields employing a reasonably high degree of mathematics. Students will be able to conceptualize engineering problems as computational problems and write computer programs for basic computing problems using the Python computer programming Language.

4.2.34 CS463: Computer Vision

Prerequisites: Data Structures and Algorithms AND (Calculus 1 OR Applied Calculus OR Engineering Calculus) AND (Linear Algebra OR Multivariable Calculus and Linear Algebra) AND (Statistics with Probability OR Statistics for Engineering & Economics)

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course introduces computer vision, a subfield of artificial intelligence dealing with how computers gain high-level understanding from digital images or videos. Topics covered include the fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding, depth from stereo and motion, camera calibration, object tracking, boundary detection, and object recognition. The focus will be on theory as well as on practice and implementation, using both classical machine learning and deep learning approaches.

4.2.35 CS463: Computer Game Development

Prerequisites: Web Technologies OR Intermediate Computer Programming OR Applied Programming for Engineers

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

4.2.36 CE451: Embedded Systems

Prerequisite: Digital Systems Design

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course will cover the design and implementation of embedded systems from a hardware and software perspective. Students will go through the design process of embedded systems and analyse the tradeoff between a hardware and software implementation. They will also learn software development techniques unique to embedded systems such as real-time operations, I/O operations, and communications. The bare metal approach to embedded systems development is highlighted. Students will learn to read data sheets and implement drivers with bit-level manipulation. There is an emphasis on creating responsive multitasking systems. An introduction to a Real Time Operating System will be given.

4.2.37 IS351: Systems Analysis and Design

Prerequisites: Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4.5; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course will cover the principles of information systems including analysis and design. Students will learn techniques in data requirements collection and analysis along with methods to modeling data needs. Modeling of data will occur at the conceptual, logical, and physical levels along with an ability to compare and contrast the different approaches given their merits and limitations. Students will understand the importance and constraints imposed by the domain of the information system along with business rules that guide the design. Functional dependencies and domain normalization will also be discussed as part of the requirements analysis. Object-oriented information system modeling will be surveyed. User-centred design techniques will be explored.

4.2.38 Mathematics Track

Mathematics courses taken by various majors at Ashesi are housed in the Computer Science Department.

4.2.38.1 MATH101 College Algebra

Prerequisites: None

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The goal of this course is to help freshmen develop a good knowledge of basic mathematical principles. Because the best way to learn mathematics is to do mathematics, classes will include a lot of meaningful activities through which students will build mathematical intuition, effective problem-solving skills, and discover real-world applications of mathematics.

4.2.38.2 MATH121 Pre-calculus 1

Prerequisites: None

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

One definition of mathematics is the science of patterns. Patterns are all around us and the human brain is wired to recognize them. Pre-calculus uses the formal concept of functions to identify and describe patterns found in data, patterns expressed as a formula, and patterns identified visually in a graph. The emphasis of the course is on developing a conceptual understanding of the definition of a function, the characteristics of important function families, connections to real life, and how the study of functions facilitates the understanding of calculus. A focus on problem solving strategies, such as drawing diagrams, systematic lists, looking for patterns, matrix logic, unit analysis, estimation, and others, further develop students' skills in quantitative reasoning.

4.2.38.3 MATH122 Pre-calculus 2

Prerequisites: Pre-calculus 1

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course is a sequence to the Pre-calculus 1 course. Its focus continues to be on functions and their connections to real life, and how the study of functions facilitates the understanding of calculus. A focus on problem solving strategies, such as drawing diagrams, systematic lists, looking for patterns, matrix logic, unit analysis, estimation, and others, further develop students' skills in quantitative reasoning.

4.2.38.4 MATH141 Calculus 1

Prerequisites: None

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course seeks to equip students with an intuitive idea of limits. We will discuss continuity and the derivative of a function. Rules of differentiation would be examined and applied. The derivative of the elementary and transcendental functions would be discussed. We would apply the taught theoretical concepts to solve real-life problems.

4.2.38.5 MATH152 Statistics for Engineers

Pre-requisites: Engineering Calculus

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course is a calculus-based, mathematical introduction to the fundamental principles of probability theory, statistics, and applications. Topics include descriptive measures, the axioms and properties of probability, combinatorial analysis used in computing probabilities, conditional probability, independence of events, sampling theory, discrete and continuous random variables, the standard distributions, estimation and hypothesis testing, analysis of variance, regression and correlation, expected value and variance, joint distributions, distributions of a function of a random variable, and sampling distributions. Also included are theoretical results such as Bayes Theorem, Central Limit Theorem, Law of Large Numbers, the Empirical Rule, Hypothesis Testing and Confidence intervals at least for a single mean and a single proportion. Programming in R or a similar language will be used to gain experience with statistical analysis in practice.

4.2.38.6 MATH 161 Engineering Calculus

Required for CE, EE and ME students

Pre-requisites: none

This course equips students with knowledge of differential and Integral Calculus which is fundamental to the field of Engineering. The focus is three dimensional: Concepts, Methods and Applications. Technology such as graphing utility and GeoGebra will be used to aid concept building and solution process.

4.2.38.7 MATH211 Multivariable Calculus & Linear Algebra

Prerequisites: Calculus for Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Physical problems require problem solving approaches which combine mathematical thinking and technology to develop modern solutions. Linear algebra and multivariable calculus is a course which provides the essential and foundational toolkit needed to approach such real-life problems. In this course, you will build on your existing differentiation and integration of single variable studied in prerequisite courses and expand into multivariable calculus and linear algebra. Students will learn how to solve variety of equations in multi-dimensional spaces as well as study how to manipulate linear equations and vectors to solve some engineering problems.

4.2.38.8 MATH221 Statistics with Probability

Prerequisites: Pre-Calculus 2 or Calculus 1

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

What influences consumer choices? Why are some people healthier, academically more successful, or more athletic than others? Are you interested in understanding how climate change is impacting communities in your home country? How can the vast amount of data collected and stored online be used to improve our quality of life? The discipline of statistics seeks to turn data into useful information that can help answer these and many other questions that may pique your interest. In this course, learning statistics will be motivated by using real data to answer questions that YOU are passionate about. Each student will: (1) generate a testable hypothesis from real data; (2) understand how large datasets are structured; (3) format and manage data; (4) conduct descriptive and inferential statistical analysis; and (5) communicate the results of their research to expert and novice audiences. The process of converting data into useful information draws on the following statistical foundation skills taught in the course such as producing data, exploratory data analysis, probability and inference. Statistical computing software is the essential tool that ties the quantitative research process together. In this course, you will use R and R Studio to manage data, carry out statistical analysis, conduct simulations, and create graphs and charts to represent data visually – all in the service of answering your own interesting research question!

4.2.38.9 MATH233 Quantitative Methods

Prerequisites: Pre-Calculus 2 or Calculus 2 AND Statistics or Statistics for Engineering & Economics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1 ; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course will survey quantitative approaches to work in the business world. The course introduces students to concepts, techniques and software with which all successful managers should be familiar. The course has three main components: operation research/management science, project management, and statistics.

The course is hands-on, using spreadsheet techniques with minimal reference to complex or abstract mathematics and the R software. The statistical tests will be useful in nearly any senior project work, as well as any significant quantitative decision-making in a business context. Students will develop critical thinking and problem solving kills and become proficient at applying Operational Research/Management Science techniques, construct models to inform business decisions.

4.2.38.10 MATH142 Calculus II

Prerequisites: Calculus I

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 6-9 per week

Many quantities in Business and the Sciences result from an accumulation or integration process. For instance, total cost of running a coffee shop for a given month, the total revenue accrued by Local Revenue Authorities over a two-year period, the total distance travelled by Inter-City Transport operators, etc. Therefore, accumulation or integration is an everyday experience. In many instances, one can only find information about the rate of change of the desired quantities. Integral calculus is the branch of Mathematics that deals with techniques that lead to complete knowledge of such unknown quantities based on knowledge of their rates of change (derivatives). Key areas of focus of the course include Concepts, Techniques and Application of Integration to Business and related fields.

4.2.38.11 MATH211 Multivariable Calculus & Linear Algebra

Prerequisites: Calculus I & II

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Physical problems require problem solving approaches which combine mathematical thinking and technology to develop modern solutions. Linear algebra and multivariable calculus is a course which provide the essential and foundational toolkit needed to approach such real-life problems. In this course, you will build on your existing differentiation and integration of single variable studied in prerequisite courses expand into multivariable calculus and linear algebra. Students will learn how to solve variety of equations in multi-dimensional space as well as study how to manipulate linear equations and vectors to solve some engineering problems.

4.2.38.12 MATH 251 Differential Equations & Numerical Methods

Prerequisites: Multivariable Calculus & Linear Algebra, Applied Programming for Engineering or Computer Programming for CS

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course will introduce students to the topics associated with differential equations and applied numerical methods in solving engineering problems. Students will learn how to translate engineering problems into differential equations, develop MATLAB models and investigate different numerical methods to find solutions.

Using software, students will learn how to solve differential equations, find roots of equations, the method of gradient descent, discrete and continuous optimization, and finding the solution of linear equations using numerical methods. Techniques will be applied in a series of projects focused on engineering applications.

4.3 Engineering

4.3.1 Engineering Core

4.3.1.1 ENGR 112 Introduction to Engineering

Prerequisites: None

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course will provide a broad overview of the engineering discipline, with the goal of providing a foundation for the rest of the curriculum in terms of engineering concepts, hardware/software skills, and application of the design process. The course will introduce students to basic principles from computer, electrical, and mechanical engineering and challenge them to apply those concepts through the designing and building of a team project. Students will also practice fabrication skills, CAD and Arduino to successfully accomplish their interdisciplinary project. The course is designed to aid students to build an engineering approach to problem-solving. It will also expose the students to potential career trajectories, the ethical standards for professional engineers, and build an eye for using engineering to address local design needs.

4.3.1.2 CS 112 Computer Programming for Engineering

Prerequisites: None

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 6-8 per week

This is a first course in computer programming, primarily intended for students pursuing a major in computer science or engineering, and/or who have had some previous programming practice. Topics include computer representation of data, object-oriented programming, variables and assignments, primitive types and operations, conditional execution, iteration, arrays, classes, methods, recursion, object types, encapsulation, inheritance, and reasoning about programs. The course includes a laboratory component designed to enhance comprehension.

This course gives students an intensive introduction to programming as a means of problem-solving. It also introduces them to the broader fields of computer science and information systems and shows a connection between computer programming and other disciplines. Concepts will be illustrated in the Python programming language. This course will introduce the object concept, using and declaring functions (methods). Basic software engineering concepts will also be introduced and will be used to solve problems through approximation, simulations, recursive formulas, and data processing.

*4.3.1.3 ENGR 212 Instrumentation for Engineering**

Prerequisites: Circuits and Electronics and Statistics for Engineering

Ashesi Units: 0.5; Credit Hours: 2; Hours per Week in Classroom: 1.5; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 4-5 per week

This course continues the concept of measurement and measurement error that is introduced in the Physics sequence. Students study measurement systems, instruments, and measurement errors, and the use of probability and statistical analysis to design and execute experiments in the presence of measurement errors. An emphasis of the course is the design of instrumentation for experimental problem-solving in real systems.

*4.3.1.4 ENGR 300 Year 3 Group Project & Seminar**

Prerequisites: Leadership Seminar 3

Ashesi Units: 0.5; Credit Hours: 2; Hours per Week in Classroom: 1.5; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 5-6 per week

In their third year, engineering students will participate in a one-year group project that ideally cuts across multiple engineering fields (electrical and electronic, mechanical and computer), to revisit the design process at a higher level, to deepen teamwork skills, and to reinforce system level thinking. Part 1 of the third-year project is implemented through Leadership 4 for Engineers, which will address leadership, service learning, and responsibilities of the engineering profession to the community. Projects undertaken will include a service-learning component. Students will consider more than technical feasibility in their solutions, but also the desirability and sustainability of

their solution to the community and the environment. In the course Third Year Group Project and Seminar, a weekly seminar that will facilitate group meetings and coordinate milestone completions, as well as provide a forum for discussion regarding professional issues and system level design. Students will also be required to reflect on their teamwork experiences, their own learning, and their completed group project, and present their project in a public forum. Learning objectives for the Third Year Group Project and Seminar include a maturing of design thinking and creative thinking skills, consideration of qualities such as environmental and societal impacts of their design, deepening of system-level thinking, project management experience, teamwork and communication skills development.

4.3.1.5 SC 221 Materials Science & Chemistry

Prerequisites: Engineering Mechanics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course will introduce students to the basic principles of chemistry and their application to materials science and engineering. Students will study the impact of atomic, ionic, and molecular structure of materials on their micro-structure and properties, and the relationship between electronic structure, chemical bonding, and atomic order. Principal applications and properties of metals, polymers, and ceramics, and composites materials will be studied. Examples from industrial practice and emerging technologies will be used, including the environmental impact of chemical processes, the chemistry involved in energy generation and storage (e.g., batteries and fuel cells). At the end of the course, students will be able to identify materials used in engineering and understand their thermo-chemical and electrical properties.

4.3.1.6 ENGR 311 System Dynamics

Prerequisites: Differential Equations

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The aim of this course is to expose students to understanding the behaviour of engineering systems using systems thinking. The course is an introduction to mathematical modelling of dynamic systems and response analysis of these systems, including, but not limited to, mechanical, electrical, electromechanical, hydraulic, fluid, and thermal systems. The mathematical models will be obtained analytically, but an experimental approach will be introduced. Computer simulation of various systems, using appropriate software, will be conducted.

4.3.1.7 ENGR 312 Control Systems

Prerequisites: Systems Dynamics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course builds on System Dynamics (ENGR311) and introduces students to the theory and practice of control systems. Emphasis is placed on the practical application of the subject to the analysis and design of feedback control systems. Students will model various control systems in the frequency and time domain; mostly, mechanical, electrical, and electro-technical dynamic systems will be considered. Students will study various classical and modern control techniques that will be used to analyse and design controllers for linear systems. Computer software will be applied in the modelling, analysing, and designing of the control systems. Simulation results will be compared with experimental results. Practical and industrial examples from different engineering fields will be discussed. The course focuses on continuous systems, but digital control systems are introduced. Non-linear dynamic models are also introduced. The course is suitable for students pursuing computer, electrical, and mechanical engineering and computer science.

4.3.1.8 ENGR 401 Senior Project & Seminar

Prerequisites: Year 3 Group Project

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9-10 per week

A one hour per week seminar provides a discussion forum for technical writing, ethics and social responsibility, and other topics, and will also serve to guide the project management timeline of the project. At the end of the senior

project, students will write a technical report (summary) of their work and do a public presentation of their work. To reinforce professional writing, each member of a senior group project will write-up their own supporting documents.

4.3.1.9 ENGR 413 Project Management and Professional Practice

Prerequisites: Year 3 Group Project

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 6-7 per week

In this course, students will learn to plan, strategize, and execute an engineering project. The course will develop students' skills to manage projects and build on leadership skills and ethical reasoning they have acquired in core courses. Students will learn about environmental, safety and health issues that must be considered during the implementation of a project. Students will also learn, discuss, and reflect on professional issues such as social responsibility, ethics, licensing, and regulatory reporting.

4.3.1.10 SC 113 Physics: Electromagnetism

Prerequisites: Multivariable Calculus & Linear Algebra

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 7-8 per week

This course is an introduction to electrostatics, electrodynamics, and electromagnetism. The basic principles behind electrical engineering and electronic communication will be discussed. At the end of the course, students will understand simple electronic circuits and the fundamental theories and principles needed to continue their study of electronics and electrical systems. Writing quality lab reports will continue to be emphasised.

4.3.1.11 CS213 Object-Oriented Programming

Prerequisites: Either Computer Programming for CS OR Computer Programming for Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course builds upon the programming concepts from the Computer Programming for CS course and will develop students' ability to program using the object-oriented paradigm and the Java language. It will give students an appreciation of the advantages of object-oriented programming, help them define and construct objects; and leverage abstraction, inheritance, polymorphism, and encapsulation to develop robust and maintainable applications. It will also introduce students to event-driven programming and graphical user interfaces, as well as the use of standard Java packages and the Java collections API. Good software engineering practices will be featured in various aspects of the course: characteristics of good software; documentation, testing; and coding practices which promote correctness and robustness. Also, notations like the Unified Modelling Language (UML) will be employed. Through one or more team projects, students will gain experience in designing and implementing larger applications than in their previous programming classes.

4.3.1.12 CS331 Computer Organization and Architecture

Prerequisites: EITHER Computer Programming for CS OR Computer Programming for Engineering. Completion or concurrent enrolment in Discrete Structures and Theory.

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course presents the fundamental concepts of computer organization and instruction set architectures. Assembly language programming is used to present and illustrate the concepts of instruction set design. The basics of Central Processor Unit (CPU) design and implementation are covered, including some performance enhancing methods like pipelining and memory caches. The interface to the Compiler and Operating System is described in terms of the interaction between the hardware and software components of a system. The course discusses developments in modern computer system such as parallel processing, virtual computing and other new architectures.

*4.3.1.13 CE 122 Applied Programming for Engineers**

Prerequisites: Computer Programming for Engineers

Ashesi Units: 0.5; Credit Hours: 2; Hours per Week in Classroom: 1.5; Hours per Week in Lab: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 4-5 per week

In this course, you will be introduced to basic computer programming techniques and build on your existing computer programming experience and learn how to use programming to solve real-life engineering and scientific problems. You will improve on the modeling skills you have gained from the mathematics and physics courses you took and apply them to develop engineering simulations. You will gain experience in writing computer programs in the MATLAB and C programming languages. You learn how to write about your project in a scientific report. We will also discuss/introduce different ways of applying some programming techniques in courses like Big Data Analysis, Differential Equations, Numerical Methods, Control Systems and System Dynamics.

4.3.1.14 EE 222 Circuits and Electronics

Prerequisites: Physics Electromagnetism

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

In this course students will study the principles and workings of electronic components and design circuits common in electronic systems like amplifiers and filters. Students will learn how to develop mathematical models for electronic circuits and analyze circuit responses in the time and frequency domain. At the end of the course students should have learnt how to model and design simple analog electronics systems. Students will learn to analyze electrical circuits in single- and three-phase power systems.

4.3.1.15 CE 322 Digital Systems Design

Prerequisites: Communication Systems

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 7-8 per week

In this course students will study the principles of digital systems and computers. They will learn digital system theory and design techniques, including Boolean algebra, binary arithmetic, digital representation of data, truth tables, gates, flip-flops, finite state machines, memory, and timing issues. Students will gain experience with several levels of digital systems, from simple logic circuits to microcontrollers, in order to design, simulate and implement digital systems. They will also learn how processors and microcontrollers are used for control by interfacing sensors and actuators.

4.3.1.16 CE 451 Embedded Systems

Prerequisites: Digital System Design

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

This course will cover the design and implementation of embedded systems from a hardware and software perspective. Students will go through the design process of embedded systems and analyze the tradeoff between a hardware and software implementation. They will also learn software development techniques unique to embedded systems such as real-time operations, I/O operations, and communications. The bare metal approach to embedded systems development is highlighted. Students will learn to read data sheets and implement drivers with bit-level manipulation. There is an emphasis on creating responsive multitasking systems. An introduction to a Real Time Operating System will be given.

4.3.2 Electrical Engineering Courses

4.3.2.1 EE 242 Electrical Machines I

Prerequisites: Circuits and Electronics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

This course introduces students to the fundamental principles underlying electro-mechanical machines and devices, their design, and their maintenance. It provides a treatment of transformers, synchronous generators and motors, induction motors, speed and torque control, protective devices, and introduction to DC Machines.

4.3.2.2 EE 342 Advanced Electrical Machines

Prerequisites: Electrical Machines I

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

This is an advanced class that provides students further principles governing the operation of electro-mechanical machines and devices, their design, and their maintenance. There is also a treatment of special purpose motors such as variable reluctance machines and stepping motors. It provides an advanced treatment of power electronics and motor drives, DC motors and DC generators.

4.3.2.3 EE 421 Digital and Analog Signal Processing in Telecommunications

Elective for CE and EE students

Prerequisite: Communication Systems

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 7-8 per week

This course includes the study of signal processing and technology used in the telecommunication industry. Students will study various digital and analog signal processing techniques. Starting from the basic definitions of a discrete-time signal, through Fourier analysis, filter design, sampling, interpolation and quantization, more advanced tools are studied to aid the study and design of digital communications systems. Note: CE and EE students wishing to work in the telecommunications industry are advised to take Digital and Analog Signal Processing in Telecommunications as one of their electives.

4.3.2.4 ME 301 Mechanical Machine Design

Prerequisites: Mechanics of Materials

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

This course covers the principles and current practices of machine element design, including solid modeling and finite element analysis (FEA). The course introduces the design of machine members for static and fatigue strength. The design and selection of common machine elements such as shafts, gears, bearings, springs, keys, power screws and fasteners will be considered. As part of the course there will be a group design project that will involve the use of engineering (mechanical) design process, CAD, FEA, CAM, fabrication of machine components and assemblies to design a physical system and build a working prototype to satisfy design requirements for a given need. Other topics such as codes and standards, project planning and communication skills are also covered.

4.3.2.5 ME 311 Mechanics of Materials

Prerequisites: Material Science

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

This course introduces the theory and application of static engineering mechanics as it relates to statically determinant and indeterminant structural systems. The course involves determination of stresses, deformations, and strains. The course will cover internal resultant loadings in simple plane trusses and beams, elastic properties of solids under axial and torsional loads, stress, strain, and deformation due to axial, torsional, bending, thermal, transverse loads, combined loading, deflection of beams, and columns. Also, transformation of stress and stresses in thin-walled pressure vessels will be covered. The course includes the use of computational software to solve practical engineering problems numerically.

4.3.2.6 ME 212 Thermodynamics

Prerequisites: Engineering Mechanics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

This course is an applied foundation course in thermal science designed to introduce students to the fundamental concepts and the laws of thermodynamics. It extends to the applications of the first and second laws of thermodynamics to systems devised for the production of mechanical power, cooling and heating. The course teaches students about the principles, operations, design, and analysis of thermal systems including power generation, refrigeration, Air conditioning and combustion of fuels. Students will also be introduced to non-conventional power generation resources and utilization.

4.3.2.7 ME 422 Heat Transfer

Prerequisites: Fluid Mechanics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

The course builds understanding of the physical behavior of various modes of heat transfer, including conduction, convection, and radiation. It also includes the design and sizing of heat exchangers; fundamentals of air conditioning and refrigeration vapor cycles, and an introduction to numerical modeling and analysis using finite element analysis software (e.g., SolidWorks Simulation). Labs and projects will involve temperature measurements and the design-build-analysis-test of thermal systems.

4.3.2.8 ME 431 Fluid Mechanics

Prerequisite: Thermodynamics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

How can we model and analyse problems involving fluids? This course investigates the application of fluid mechanics in engineering and industrial processes. We will discuss theories and principles of fluid dynamics and statics using engineering applications as examples. Students will learn various analytical approaches to model and solve basic fluid problems. They will experimentally solve problems during the labs, and they will learn to design to a first-order, fluid systems like pipes and pump systems. At the end of the course students should be able to design and analyze different fluid systems.

4.3.2.9 EE 453 Power Systems Analysis

Elective for EE and ME students

Prerequisite: Power Engineering

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week in Lab: 2; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8-9 per week

This course is a study of advanced topics in electric power distribution systems planning and operation. In this course, students will learn how to analyse flows on power networks and their applications to real systems. It provides students with a working knowledge of power system problems and computer techniques used to solve some of these problems. It also provides a technical treatment of the general problem of power system stability and its relevance. They will learn how to strategically bring together power technology to make energy available to industry by considering need, environment and sustainability. Note: EE and ME majors wishing to work in the power systems industry are advised to take Power Engineering and Power Systems Analysis as their two electives.

4.3.2.10 EE 454 Renewable Energy and Smart Power Grid

Elective for EE and ME students

Prerequisite: Power System Engineering and Power Electronics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

A Smart Grid is the integration of numerous technologies, systems and processes with the aim to modernize and fully automate the entire electricity grid covering generation, transmission, distribution, utilization plus conservation

of energy. This course introduces students to smart grids and intelligent distribution networks. Renewable energy sources and their integration in smart grids as well as energy storage technologies are discussed and these include distributed generation technologies, control technologies, modeling and storage technologies. Demand side/load management is explored, including reactive power optimization. Other topics that this course addresses are smart metering techniques, grid network security and best practices in this domain. Students will also be introduced to electric vehicles in smart grids.

4.3.2.11 ENGR 442 Mechatronics Systems Design

Elective for EE and ME students

Prerequisite: Mechanics, Sensors, Control Theory, Microcontrollers, Electronics, and Electrical Motors.

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

Mechatronics is the synergistic integration of mechanical disciplines, controls, electronics and computers (software) in the design of high-performance machines, devices and processes. This course reviews principles in software programming, machine design, modelling of multi-domain dynamic systems, controls theory, electronics circuits, real-time controls implementation, and system-level integration. Hands-on lab exercises and projects provide extensive coverage of mechanical components, sensors, actuators, electrical drives, signal conditioning circuits, modelling and simulation tools, DAQ hardware and software (microcontrollers), and microprocessors. The main idea of the course is to review and interface the described subsystems to design fully integrated mechatronics systems that meet specified requirements.

4.3.2.12 EE 442 Power Electronics

Elective for EE and ME students

Prerequisite: Circuits & Electronics, Introduction to Electrical Machines

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

In Power Electronics the students will study various static methods to control the power flow between source and load. Due to the high level of power, the main solution for these methods is either forced switching for transistors or naturally for diodes; the thyristors present a forced switching ON and naturally switching OFF.

This subject aims at familiarizing the student with power electronic components in terms of how they work and how they are applied. First of all, the student must learn to know the operation and limitations of the different components. Secondly this course aims at creating an understanding of how these components are applied in different basic types of converters like ac-to-dc converters (rectifiers), dc-ac converters (inverters), dc-dc converters (choppers & switch-mode power supplies) and other types of power conversion methods. A basic foundation is also laid concerning the parameters with which the performance of these converters is measured.

Power Electronic converters like ac and dc drives are used more and more to control the speed and torque of ac and dc motors which are covered in subjects like Electrical Machines III & IV. The controlling of these motors by drives is used in factory processes.

4.3.3 Mechanical Engineering Electives

4.3.3.1 ME 432 Computational Fluid Dynamics

Elective for EE and ME students

Prerequisite: Fluid Mechanics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course provides students with an in-depth understanding of thermal-fluid science and its application in solving problems. The course will introduce students to how to model thermofluid problems, write simple computer programming codes, and use basic computational/numerical tools to solve engineering problems. The course will cover computational simulations using MATLAB, SolidWorks, and Ansys Workbench.

4.3.3.2 ME 412 Advanced Thermodynamics

Elective for EE and ME students

Prerequisite: Thermodynamics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course is an applied aspect of thermal science and engineering. It is designed to introduce students to the design, analysis and implementation of thermal systems. Students will apply the principles of thermodynamics to the operation of different thermal systems including thermal power generation, conventional automobile engine power operations, refrigeration, psychometry and air conditioning processes, fuels and combustion processes. Students will also be introduced to non-conventional and utilization of energy resources and energy management.

4.3.3.3 ME 423 Refrigeration and Air-conditioning

Elective for EE and ME students

Prerequisite: Heat transfer

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course a specialized area in thermal engineering. It is designed to expose students to the field of heating, ventilation, air conditioning and refrigeration (HVACR) principles, processes and systems. It is treated in two parts, Refrigeration Engineering, followed by Air Conditioning Engineering. Each part begins with introduction of the basic theory of the subject and thereon to the practical system and its components with the aim of equipping the student sufficient background to pursue a future career in the HVACR profession. This course advances on the theory behind refrigeration and air conditioning and brings the student closer to the practical systems.

4.3.3.4 ME 402 Advanced Mechanical Machine Design

Elective for EE and ME students

Prerequisite: Mechanical Machine Design

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course builds on Mechanical Machine Design (ME 301) and covers the principles and current practices of design and selection of various machine elements, including solid modeling and finite element analysis (FEA). The elements include gears, springs, keys and seals, belt drives, chain drives, screws, fasteners, nonpermanent joints, clutches, brakes, coupling, flexible mechanical elements, flywheel, welding, bonding, and design of permanent joints.

4.3.3.5 ME 444 Advanced Manufacturing Processes

Elective for EE and ME students

Prerequisite: Manufacturing Processes

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course builds on Manufacturing Processes (ME 441) and covers theory, application, and design considerations in manufacturing processes, including: solidification processes (glass-working, shaping processes for plastics, and processing of polymer matrix composites and rubber), processing of ceramics and cements, material removal processes (power and energy in machining, cutting-tool technology, economic and product design considerations in machining, and grinding and other abrasive processes), surface processing operations, joining and assembly (fundamentals of welding, welding processes, brazing, soldering, and adhesive bonding, mechanical assembly), special processing and assembly technologies (rapid prototyping and additive manufacturing, processing of integrated circuits, and electronics assembly and packaging), manufacturing systems (automation technologies for manufacturing systems and integrated manufacturing systems), and manufacturing support systems (process planning and production control and quality control and inspection). Also, machines and tooling, machine tools design, dimensional and tolerances analyses, design of jigs, fixtures, and tools in modern manufacturing processes will be covered. Machine shop and factory design will be introduced.

4.3.3.6 ME 461 Composite Design and Fabrication

Elective for EE and ME students

Prerequisite: Materials Science & Chemistry

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course provides knowledge on the fabrication of different types of composites, and the understanding of the dependence of their behavior on the characteristics, relative amounts, geometry/distribution, and properties of the constituent phases. It seeks to equip students to be able to select and combine different engineering materials based on their properties to maximize their durability and performance. The possibility of designing materials with property combinations that are better than those found in any monolithic metal alloys, ceramics, and polymeric materials will also be explored.

4.3.3.7 ME 445 Machine Shop and Factory Design

Elective for EE and ME students

Prerequisite: Manufacturing Processes

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This introductory course deals with choosing location for industrial plants, machine shop and factory designs. It also covers Planning the layout of the shop or factory to avoid unnecessary handling. Batch production, line-flow production. Handling work at machine; moving work about the shop: transport conveyors and work handling appliances - gravity, chain, and belt conveyors, hoists, cranes, trucks. Work flow; plant capacity. Storing materials and finished products. Tool rooms; accessibility of tool rooms. Tool room layouts, Industrial ventilation, lamination, quality and quantity, lighting design and economics. Sound, noise and ultrasonic noise control and applications. Accidents prevention, mechanical guarding of machines. Electrical equipment; occupational hazard and fire protection.

4.3.3.8 ME 433 Gas Dynamics and Jet Propulsion

Elective for EE and ME students

Prerequisite: Fluid Mechanics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course introduces students to the basic concepts and importance of gas dynamics and jet propulsion. Areas to consider include basic concepts and isentropic flows: energy and momentum equations of compressible fluid flow, stagnation states, Mach waves and Mach cone-effect of Mach number on compressibility; Flow through ducts: flows through constant area ducts with heat transfer (Rayleigh flow) and friction (Fanno flow), variation of flow properties; Normal and oblique shocks: governing equations, variation of flow parameters across the normal and oblique shocks, Prandtl-Meyer relations, Applications; Jet propulsion - theory of jet propulsion, thrust equation, thrust power and propulsive efficiency; Space propulsion: types of rocket engines, propellants feeding systems, ignition and combustion, etc.

4.3.3.9 ME 443 Renewable and Non-renewable Energy Systems

Elective for EE and ME students

Prerequisite: None

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course introduces renewable and non-renewable energy systems, with a scientific scrutiny of the energy field and an emphasis on alternate energy sources and their technology and application. The course will explore our society's present needs and future energy demands, review conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable, and non-renewable energy sources.

4.3.3.10 ME 453 Automotive Engineering

Elective for EE and ME students

Prerequisite: Mechanics of Machines

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course provides students with knowledge and understanding of basic principles on which automobiles function. Students will be introduced to the various components of automobiles (Power House, Clutch, Transmission, Drive Line Suspension, Steering, Brakes, Wheel and Tyres, Emission Control, Electricals, etc.) their working principles. The course will also introduce maintenance, safety regulations, workshop practice and equipment used in the automobile industry. There will be practical and workshop for students to gain hands-on experience in the automobile industry. Finally, students will be acquainted with modern issues facing automotive engineering.

4.3.3.11 ME 451 Aerospace Projects

Elective for EE and ME students

Prerequisite: Fluid Mechanics

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

How does one design and build aerospace systems? This course is an overview of aerospace engineering, covering the major topics on which analysis must be carried out. This includes aerodynamics, aircraft performance, aerospace materials and their structural properties, flight dynamics, and stability and control. Students will learn analytical approaches in each of these topics and then apply them to the design of real aerospace systems. The lab sessions will be used to cultivate relevant fabrication skills, measure aerodynamic and material properties, and build and test prototypes. Three different aerospace systems will be built in the course, and the last one serves as a final project that will be a team-based vehicle design competition.

4.3.3.12 ENGR 444 Automation and Production Systems

Elective for EE and ME students

Prerequisite: Manufacturing Processes

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course provides students with up-to-date coverage of production systems, how they are sometimes automated and computerized, and how they can be mathematically analyzed to obtain performance metrics. The course is designed primarily for engineering students at the advanced undergraduate or beginning graduate levels in industrial, mechanical, and manufacturing engineering, who wish to learn about automation and production systems technologies in modern manufacturing. Students will also be exposed to computer-integrated manufacturing.

4.3.4 Computer Engineering Electives

4.3.4.1 EE 421 Digital and Analog Signal Processing in Telecommunications

Elective for CE and EE students

Prerequisite: Communication Systems

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course includes the study of signal processing and technology used in the telecommunication industry. Students will study various digital and analog signal processing techniques. Starting from the basic definitions of a discrete-time signal, through Fourier analysis, filter design, sampling, interpolation and quantization, more advanced tools are studied to aid the study and design of digital communications systems. Note: CE and EE students wishing to work in the telecommunications industry are advised to take Digital and Analog Signal Processing in Telecommunications as one of their electives.

4.3.4.2 CS 432 Networks & Data Communications

Required of CE and CS majors, elective for MIS, EE and ME majors

Prerequisite: Computer Programming

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week in Lab: 1.5; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

This course introduces students to the fundamental concepts of computer networks and data communications, with practical applications; students will be able to recognize the components, relevance, advantages, and disadvantages of networking computers. Students will be introduced to the principles of data communications and transmission. Protocols employed in layers 1 to 3 will be examined in depth. Layer 4 protocols will be highlighted and compared to layer 2.

Methods and mechanisms for constructing distributed computing systems and network services are discussed in the context of common Internet systems such as electronic mail, print and file servers and Web services.

Hands-on exercises are used to help reinforce the fundamental concepts learnt. Labs will cover typical network operations tasks. Students will review hardware used in practice, common topologies and set up services on typical enterprise networks.

4.3.4.3 EE 422 Advanced Communication Systems

Elective for CE and EE students

Prerequisite: Communication Systems

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

The course will describe the protocols used in current networks. It will provide skills needed in designing and deploying efficient and effective data communications and network technologies. This course will also develop understanding of some fundamental concepts of information theory, as well as techniques used to model and analyse communication networks. It will briefly highlight how to develop analytical tools and conceptual models for modeling and analyzing network performance. Subtopics will include Fairness and network utility maximization, Optimization based routing and congestion control, Basic queueing models and their application to switching and scheduling in networks.

4.3.4.4 CE 458 Internet of Things

Elective for CE and EE students

Prerequisite: Circuits and Electronics for Engineering students, Database Systems for CS/MIS students

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 1.5;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 9 per week

The Internet of Things (IoT) course takes an end-to-end view of IoT and tackles the devices, networks, data analytics, programming, security, and business aspects. This holistic approach exposes the student to all aspects of a functional IoT system and how to design robust, scalable and a secure IoT network. Labs and small projects will be used to gain understanding of key concepts at the various layers and drive a hands-on experience. Key among these are the devices, network protocols, database, and programming aspects. Students will review hardware types and software tools and be introduced to IoT design principles which cover how to transition from an IoT idea to an IoT product or solution, building prototypes and commercializing them. Since IoT is still emerging, businesses are going to be either adopting IoT solutions or transforming their existing businesses to include IoT in a seamless and sustainable manner. The course introduces students to business concepts that prepare participants to lead in this budding industry.

4.3.4.5 CS 452 Machine Learning

Machine learning is the science of getting computers to act without being explicitly programmed. In the past decade, machine learning has given us self-driving cars, practical speech recognition, effective web search, and a vastly improved understanding of the human genome. Many researchers also think it is the best way to make progress towards human-level AI. This course provides an introduction to machine learning techniques. Students will learn how the techniques are applied, the mathematical and statistical unpinning of the models and how to explore proper

application of the models. Topics include supervised and unsupervised machine learning, statistical inference and prediction. A wide variety of algorithms will be presented, including logistic regression, K-nearest neighbors, naïve bayes, decision trees, neural networks, k-means, mixtures of Gaussians, principal components analysis, expectation maximization. The course will also discuss modern applications of machine learning such as image segmentation and categorization, speech recognition, and text analysis. This course will briefly touch on societal and ethical effects of AI technologies. Students will explore the effects of these new technologies on culture.

4.3.4.6 EE 421 Digital and Analog Signal Processing in Telecommunications

Elective for CE and EE students

Prerequisite: Communication Systems

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 3; Hours of Study Outside of the Class: 9 per week

This course includes the study of signal processing and technology used in the telecommunication industry. Students will study various digital and analog signal processing techniques. Starting from the basic definitions of a discrete-time signal, through Fourier analysis, filter design, sampling, interpolation and quantization, more advanced tools are studied to aid the study and design of digital communications systems. Note: CE and EE students wishing to work in the telecommunications industry are advised to take Digital and Analog Signal Processing in Telecommunications as one of their electives.

4.3.4.7 CS 445 Applied Cryptography and Computer Security

Elective for CS, CE and EE students

Prerequisite: Data Structures or Discrete Math, Database management Systems, Computer programming for Eng.

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 3; Hours of Study Outside of the Class: 9 per week

Computer Security concerns the theory, concepts, techniques and tools used to ensure confidentiality, integrity, and availability. This means understanding security frameworks, threat models, security policies, and mechanisms for prevention, detection, and recovery from attacks.

4.3.4.8 CE 452 Very Large-Scale Integration (VLSI)

Elective for CE and EE students

Prerequisite: Digital Systems Design

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion/lab: 3; Hours of Study Outside of the Class: 9 per week

This class will be using a variety of tools that will give students experience with full-custom and automated CMOS semiconductor design.

As part of this class, we will be designing chips for OpenRoad (full custom) / OpenLane (synthesized) chips and possibly fabricating chips with eFabless. To accomplish this, we will be using several open-source tools.

4.3.4.9 CE 432 Neural Networks

Artificial neural network (ANN) is a numerical implementation of the processing functionality of the human brains to solve real world or physical problems. The concept is based on the notion of massive parallel and distributed computing with learning approach of the brain. Neural networks are able to self-generate when given an objective, training data, and computing power. Typical of an intelligent system, neural networks possess abilities such as being able to acquire information by themselves, have a structure that is flexible enough to represent the information, and have mechanisms that enable them to adapt to their environment using the information acquired. By virtue of its capabilities and versatility, neural networks hold significant promise on how complex engineering and scientific problems could be solved. Neural networks techniques have brought major innovations in applications such as driverless cars, robotics, face recognition, speech and pattern recognition, prediction systems, industrial automation, smart manufacturing, autonomous vehicles, aerospace, financial systems, banking system, defense, entertainment, telecommunications, transportation, agriculture, social media, medical diagnosis, etc. This course will provide the fundamental concepts on operations of neural networks, architectures and design, learning rules and training of the

neural network for applications. Emphasis will be placed on the design principles, mathematical analysis of the networks, methods of training, and their application to solve engineering problems. Matlab tool will be used to design and test various network architectures. As part of the course students will undertake a special course project that will involve developing a neural network model to solve a practical engineering problem.

4.3.4.10 CS 313 Intermediate Computer Programming

This course is a continuation of Object-Oriented Programming (OOP) with Java. It will introduce students to the C++ programming language and teach them to implement in C++ the OOP concepts and ideas they have previously learned. It will introduce additional concepts that will enable students to develop moderately sized applications. These additional concepts will include event-driven programming, multi-threading, design patterns and Unified Modeling Language (UML). The unique advantages of C++ will also be emphasized such as those they bring to Operating Systems and Big Data.

4.3.4.11 CS 441 Mobile Application Development

This course introduces the principles of developing interactive mobile applications and services that may be resident on a phone or the web. There will generally be interaction between the client app and the service online. Students will be exposed to a variety of different popular, contemporary or emerging platforms and operating systems, and be sufficiently informed about the different options and capabilities available on these platforms. Students will also be exposed to the features (both hardware and software) and sensors available on mobile devices and will be encouraged to explore their use in building applications and services. This course requires good programming skills in at least a working knowledge of one language, as well as web development ability. Principal topics include mobile friendly mobile web application development. Client-side application development on platforms which include at the minimum Android will be explored. Contemporary cross platform approaches will also be investigated. Insight into entrepreneurship (building a business around a mobile application) will be provided. Attention will be paid to emerging technologies. The course is very project oriented, as students must receive many hours of hands-on practice and experimentation.

4.3.4.12 CS 461 Data Science

Data Science is a powerful toolkit for using data to answer questions and guide decision making. It involves skills and knowledge from statistics, software engineering, machine learning, and data engineering. This course is designed for students interested in using a powerful data science toolkit to collect, clean, pre-process, visualize datasets and fit models. It will provide most of the knowledge needed to start applying statistical and machine learning algorithms to projects by combining hands-on practice with essential theory. In this class, students work on data science projects that involve collecting data or finding data sources, exploratory data analysis and interactive visualization, statistical analysis, predictive analytics, model selection and validation. Course work also involves readings and case studies on ethical practice in data science.

4.4 Humanities and Social Sciences and Liberal Arts Core

4.4.1 AS 111 Ashesi Success

Required for All Freshmen

Prerequisite(s): None

Typically offered in Semester Two

Course Type: Seminar, Experiential

Credit Hours: 3; Ashesi Credit Units: 0; Hours per Week in Classroom: 3; Hours per Week of Discussion: 0

A program designed to enhance your overall success in college and in life. The most important objective of the program is personal empowerment: learning who you are as a college student, learning who you are as a human being and what you stand for, learning how to speak up when your values are in conflict with those around you, and learning what it takes for you to keep yourself balanced and on course to success. When you are empowered, your actions are more purposeful and your choices more deliberate. When you are empowered, you are more engaged and more motivated every day. And when you are empowered, you have a greater sense of well-being and enjoyment in life.

4.4.2 Core Course Electives

First-Year Experience Courses

4.4.2.1 ENGL 001 Writing, Public Speaking, and Multimedia Communications

Required for All Freshman

Prerequisite(s): None

Typically offered in Semester One

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1

This course is designed to equip you with effective communication, research, and analysis skills that will enable you to successfully present your team's work for the Challenge and prepare you for further development of these skills in the Written and Oral Communications course in Spring. You will specifically hone your skills in the following areas: writing, public speaking, argumentation, multimedia communication, and research. You will also build your teamwork skills by collaborating on the culminating project together, which will be in-class team debates on contemporary issues related to the African Development goals 3, 7, and 18 (healthy and nourished citizens, environmental sustainability, and youth empowerment).

4.4.2.2 FYE 001 How to Communicate Like a Leader (Optional)

Required for All Freshmen

Prerequisite(s): None

Typically offered in Semester One

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1

In this intensive, two-week course experience, students model leadership scenarios by learning the elements of oral communication by leaders, analysing real-world examples, and finally role-playing competing interests while collaborating on an original speech. This course builds on skills learned in Written, Oral, and Multimedia Communication class in Ashesi's the first-year experience in Semester 1 of the academic year 2020-2021 by reflecting on the motivations and trade-offs involved in pleasing different constituencies of the audience for a speech. Structured discussion and reflection enable students to gain a deeper understanding of the opportunities and challenges inherent in winning support while remaining ethical.

4.4.2.3 FYE 002 English Bridge (Optional)

Required for All Freshmen

Prerequisite(s): None

Typically offered in Semester One

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1

Students will hone their reading writing skills through intensive workshops focused on developing their reading comprehension and writing clarity and concision. This optional module is for students who qualified for this module based on the first week diagnostic assessment and for any other students who would like to join the course.

4.4.2.4 ENGL 112 Written and Oral Communication

Required for all BA, MIS & CS, ENG Majors

Prerequisite(s): None

Typically offered in Semester Two

Course Type: Lecture

Credit Hours: 4; Ashesi Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course seeks to guide students to discover or re-discover their identity (or identities) as formal writers and speakers. To this end, this course will endeavor to introduce and have students critically assess established identities in text construction (writing and speaking) as well as consumption (reading and listening). Besides multiple opportunities to speak and write logically and with originality, students have the opportunity to practice, think and talk about the writing process and experience. You will learn to plan, organise, revise and edit your writing. You will also learn to apply the techniques of critical reading and personal reflections to understand and think about your writing process. The course also emphasizes peer review and reflective writing as important strategies for conversing about writing. In this class, we will engage writing and communication as a socially situated act that is significantly shaped by experience and context.

4.4.2.5 ENGL 113 Text and Meaning

Required for all MIS & CS, ENG Majors

Prerequisite(s): Written & Oral Communication

Typically offered in Semester One

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Text and Meaning is one of the foundational courses at Ashesi University. This course invites students to turn their critical and creative attention to the study of literary and critical theories such as Feminism, Marxism, and Postmodernism among others. Through readings and activities that welcome critical thinking, students will participate in a range of activities that will enhance their ability to pose questions, propose hypotheses, gather and analyse data, and make arguments. Within this course, the term 'text' is used in its broadest possible sense, and includes literature, newspapers, magazines, speeches, advertising, websites, blogs, film, music and documentaries. Likewise, reading is theorized and given an expansive scope that covers not only the processing of letters on a page but text consumption more broadly, including listening, viewing/watching, observing, and other modes. As in Written and Oral Communication, students will share their research and findings through a range of written and multimodal assignments.

4.4.2.6 SOAN 325 Research Methods

Required for all BA, MIS & CS Majors

Prerequisite: Statistics, or Statistics for Engineering & Economics

Typically offered in Semester One

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The course is designed to provide the student with broad fundamentals of research methods. To this end, students will be introduced to quantitative, qualitative and mixed methods approaches for conducting research. Students will be guided through the various stages of conducting research; i.e. writing research proposals, where they will identify problems to study; collecting information by conducting appropriate literature review; collecting appropriate primary and/or secondary data; analyzing data; writing mini reports; and critiquing published articles. Class time will be devoted to lectures, data analysis and in-class assignments. The course is hands-on, using R as the main software.

4.4.3 Leadership Seminar Series

The Leadership Seminar Series is a series of interdisciplinary seminars designed to promote self-awareness among Ashesi's students and to expose them to the ideas of great historical thinkers and contemporary leaders. Students will be asked to think broadly and to explore how they might use the examples set by other leaders to achieve their goals in their future professional lives. The leadership seminar series draws upon experts in different fields of corporate, social and academic life. Students must complete the full series in order to graduate from Ashesi University. The series consists of the following seminars:

4.4.3.1 SOAN 111 Leadership Seminar 1

Required for all BA, MIS & CS, ENG Majors

Prerequisite(s): Ashesi Success; Written and Oral Communication

Typically offered in Semester One

Course Type: Seminar

Ashesi Units: 0.5; Credit Hours: 2; Hours per Week in Classroom: 1.5; Hours per Week of Discussion: 0; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 3 per week

This course explores such questions as "What is good leadership?", "What are the attributes of a Great Leader?" and "What does a good leader do or not do?" In this seminar, students will do readings of various historical and contemporary public and business leaders and explore the ethical dimensions of leadership. This is a half unit seminar taught in the format of discussions and assigned readings.

Course content addresses the purpose of leadership and the qualities of a great leader. Students will explore ethics and civic engagement in course readings and discussions. By comparing frameworks for leadership and ethical decision-making and applying those frameworks to leaders in a variety of contexts, students learn to analyze and evaluate the leadership they observe around them. Weekly writing assignments build students' skills in reflective writing. In-class discussions and debate build students verbal communication and presentation skills.

4.4.3.2 SOAN 211 Leadership Seminar 2

Required for all BA, MIS & CS, ENG Majors

Prerequisite(s): Leadership Seminar 1

Typically offered in Semester Two

Course Type: Seminar

Ashesi Units: 0.5; Credit Hours: 2; Hours per Week in Classroom: 1.5; Hours per Week of Discussion: 0; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 3 per week

This seminar probes the most fundamental questions about the good society: "What are the most fundamental rights of humanity? "What impact does the national government have on the trajectory of nations? "What is the Social Contract - Rule of Law, and what impact does it have on civilisations?

After taking this seminar, students should have a deeper understanding of constitutional law and the concept of nations, whose leaders are expected to be servants of the people. This seminar also expands on the discussion of ethics, from corporate social responsibility to ethical issues in public office. Students will develop their skills in writing analytical and reflective papers.

4.4.3.3 SOAN 311 Leadership Seminar 3

Required for all BA, MIS & CS, ENG Majors

Prerequisite(s): Leadership Seminar 2

Typically offered in Semester One

Course Type: Seminar

Ashesi Units: 0.5; Credit Hours: 2; Hours per Week in Classroom: 1.5; Hours per Week of Discussion: 0;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 3 per week

Leadership III seeks to challenge reflective thinking on what constitutes a "good society" and how best economic activity could be organized to realize it. How do we best achieve a balance of liberty, efficiency, equality, and community? At the end of this seminar series, students should have a better understanding of the interplay between natural and civic rights on the one hand and sustainable economic activity on the other. The aim is not to achieve consensus among participants as much as to get students to appreciate the tensions among various elements of the good society and why even within a predominantly capitalist democratic society, people may disagree and pursue differing philosophies.

The Leadership III module builds on the foundations of Leadership I and II by focusing on the issues pertaining to the economic organization of the good society from the perspective of leadership as an inclusive, participatory, and ethical process of change-making in society.

This course provides students with an opportunity to engage and explore classic texts in economics, political economy, and development to understand and familiarize themselves with the various theoretical and philosophical

arguments and concepts in the field of development and leadership while forming their own views and positions on economic matters. Moreover, the course allows the students to apply the philosophical arguments of selected texts to explore current global Sustainable Development Goals (SDGs) by using current data and resources to analyze socio-economic issues in the world with special reference to African nations.

4.4.3.4 SOAN 411 Leadership Seminar 4

Required for all BA, MIS & CS, ENG Majors

Prerequisite(s): Leadership Seminar III

Typically offered in Semester One and Semester Two

Course Type: Seminar

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course is a capstone to the Leadership Seminar Series and puts into practice many of the general concepts discussed in the previous leadership seminars and other courses taken at Ashesi. Service-learning, a vital component of the course, is intended to help you develop a sense of citizenship by becoming engaged with your surrounding community, putting the lessons learned throughout your leadership journey in the various seminars into practical use.

Servant leadership is the core concept we will explore in this seminar. You will have opportunities to reflect on the concept in different ways, including assigned readings and class discussions, debates, identifying and finding solutions to a service project in a community of your choice, various reflective assignments, team, and individual presentations, flip classrooms, shared readings, journaling, and guest speakers. This seminar is a full-unit capstone; it is not meant to be a 'cerebral' course. It's supposed to tug at your heart primarily; therefore, reading ahead of class is crucial. You will be expected to:

- Respect our Circle of Trust, as we share both shallow and deeply personal experiences and thoughts. NOTHING is a taboo topic in this class. If it's on your mind, let's share it!
- Open up and participate fully in all discussions so we can learn from you. No silent spectators!
- Be willing to serve and serve well! Quantum leaders inspire & institutionalize positive change!

The overarching purpose of this seminar fits squarely within Ashesi's mission with its focus on ethical leadership. If the next generation of leaders embraces service as central to leadership, we can help transform our continent and the world! The course content will challenge you to reflect deeply on your leadership journey through the lenses of multiple Servant leadership concepts, including self-awareness, personality, and communication and public speaking for impact, leading quietly, followership, power versus service models of leadership, managing and learning from failure, Ubuntu, key practices of Servant leaders, through the examples of Servant leaders and changemakers across the African continent and in-class guests culminating into a practical opportunity to act out your sense of citizenship through your service project. Finally, the seminar aims to equip you with the needed skills to identify, analyse and evaluate the actions and activities of Servant leaders around you with a particular focus on civil society, advocacy and activism, private and public sectors, NGOs, and social entrepreneurship.

4.4.4 Africana/African Studies Elective Courses

4.4.4.1 ENGL 231 African Literature & Film

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in semesters one & Two

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course aims to introduce students to some of the major debates in the subjects of African Literature and Film. Through an interdisciplinary approach, we will study African cultural creations in both mediums and others subtending or related to them, supplemented with short theoretical readings centred on the following interconnected topics: decolonisation, gender, language and storytelling.

We will cover a range of themes, issues and debates, including but not limited to the following: the continent's engagement with Western thought and literary traditions, explore traditional oral literatures, examine commonalities in style and theme and tackle issues of gender and ethnicity. We will also examine literary works as complex expressions of their contexts, as well as indicators or an index of the values and worldviews of the societies in which they were composed from which they emerged, and those they came to subsequently enter.

The class is delivered through a variety of means, employing various techniques. Through class discussions, writing assignments and individual research, students will be able to combine, integrate and ultimately contribute to the sum of knowledge learned in this class with knowledge and skills gained in other courses, notably Written & Oral Communication and Text & Meaning.

4.4.4.2 POLS 221 African Philosophical Thought

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester One

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

A serious thinking through or reflection on the practical/tangible aspects of the human experience is the goal of philosophy. This course is an introduction to a variety of themes of philosophical thinking in Africa. The approach adopted to advance the goals of the course, differs from traditional philosophy courses in a significant way. Specifically, we will read about the works of African philosophers; apply/interrogate such thoughts in such works to grounded cultural practices in actual and mediated lives; and think through and dialogue with fellow colleagues on the readings in this class. Thus, needless to say, throughout the course we will use concrete examples to ground readings which may sometimes be abstract. The goal of this grounded approach is to demonstrate the relevance of philosophical thinking in contemporary times and also to negate the idea that 'philosophy' does not 'touch ground' (that is, it is only intellectual exercise) and is thus only a 'thinking' (and boring) subject.

4.4.4.3 POLS 231 Africa in International Settings: Africa Beyond Aid

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in alternate years

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Across the African continent many want to do away with decades of aid dependency striving instead for a more assertive Africa on the international scene. This course encourages informed debate and a varied assessment of what overseas development assistance has evolved into over the years and how can it be complemented and replaced by more effective and relevant resources. It will offer a variety of case studies from individual African countries as well as identifying regional trends and characteristics.

The course aims to locate the topical 'Beyond Aid' debate in a theoretical, historical and regional perspective. It offers an introduction to main tenets of development theory and provides an overview of how international norms guiding development policy have evolved from the first development decade of the 1960s to the Sustainable Development Goals (SDGs) adopted by the UN in 2015.

Furthermore, the course assesses the changing role of development assistance in the context of African economic and social development and will compare contemporary data on the role of aid relative to trade, remittances and foreign direct investments. It will look at challenges confronting African countries aiming to offer a more diverse and varied understanding of development options and constraints relative to the often-stereotyped perceptions of 'one size fits all' presumably meant to apply across 54 very different nations on the continent. And it will look at how access to financial resources influence the position of African governments in shaping current geopolitical alliances.

4.4.4.4 POLS 332 Governance in Africa

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester Two

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Scope & Sequence

'Governance in Africa' forms part of the African Studies Elective course for level 300 designed for students pursuing 3rd and 4th years. The course helps students prepare for capstone projects and may further provide useful context for other courses taught in social theory, leadership 3 and 4, international trade & policy. During the course, students will be assisted to understand basic research methods, familiarize with the American Psychological Association (APA) formatting and referencing requirements, use of library and web resources to acquire relevant data and literature, and apply analytical skills and critical thinking to class debates as well as the submission of summative assessment papers.

Research Base

Ordinarily, the concept of 'governance' mirrors activities being undertaking by government(s). In international diplomacy, public policy and social theory, the concept is usually associated with prefixes such as good or bad governance, responsible or accountable governance, effective or ineffective governance, amongst others.

Since the 1990s, international development partners have addressed, and continue to engage in diverse development challenges in response to the changing global dynamics. In the Sub-Saharan Africa, where under development continue to linger, 'good governance' has found space in governance lexicology and considerably shaped policy direction as well as formed part of precondition(s) for development assistance.

Primarily, stakeholders' efforts have focused on the supply side of governance: enhancing capacity of state institutions to public participation, coordination, engagement, accountability, equity, transparency and other well-intentioned considerations. Later developments witnessed a shift of attention to the demand side where civil society and non-state players articulate interests and demand access to government. Subsequently, academic literature has focused on the interface of both the demand and supply side of governance.

Accordingly, 'Governance in Africa' seeks to unveil governance beyond the prerogative of government. The course presents an institutional process involving multiple actors in and outside the confines of government striving at authoritative decision-making arrangements. Governance is presented recognizing the geographical and social contexts, thus, projecting a 'best-fit' practical approach as opposed to the superlative conception of 'best practice'.

The course offers students analytical track to understanding existing governance arrangements in Africa, considers available opportunities and institutional arrangements and how these can be fine-tuned to ensure more responsiveness to the needs of society – public and private interests.

4.4.4.5 SOAN 225 Ghanaian Popular Culture

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester Two

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This Ghanaian Popular Culture course is an undergraduate, 300-level, African Studies elective at Ashesi University. The course uses creative and engaging content in Ghanaian Popular Culture (for instance, video movies, vehicle inscriptions, political cartoons) as a channel for teaching disciplinary analytical thinking and reasoning skills to focus on academic writing, and to indirectly prepare students for capstone projects.

4.4.4.6 SOAN 233 African Music and the Contemporary Art Music Scene

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester Two

Course Type: Lecture, Experiential

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course explores how the character of traditional African traditional music and culture has been reimagined and integrated in contemporary times as Popular, World, Jazz, and Afro Beat and Art/classical music forms by nationalistic African composers. We analyse these music genres for African 'signifiers', consider selected scholarly theories about Afro-classical music by Akin Euba, John Nketia, and Kofi Agawu, formulate theories, applications, and conclusions about the marketing and reception Afro-classical music, and reflect on our own social responsibility to this music genre as educated Africans.

The course content is found in Canvas. Reading articles are stored in Canvas in their pdf formats. The lecture itself is on zoom and accompanied by Google slides. All relevant data can be found on the slide which can be accessed through a link. A significant portion of the lecture is spent listening to music and discussing the compositions. Music links are found on the weekly google slides. Weekly announcements as well as a calendar are presented on Canvas and updated by the Faculty Intern to keep students apprized about weekly expectations. In addition to (2) two weekly lectures, there is an hour-long discussion class held by the FI.

Mission: The mission of Ashesi University is to educate a new generation of ethical, entrepreneurial leaders in Africa; to cultivate within our students the critical thinking skills, the concern for others and the courage it will take to transform a continent.

Vision: Our vision is an African renaissance driven by a new generation of ethical, entrepreneurial leaders. We aim to educate such leaders, and to drive a movement in African higher education to scale up the education of such leaders.

4.4.4.7 SOAN 322 African Cultural Institutions

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester Two

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Contemporary African societies reflect the interplay of tradition and change. The institutions of the past have not simply given way to the newer ones of the present. It is an interplay among what Ali A. Mazrui called a "Triple Heritage" of Indigenous Africa, Islamic Africa, and Euro-Christian/Western Africa. Kwame Nkrumah identified the same dynamic and described it as "Consciencism"—how these three influences on contemporary African life and institutions generate a "crisis of conscience". Thus, African cultural institutions and practices continue to give direction to the internal and external changes that are taking place in Africa and in the Americas today. This course examines the social, political, economic and religious institutions embodying patterns of culture that have evolved over thousands of years and represent Africa's contribution to global civilization. The course enables students to see Africa in a global perspective and provides a framework for scholarly reflection. We approach this course from socio-anthropological perspectives and identify culture as:

A lived experience developed over time with contours and detours based on geography, history and environment,

- African cultures as different yet similar to all other cultures

The course focuses on three interrelated themes: (a) Cultural processes and institutions that existed just prior to the "arrival" of Europeans, (b) the raptures to these cultural processes and institutions—caused especially by the trans-Atlantic slave trade and its subsequent colonial phase, and (c) the legacies of these ruptures during the postcolonial era to the present. Of particular concern will be the effect on processes of development and

democratization. The integration and/or influences of African cultural institutions with other parts of the world, and the centrality of "Africa" in the world receive attention.

4.4.4.8 SOAN 227 Religion in Africa

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester Two

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course is an introduction to a cross-cultural study of religions and cultures of Africa through the disciplines of anthropology, history, and sociology of religion. The goal of the course is to teach students to think critically about the traditional religious heritage of Africa as a profound reflection on the human condition. This goal is achieved through a systematic study of the attitudes of mind, beliefs, as well as practices which have evolved in the many African societies such as the Akan of Ghana, Yoruba and Ibo of Nigeria, Malinke of Guinea, the Ewe/Fon of Dahomey/Benin, the Luo of Tanzania, K(G)ikuyu and Masai of Kenya, the Zulu of Southern Africa, and the Mende of Sierra Leone. Through the viewing of documentary films, movies, lectures, and discussions, the meaning, structure, nature, and world views of contemporary Africans are closely examined.

In addition, the course offers an overview of how cultural and religious knowledge is generated, understood, and used as Africans in general and Sub-Saharan Africans in particular, draw on their music and dance, myths, art forms and symbols to articulate and elaborate on the cosmos, life, sickness, health, and death, as they organize their lives. It does so by retrieving and analyzing the significance of creation myths, religious personalities such as rulers, diviners, and healers, in relation to the role of the ancestors.

Finally, it reflects on the social, cultural and historical factors which have engendered religious changes in Africa. Particularly it unpacks the problematic emergence of two world religions, Christianity and Islam "Guest Religions" and their encounters with the indigenous religions of Africa. Attention is paid to the impact is the "host" on the "guest" religions. In the end, it is hoped that students are enabled to interpret, articulate and synthesize religious knowledge, experience, and reflection as they deal with African ideas, belief systems and practices.

4.4.4.9 SOAN 301 Introduction to Africana Studies: The Global Black Experience

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester One and Semester Two

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

Introduction to Africana Studies surveys the sum-total of the content of Black peoples' lives historically and in the present. The course raises and attempts to answer some key questions: What is the nature and historical contours of the Global Black Experience? How have our understandings and appreciations of this experience changed over time? What is "Africa" to (a) Continental Africans? (b) Caribbean/South American Africans? (c) North American Africans and (d) Indian (Asia) Africans—such as the Sidi of Mumbai? The term "Africana" therefore encapsulates the "wide community" of Africa. It offers an openly conceptual framework to attract new and emerging ways of understanding the global Black experience.

The course therefore explores the interconnectedness of Black subject identities, experiences, issues, themes, as well as topics, and applies them dynamically to diverse locations of the Black world. Specifically, it sheds light on the global approach to the African Diaspora, showing how globalism underscores the distinctive role that Africa and African people have played in their contributions to world affairs. It seeks to demonstrate how Africana people have reclaimed their own "story", noting that "until lions have their own historians, tales of hunting will always glorify the hunter."

Thus, the methodology of this course uses a paradigm which identifies the multiple levels of Black reality over time. The basic facts and perspectives of the course come from the synthesis of three main sources: Africana intellectual

tradition, the traditional academic disciplines (particularly the humanities and social sciences), and the Black Studies Movement. The course is also concerned with the development of academic skills. Through lectures, discussions, documentary and feature films, students are guided to learn how to read and interpret the scholarly output of the field of Africana Studies, master key concepts, definitions, and terminologies. In addition, students learn to express their understandings and reactions to the subject matter both verbally (oral presentations) and in writing in the mode associated with the discipline of Africana Studies.

4.4.4.10 POLS 322 China-Africa Relations

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester Two

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The period from the 1990s has witnessed rapidly bourgeoning Sino-Africa ties, even though ties between them are not new. This is an interdisciplinary course intended to study the historical, economic, cultural, military, and political relations between the People's Republic of China and independent Africa. Employing a miscellany of primary source documents and secondary sources, the course will explore these interactions between China and Africa. We shall be particularly interested in a number of pertinent questions, including, does present-day Chinese engagement in Africa amount to a "new scramble for Africa" or "neo-imperialism"? Is China a hegemonic power in Africa? What are the implications of the "Beijing Consensus", and how has China's embrace of market reform in the 1980s changed her economic and ideological ties with Africa? This course also investigates the nascent role of Chinese companies and businesses in a fast-developing Africa. The goal is to augment students' comprehension of the dynamics of China-Africa relations in a progressively globalized world.

4.4.4.11 POLS 234 Comparative Politics: Politics in Africa

Non-major elective

Prerequisite(s): Written & Oral Communication, Text & Meaning

Typically offered in Semester One

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course is designed to study theoretically and empirically contemporary Politics of Africa. It is a study of African states and their domestic politics, laying emphasis on state-society interactions, governance, governing ideologies, forms of social (ethnic) and political pluralism, monopolization of political and economic power, popular resistance to power, connections, disruptions, and fractures from global politics, chronic underdevelopment and political repression of citizens, the rise of active polities, and the uses and abuses of cultural ties amid dynamism and pervasive violence. In fine, we shall interrogate the processes, institutions, ambiguities, antinomies and contradictions of African politics. The course also involves a study of the many theoretical and epistemological approaches developed to address the issues of African politics.

4.4.5 French Elective Courses

4.4.5.1 FRENC 111 Introductory French 1

Non-major elective

Prerequisite(s): None

Typically offered in Semester One and Semester Two

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The economic development being experienced by Ghana and the geographical location of the country (surrounded by francophone countries), its trade relations with its neighbouring francophone countries, makes both the French language a fundamental means of communication in Ghana, especially in business and at all levels of business transactions. To be competent and competitive in the region, companies have understood that to be able to communicate, both in French and English is a plus, and that there is therefore a need to have bilingually trained staff.

In response to this need, Ashesi University has decided to offer its students, training in French, which will enable them to become « independent users » of French which means that they can easily survive in a francophone environment. The objective is to bring them to attain a level B1 or B2 of the CEFR (Common European Framework of Reference for Languages).

The Common European Framework divides learners into three broad divisions that can be divided into six levels: A1, A2, B1, B2, C1 & C2. For each level, it describes what a learner should be able to do in reading, listening, speaking and writing. We want our students who are taking the Introductory French 1 class to get to meet the requirements of level A1.

4.4.5.2 FRENC 122 Professional French 1

Non-major elective

Prerequisite(s): Introductory French 2 or three years of JHS school French. (Francophone are not allowed to take this course as it is a French as a Foreign Language course)

Typically offered in Semester Two

Offered: Fall

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The economic development being experienced by Ghana and the geographical location of the country (surrounded by francophone countries), its trade relations with its neighbouring francophone countries, makes both the French language a fundamental means of communication in Ghana, especially in business and at all levels of business transactions. To be competent and competitive in the region, companies have understood that to be able to communicate both in French and English is a plus, and that there is therefore a need to have bilingually trained staff.

In response to this need, Ashesi University has decided to offer its students, training in French, which will enable them to become « independent users » of French which means that they can easily survive in a francophone environment. The objective is to bring them to attain a level B1 or B2 of the CEFR (Common European Framework of Reference for Languages). The Common European Framework divides learners into three broad divisions that can be divided into six levels: A1, A2, B1, B2, C1 & C2. For each level, it describes what a learner should be able to do in reading, listening, speaking and writing. We want our students who are taking the Professional French 2 class to get to meet the requirements of level B1.

4.4.5.3 FRENC 123 Introductory French 2

Non-major elective

Prerequisite(s): Introductory French 1 or three years of JHS school French. (Francophone are not allowed to take this course as it is a French as a Foreign Language course)

Typically offered in Semester One and Semester Two

Offered: Spring

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The economic development being experienced by Ghana and the geographical location of the country (surrounded by francophone countries), its trade relations with its neighbouring francophone countries, makes both the French language a fundamental means of communication in Ghana, especially in business and at all levels of business transactions. To be competent and competitive in the region, companies have understood that to be able to

communicate, both in French and English is a plus, and that there is therefore a need to have bilingually trained staff.

In response to this need, Ashesi University has decided to offer its students, training in French, which will enable them to become « independent users » of French which means that they can easily survive in a francophone environment. The objective is to bring them to attain a level B1 or B2 of the CEFR (Common European Framework of Reference for Languages).

The Common European Framework divides learners into three broad divisions that can be divided into six levels: A1, A2, B1, B2, C1 & C2. For each level, it describes what a learner should be able to do in reading, listening, speaking, and writing. We want our students who are taking the Introductory French 2 class to go towards the requirements of level A2.

4.4.5.4 FRENC 214 Professional French 2

Non-major elective

Prerequisite(s): Professional French 1 or a test to three years of JHS school French. (Francophones are not allowed to take this course as it is a French as a Foreign Language course)

Typically offered in the Semester Two

Offered: Spring

Course Type: Lecture

Ashesi Units: 1; Credit Hours: 4; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1; Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The economic development being experienced by Ghana and the geographical location of the country (surrounded by francophone countries), its trade relations with its neighbouring francophone countries, makes both the French language a fundamental means of communication in Ghana, especially in business and at all levels of business transactions. To be competent and competitive in the region, companies have understood that to be able to communicate both in French and English is a plus, and that there is therefore a need to have bilingually trained staff.

In response to this need, Ashesi University has decided to offer its students, training in French, which will enable them to become « independent users » of French which means that they can easily survive in a francophone environment. The objective is to bring them to attain a level B1 or B2 of the CEFR (Common European Framework of Reference for Languages).

The Common European Framework divides learners into three broad divisions that can be divided into six levels: A1, A2, B1, B2, C1 & C2. For each level, it describes what a learner should be able to do in reading, listening, speaking and writing. We want our students who are taking the Professional French 2 class to get to meet the requirements of level B1.

4.4.5.5 FRENC 315 Francophone Literature, Films and Creative Writing

Non-major elective

Prerequisite(s): Professional French 2 or a DELF B1 or a test in French. (Francophones are allowed to take this course)

Typically offered in alternate years

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1;

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

This course introduces students to African literature written in French with emphasis on the work of major authors from West Africa and other authors parts of the Negritude movement. The study of diverse literary genres (Tales, epic, novel, short story, poetry, essay) will be supported by insights into the respective geographical, historical, linguistic, and societal context such as the triangular trade, the colonial era in Africa and the Negritude (Movement) School and its impact on African Literature.

In this course students will read and analyse books and books' extracts, watch and debate about films and documentaries for the period starting in 1940's and going up to the present. Through all those documents students

will also learn about the Francophonie, the African francophone culture. Creative writing and writing with constrains will help students to improve their general and academic writing in French.

The course is an "Africana course" and will allow them to become more confident of their communication skills in French whether it is reading, writing, understanding or speaking.

This course is taught in French and is open for francophone students and/ or students who are advance users of French (at least a B1 level).

4.4.5.6 FRENC 226 French Media and Communication

Non-major elective

Prerequisite(s): Introductory French 2 or French around the world of fashion, DELF A2

Have an intermediate level in French (A2 level on the CECR grid here under)

Typically offered in alternate years

Course Type: Lecture

Credit Hours: 4; Ashesi Credit Units: 1; Hours per Week in Classroom: 3; Hours per Week of Discussion: 1

Hours of Study Outside of the Class (reading, assignments, studying, projects, and so on): 8 per week

The focus of this course will be on the development of fluency and spontaneity of oral and written expression through radio animation. Student will have close interaction with various aspects of modern African francophone culture and during synchronous class discussions, students will be given the opportunity to formulate their opinions about current points of controversy in West Africa and report back on their online researches, while weekly written assignments (essays, synopsis, conductors, scripts) will help students improve their writing skills and prepare their final project: a 30-minute radio program. For this course, students will surround themselves with aspects of everyday francophone west African culture: media (newspapers, radio, TV) pop culture (cinema, art festivals, music), and literature in order to simulate, as much as possible, complete immersion with oral and written comprehension.

We will also help students to take into account that today's media industry expands beyond traditional print (newspaper) and broadcast (Television and Radio) but also includes blogs, vlogs and social networking. As the most successful people in today's media are, whether they are doing media as a hobby, an engagement or professionally our students will not only get some skills in writing and speech, but they will also become excellent online and offline communicators and problem solvers. They will become innovative and entrepreneurial, bold and curios, open-minded and collaborative. By taking this course, students will also gain a critical understanding of the media industry while acquiring technical and professional skills in French communication, information design and using them in the Ashesi Radio and beyond.

5 European Credit Transfer and Accumulation System (ECTS) per Department

5.1 ECTS for Degree in Business Administration

Learning Activity	Learning Hours
Per Semester	
• In class instruction per course	42 hours (3 hrs. X 14 weeks)
• In class discussion associated with course	14 hours (1 hr. X 14 weeks)
• Out of class independent study associated with course instruction and discussion	112 hours ([42 hrs. + 14 hrs.] X 2)
TOTAL per course	168 hours
There is a minimum of 33.5 courses in a program for a degree	5,628 hours (168 hours X 33.5)
Experiential Learning per Program	
• Foundations of Design and Entrepreneurship I	60 hours
• Foundations of Design and Entrepreneurship II	60 hours
• Internship	160 hours
• Leadership IV	50 hours (10 hrs. pre and post fieldwork + 40 hrs. fieldwork)
• Capstone	140 hours
TOTAL hours of learning per program	6098 hours
ECTS (using 1 ECT = 25 hours)	Approx. 244 ECTS

5.2 ECTS for Degree in Engineering

Learning Activity	Learning Hours
Per Semester	
• In class instruction per course	42 hours *(3 hrs. X 14 weeks)*
• In class lab associated with major course	28 hours *(2 hr. X 14 weeks)*
• In class discussion associated with general courses	14 hours *(1 hr X 14 weeks)*
• Out of class independent study associated with major course instruction and discussion	140 hours *([42 hrs. + 28 hrs.] X 2)*
• Out of class independent study associated with general course instruction and discussion	112 hours *([42 hrs. + 14 hrs.] X 2)*
TOTAL per major 16 courses	210 hours
TOTAL per general 18 courses	168 hours
There is a minimum of 16 major courses in a program for a degree	3,360 hours *(210 hours X 16)*
There is a minimum of 18 general courses in a program for a degree	3,024 hours *(168 hours X 18)*
Experiential Learning per Program	
• Foundations of Design and Entrepreneurship I	60 hours
• Foundations of Design and Entrepreneurship II	60 hours
• Internship	160 hours
• Leadership IV	50 hours *(10 hrs. pre and post fieldwork + 40 hrs. fieldwork)*
• Capstone	100 hours
TOTAL hours of learning per program	6,814 hours
ECTS (using 1 ECT = 25 hours)	Approx. 273 ECTS

5.3 ECTS for Degree in Computer Science and Information Systems

Learning Activity	Learning Hours
Per Semester	
• In class instruction per course	42 hours *(3 hrs. X 14 weeks)*
• In class discussion associated with major course	21 hours *(1.5 hrs. X 14 weeks)*
• In class discussion associated with general course	14 hours *(1 hrs. X 14 weeks)*
• Out of class independent study associated with major course instruction and discussion	126 hours *([42 hrs. + 21 hrs.] X 2)*
• Out of class independent study associated with general course instruction and discussion	112 hours *([42 hrs. + 14 hrs.] X 2)*
TOTAL per major course	189 hours
TOTAL per general course	168 hours
There is a minimum of 14 major courses in a program for a degree	2,646 hours *(189 hours X 14)*
There is a minimum of 19.5 general courses in a program for a degree	3,276 hours *(168 hours X 19.5)*
Experiential Learning per Program	
• Foundations of Design and Entrepreneurship I	60 hours
• Foundations of Design and Entrepreneurship II	60 hours
• Internship	160 hours
• Leadership IV	50 hours *(10 hrs. pre and post fieldwork + 40 hrs. fieldwork)*
• Capstone	100 hours

Learning Activity	Learning Hours
TOTAL hours of learning per program	6,352 hours
ECTS (using 1 ECT = 25 hours)	Approx. 254 ECTS

6 Course Catalogue for Joint MAS and MSc Mechatronics Engineering Programs

List of courses to be taken for graduation:

3. Advanced Fundamentals [MAS]
   - Mathematical Tools I
   - Mathematical Tools II
   - Thermofluids
   - Computer Programming / Embedded Systems
   - Analog and Digital Electronics
   - Material Engineering
   - Signals and Systems
   - Dynamics
   - Statics and Solid Mechanics
   - Computational Methods

4. Mechatronics [MSc]
   - Control Systems I
   - Control Systems II and Optimal Control
   - Introduction to Robotics and Mechatronics
   - System Identification and Modelling:
   - Advanced Communication Systems and Internet of Things
   - Data Analysis and Machine Learning

5. Engineering in Perspective [MSc]
   - Finance and Policy Making for Technology Innovation
   - Leading Teams
   - Corporate Responsibility and Sustainability
   - Reducing the Environmental Footprint of Society
   - Introduction to Development Economics
   - Sustainable Engineering

6. Energy Systems [MSc]
   - Energy Systems I
   - Energy Systems and Mobility

7. Production [MSc]
   - Manufacturing Processes
   - Process Engineering
   - Product Development
   - Reliability and Risk

6.1 MAS Curriculum (Year I)

6.1.1 Mathematical Tools I

This course covers mathematical concepts and techniques necessary to model, solve and discuss scientific problems - notably through ordinary differential equations. The key is the so-called mathematical modelling cycle, i.e. the translation of problems from outside of mathematics into mathematics, the study of the mathematical problems and the interpretation of the results in the original environment. The content will span from single-variable calculus and linear algebra to ordinary differential equations.

6.1.2 Mathematical Tools II

This course is continuation of Mathematical Tools I and the main focus is on multivariable calculus and partial differential equations. The goal of Mathematics II is to provide the mathematical foundations relevant for this paradigm. Differential equations are by far the most important tool for modelling and are therefore a main focus of the course.

6.1.3 Thermofluids

This course introduces to the fundamentals of thermodynamics and fluid dynamics. In particular, it introduces the 1st and 2nd law of thermodynamics, the concept of energy, properties of compressible substances, and the kinetic theory of gases.

6.1.4 Embedded Systems and Computer Programming

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is designed for a specific function or for specific functions within a larger system. The course covers theoretical and practical aspects of embedded system design and includes a series of lab sessions. The focus of this lecture is on the design of embedded systems using formal models and methods as well as computer-based synthesis methods.

6.1.5 Digital Electronics

The course provides basic knowledge and methods to understand and to design digital circuits and systems. The content of the course includes digital and analogue signals and their representation, boolean algebra, circuit analysis and synthesis, the MOS transistor, CMOS logic, static and dynamic behaviour, tristate logic, Karnaugh-Maps, hazards, binary number systems, and coding. Moreover, will be also covered combinational and sequential circuits and systems (boolean algebra, K-maps, etc.), memory building blocks and memory structures, programmable logic circuits, finite state machines, and architecture of microprocessors.

6.1.6 Material Engineering

This module provides fundamental training in the behaviour and manufacturing properties of materials as well as an introduction to materials selection and design considerations as practiced in industry, including related concepts such as Design for Manufacturing and "green" design. The objectives of the course include, the understanding of the societal implications of materials development, the appreciation of the challenges in materials selection, following the economical aspect of process selection, and grasp that any material is much more than its chemical composition.

6.1.7 Signals and Systems

Signals arise in most engineering applications. They contain information about the behavior of physical systems. Systems respond to signals and produce other signals. In this course, we explore how signals can be represented and manipulated, and their effects on systems. We further explore how we can discover basic system properties by exciting a system with various types of signals. The course will cover discrete-time signals and systems, Fourier- and z-Transforms, frequency domain characterization of signals and systems, system identification, time series analysis, and filter design.

6.1.8 Dynamics

This course aims at providing a graduate level introduction into the identification and condition assessment of structural systems. Upon completion of the course, the students will be able to: Test Structural Systems for assessing their condition, as this is expressed through stiffness, analyse sensor signals for identifying characteristic structural

properties, such as frequencies, mode shapes and damping, based on noisy or incomplete measurements of the structural response, Establish relationships governing structural response (e.g. dynamics equations), Identify possible damage into the structure by picking up statistical changes in the structural "signature" (behaviour).

6.1.9 Statics and Solid Mechanics

The course revisits the basic concepts of forces and mechanical power, and introduces methods for the analysis of statics problems: distributed forces, centre of gravity, equilibrium, principle of virtual power, trusses, frames, forces and moments in beams and cables, friction. For the mechanical design of deformable bodies, the concepts of stress and deformations and introduced, thus allowing the formulation of the basic problem of continuum mechanics. Different constitutive models are discussed, including anisotropic linear elasticity, linear viscoelasticity, plasticity, viscoplasticity. The course will cover basic structural theories and their applications for the analysis of structural stability and fatigue problems.

6.1.10 Computational Methods

This module introduces numerical methods and techniques for solving initial boundary value problems in solid mechanics (heat conduction, static and dynamic mechanics problems of solids and structures), finite difference methods, indirect and direct techniques, variational methods, finite element (FE) method, FE analysis in small strains for applications in structural mechanics and solid mechanics.

6.2 Mechatronics [MSc]

6.2.1 Control Systems I

This course will allow the students to identify the role and importance of control systems in everyday life. Over the course of the lectures, the students will learn how to analyse systems and synthetize controllers for linear time invariant systems with one input and one output signal.

6.2.2 Control Systems II and Optimal Control

This course focuses on the theory and practice of advanced control techniques. The course will touch the concept of state feedback, and the analysis and synthesis of linear multi-variable control systems.

6.2.3 Introduction to Robotics and Mechatronics

The aim of this lecture is to expose students to the fundamentals of mechatronic and robotic systems. Over the course of these lectures, topics will include how to interface a computer with the real world, different types of sensors and their use, and different types of actuators and their use.

6.2.4 System Identification and Modelling

This course addresses system modelling for control. Different modelling approaches are analyzed: starting from generic modelling approaches based on first principles to Lagrangian and energy-based methods. Model parametrization and parameter estimation are then further discussed.

6.2.5 Advanced Communication Systems and Internet of Things

The objective of this course is to provide an understanding of the principles for transport technologies for modern communications networks and architectures as well as the internet of things. Industrial communications and sensor technology will be addressed.

6.2.6 Data Analysis and Machine Learning

The course will introduce the foundations of learning and making predictions from data. We will study basic concepts such as trading goodness of fit and model complexity. We will discuss important machine learning algorithms used in practice and provide hands-on experience in a course project.

6.3 Engineering in Perspective [MSc]

6.3.1 Finance and Policy Making for Technology Innovation

This course will provide engineering students with basic knowledge on finance and public policy related to technology and innovation. It will have a particular focus on developing country-specific finance and policy aspects. Besides

theoretical and methodological knowhow, the course will feature hands-on case studies, in which the students take an investor's or policy maker's role. Methods taught include: investment appraisal, cost effectiveness analysis, cost benefit analysis, technological forecasting, expert elicitation etc.

6.3.2 Leading Teams

The processes of human resource management are discussed (selection, reward systems, performance evaluation, career development) and embedded in the broader context of leadership in teams. Leadership concepts and group processes are presented. Practical instruments supporting leadership functions are introduced and applied in business settings.

6.3.3 Corporate Responsibility and Sustainability

What is the responsibility of companies to contribute to society, if any? And how can companies integrate their responsibility into the business model and along the supply chain? This course introduces approaches to corporate social responsibility such as international soft-laws or self-regulation instruments, and discusses the challenges companies face when implementing corporate social responsibility in business operations.

6.3.4 Reducing the Environmental Footprint of Society

This course deals with how and why international cooperation in environmental politics emerges, and under what circumstances such cooperation is effective and efficient. Based on theories of international political economy and theories of government regulation various examples of international environmental politics are discussed: the management of international water resources, political responses to global warming, the protection of the stratospheric ozone layer, the reduction of long-range transboundary air pollution, protection of biodiversity, how to deal with plastic waste, the prevention of pollution of the oceans, etc.

6.3.5 Introduction to Development Economics

The goal of this lecture is to introduce students to basic development economics. The course builds on both theories and empirics on poverty, growth and inequality. Based on this understanding, important drivers of economic development and poverty reduction are discussed, with a focus on the role technological and social innovations and experimental approaches to evaluate development policies.

6.3.6 Sustainable Engineering

In 2015, the UN Conference in Paris shaped future world objectives to tackle climate change. In 2016, other political bodies made these changes more difficult to predict. What does it mean for the built environment? This course provides an introduction to the notion of sustainable development when applied to our built environment.

6.4 Energy Systems [MSc]

6.4.1 Energy Systems I

Potential and limitations of renewable energy technologies and their contribution towards sustainable energy utilization. Engineering aspects of energy conversion for solar thermal, solar photovoltaics, biomass, wind, geothermal, hydro, and waste-to-energy technologies. Prerequisite: strong background on the fundamentals of engineering thermodynamics.

6.4.2 Energy Systems and Mobility

This course provides and introduction to current and future propulsion systems behaviour, focusing on energy generation and utilisation. It will address electrical aspects of energy engineering and topics in renewable energy. Moreover, it will also cover system optimisation and controller design for vehicles.

6.5 Production [MSc]

6.5.1 Manufacturing Processes

The course discusses fundamental terms of production engineering, plastic deformation, machining, laser-machining, mechatronics in production machine construction, quality assurance, and process chain planning.

6.5.2 Process Engineering

The course will introduce the students to the biological and chemical processes used in wastewater treatment, organic waste management, and biological resource recovery. The focus will be on fundamental principles of biological and chemical processes as well as process design based on kinetic and stoichiometric principles, e.g., anaerobic digestion for biogas production and aerobic wastewater treatment.

6.5.3 Product Development

The course introduces students to the product development process. In a team, you will explore the early phases of conceptual development and product design, from ideation and concept generation through to hands-on prototyping. This is an opportunity to gain product development experience and improve your skills in prototyping and presenting your product ideas. The project topic changes each year.

6.5.4 Reliability and Risk

The course provides advanced tools for the risk/vulnerability analysis and engineering of complex technical systems and critical infrastructures. It covers application of modelling techniques and design management concepts for strengthening the performance and robustness of such systems, with reference to energy, communication and transportation systems.

6.6 MSc Curriculum: Semester-by-semester structure/schedule of course

Semester	Course Code	Module	Credit Hours (TPC)
Year 1			
Sem. 1: Sep – Jan	MECH 581	Analysis and Design of Control Systems	(2,2,3)
	MECH 521	Data Analysis and Machine Learning	(2,2,3)
	MECH 501	Leading Teams*	(2,0,2)
	MECH 531	Energy Systems	(2,2,3)
	MECH 503	Corporate Responsibility & Sustainability*	(2,0,2)
	MECH 511	Reliability and Risk	(2,2,3)
		Semester 1 total credit	16
Sem. 2: Jan – May	MECH 582	Optimal Control	(2,2,3)
	MECH 584	Robotics	(1,2,2)
	MECH 586	Mechatronics	(1,2,2)
	MECH 502	Reducing Societal and Environmental Footprint*	(2,0,2)
	MECH 532	Energy Systems and Mobility	(2,2,3)
	MECH 542	Process Engineering	(2,2,3)
	MECH 504	Finance and Policy for Technology Innovation*	(2,0,2)
		Semester 2 total credit	17
Year 2			
Sem. 1: Sep – Jan	MECH 681	System Identification and Modelling	(2,2,3)
		Electives: (1 of these)	
	MECH 611	Sustainable Engineering	(2,2,3)
	MECH 613	Process Improvement & Optimization	
		Electives: (1 of these)	
	MECH 631	Advanced Communication Systems and Internet of Things	(2,2,3)
	MECH 633	Automation and Production Systems	
	MECH 601	Development Economics	(2,0,2)
		Electives: (1 of these)	
	MECH 613	Product Development	(2,2,3)

	MECH 651	Machine Tools (Jigs, Fixtures and Tools) Design	
		Electives: (1 of these)	
	MECH 641	Manufacturing Processes	(2,2,3)
	MECH 645	Food Production Technology	
		Semester 1 subtotal	17
Sem. 2: Jan – May	MECH 690	Internship	4
		Master Thesis	6
		Total Program Credit	**60**

6.7 Course Descriptions of Mechatronics Engineering Programs

6.7.1 MECH 581 Analysis and Design of Control Systems (2,2,3)

Objective: The students will learn how to analyse systems and synthesize controllers for linear time invariant systems with one input and one output signal.

Content

Modelling and linearisation of dynamic systems with single input and output signals; State-space description; Analysis (stability, reachability, observability, etc.) of open-loop systems; Laplace transformation; Systems analysis in the frequency domain; Transfer functions and analysis of the influence of its poles and zeros on the system's dynamic behaviour. Frequency response; Analysis of closed-loop systems using the Nyquist criterion; Formulation of performance constraints; Specification of closed-loop system behaviour; Synthesis of elementary closed-loop control systems; Proportional-Integral-Derivative (PID) controllers; Lead/lag compensation; Loop shaping; Discrete-time state space representation and stability analysis

6.7.2 MECH 582 Optimal Control (2,2,3)

Objective: This course focuses on the theory and practice of advanced control techniques like state feedback, linear multi-variable control systems, and model predictive control.

Content

Extension of the basic SISO ideas (time and frequency domain, controllability, observability, eigenvalues, poles, zeros, frequency response, etc.) to MIMO systems; Design of state feedback controllers in time domain; Pole allocation; Finite-horizon LQR; Infinite-horizon LQR; Design of state observers and observer-based controllers with state feedback; LQG approaches; Invariance; Nominal Model Predictive Control; Tracking Model Predictive Control; Stability and robustness analysis of Model Predictive Control; Robust Model Predictive Control

6.7.3 MECH 584 Robotics (1,2,2)

Objective: This introduces the fundamentals of robotic systems, including kinematics and dynamics as applied to manipulators and mobile robots.

Content

Manipulators; Kinematics; Actuators, sensors, and simple sensor processing algorithm; Trajectory planning; Motion control; Teleoperation, Master-slave systems - Supervisory control - Latency problems. Vision Systems; Path Planning

6.7.4 MECH 586 Mechatronics (1,2,2)

Objective: By the end of the course, the students will be able to independently choose, design and integrate these different building blocks into a working mechatronics system.

Content

Over the course, the lecture topics will include an overview of

- Robotics in the mechatronics context
- An introduction to different types of sensors and their use

- Data acquisition; Microcontrollers programming
- Interfacing embedded computers with the real-world
- Digital signal filtering; Digital signal processing
- Introduction to different types of actuators and their use
- An overview of computer vision
- Forward and inverse kinematics in mechatronics systems
- Control strategies for mechatronics systems
- Human-Robot interaction.

6.7.5 MECH 681 System Identification and Modelling (2,2,3)

Objective: Learn how to mathematically describe a physical system or a process in the form of a model usable for analysis and control purposes.

Content

Introduction to system modelling for control. First principles modeling; Lagrangian modeling; Energy-based methods. Model parametrization; Parameter estimation; Data fitting and statistics; Least-squares estimation; Frequency-domain identification; Time-domain identification; Prediction error methods; ARX Models; Closed-loop identification.

6.7.6 MECH 631 Advanced Communication Systems and Internet of Things (2,2,3)

Objective: The objective of this course is to provide an understanding of the principles for transport technologies for modern communications networks and architectures as well as the Internet of Things.

Content

The course will cover:

- protocol layers (both computing & IoT environment)
- delay, loss, throughput; routing algorithms
- ethernet, switching, link layer
- LANs, Constrained node networks
- Internet protocol, Forwarding, Internet routing, routing policies, BGP challenges, and solutions
- TCP protocol
- DNS, HTTP, IPv6
- Fieldbus, Modbus, Profibus, Profinet, Powerlink Ethernet, CANOpen
- Constrained devices
- Communications channels as adapted for IoT including 802.15.4 variants, (Zigbee, 6LoWPAN, WirelessHart, etc) NB-IoT, Bluetooth, Cellular, PLC, VLC et
- Protocols suited for IoT: Technologies for IoT
- IoT sensors, MCU, communication modules, database technologies, data mining technologies, and hosting, visualization
- Programming for IoT Data Collection and Communication
- Industrial Internet of Things protocols; IoT Security

6.7.7 MECH 521 Data Analysis and Machine Learning (2,2,3)

Objective: The course will introduce the foundations of learning and making predictions from data. We will discuss important machine learning algorithms used in practice and provide hands-on experience in a course project.

Content

The course will cover:

- Linear regression; Overfitting; Cross-validation/bootstrap; Model selection; Regularization; [Stochastic] gradient descent; Linear classification; Logistic regression; Feature selection; Sparsity; Multi-class classification; Kernels and the kernel trick; Properties of kernels and applications to linear and logistic regression; K-nearest neighbor; Neural networks; Backpropagation; Regularization; Convolutional neural networks; Unsupervised learning; K-means; PCA; Neural network auto-encoders; The statistical perspective (regularization as prior; loss as likelihood; learning as MAP inference); Statistical decision theory (decision making based on statistical models and utility functions); Discriminative vs. generative modelling (benefits

and challenges in modelling joint vs conditional distributions); Bayes' classifiers (Naive Bayes, Gaussian Bayes; MLE); Bayesian approaches to unsupervised learning (Gaussian mixtures, EM).

6.7.8 MECH 504 Finance and Public Policy for Engineers (2,0,2)

Objective: This course will provide engineering students with basic knowledge on finance and public policy related to technology and innovation. It will have a particular focus on developing country-specific finance and policy aspects.

Content

- Evaluation and financing of capital projects. Methods taught include investment appraisal; cost-effectiveness analysis, cost-benefit analysis; technological forecasting, expert elicitation; cash flows for a project; time value of money; evaluation criteria for investment decisions, taxation; sensitivity, scenario, and other decision analysis techniques; risk and return, sources of finance for projects, etc. Hands-on case studies, in which the students take an investor's or policy maker's role.

6.7.9 MECH 501 Leading Teams (2,0,2)

Objective: This course will provide an understanding of the basic HRM functions and their relationship to leadership and how to manage team processes and diversity.

Content

- The policies, practices, and systems that influence employees' behaviour, attitudes, and performance. Practical instruments supporting leadership functions; basic HRM functions and their relationship to leadership; instruments for selection, performance appraisal, compensation, management, and personnel development (from team leader's perspective); leadership requirements and success factors in leadership; fundamental processes in teams; how to manage team processes and diversity; Fundamentals of effective leadership and dynamics in teams. semester projects to apply HRM instruments in company contexts.

6.7.10 MECH 611 Sustainable Engineering (2,2,3)

Objective: Students will learn a holistic approach of sustainable development. Ecological, economic, and social constraints will be presented, and students will learn about methods for argumentation and tools for assessment) that influence our built environment. An objective is to address current challenges of climate change mitigation and resource depletion.

Content

The following topics give an overview of the themes that are to be worked on during the lecture:

- history and emergence of sustainable development; current understanding and definition of sustainable development. the role of cities, urbanization, and material resources (i.e., energy, construction material) in social economic and environmental sustainability; role of stakeholders, their motivations and constraints; how to evaluate challenges, identify deficits and define strategies to promote a more sustainable construction. Method 1: Life cycle assessment (planning, construction, operation/use, deconstruction). Method 2: Life Cycle Costing. Method 3: Labels and certification. Operation energy at building, urban and national scale, mobility and density questions, and embodied energy for developing and developed world. theory and application of current scientific pathways towards sustainable development.

6.7.11 MECH 601 Development Economics (2,0,2)

Objective: The goal of this course is to provide students with a basic understanding of both theories and empirics on poverty, growth and inequality. Based on this understanding, important policies for sustainable economic development and poverty reduction are discussed, with a focus on the role of technological innovations.

Content

- How development can be defined and measured – building on Sen's capability approach. Classical and endogenous growth theory and the role of capital, technological innovation, governance, education, and health for economic development. How various forms of market failures lead to environmental destruction and extreme poverty and the policies that are needed by a state to confront it. The role of globalization for the future development of countries in sub-Saharan Africa will be discussed.

6.7.12 MECH 502 Reducing Societal and Environmental Footprint (2,0,2)

Objective: The objectives of this course are to (1) gain an overview of relevant questions in the area of international environmental politics from a social sciences viewpoint; (2) learn how to identify interesting/innovative questions concerning this policy area and how to answer them in a methodologically sophisticated way; (3) gain an overview of important global and regional environmental problems and how they could be solved.

Content

This course deals with how and why international cooperation in environmental politics emerges, and under what circumstances such cooperation is effective and efficient. Based on theories of international political economy and theories of government regulation various examples of international environmental politics to be discussed include:

- the management of international water resources; political responses to global warming; the protection of the stratospheric ozone layer; the reduction of long-range transboundary air pollution; protection of biodiversity; how to deal with plastic waste; the prevention of pollution of the oceans, etc.

6.7.13 MECH 503 Corporate Responsibility & Sustainability (2,0,2)

Objective: This course introduces approaches to corporate social responsibility. It will address questions such as - What is the responsibility of companies to contribute to society, if any? How can companies integrate their responsibility into the business model and along the supply chain?

Content

The course will cover international soft-laws or self-regulation instruments, and discuss the challenges companies face when implementing corporate social responsibility in business operations.

6.7.14 MECH 531 Energy Systems (2,2,3)

Objective: Students learn the potential and limitations of renewable energy technologies and their contribution towards sustainable energy utilization.

Content

Engineering aspects of energy conversion for solar thermal, solar photovoltaics, biomass, wind, geothermal, hydro, and waste-to-energy technologies. Technologies for energy optimization

6.7.15 MECH 532 Energy Systems and Mobility (2,2,3)

Objective: This course introduces current and future propulsion systems behaviour, focusing on energy generation and utilization. It addresses electrical aspects of energy engineering and topics in renewable energy. Moreover, it will also cover system optimization and controller design for vehicles.

Content

Physical description and mathematical models of components and subsystems; Power utilization; Power electronics; Propulsion; load control; supercharging, emissions; drive train components; HV & LV power distribution.

6.7.16 MECH 641 Manufacturing Processes (2,2,3)

Objective: The course discusses fundamental terms of production engineering and process chain planning.

Content

Basic principles of manufacturing techniques; functionality of a manufacturing shop. Plastic deformation- and separative- manufacturing processes; laser machining (welding and cutting) and their layouts, product defining properties; limitations of applications such as the associated workshop facilities; principles of the industrial measurement technique; mechatronics concepts in machine tool construction; quality assurance,

6.7.17 MECH 542 Process Engineering (2,2,3)

Objective: Students should be able to evaluate and design biological, chemical (or similar) processes, and develop simple mathematical models to simulate the processes.

Content

Biological and chemical processes used (e.g. in wastewater treatment, organic waste management, and biological resource recovery. Also, an overview of other common industrial processes. Fundamental principles of biological and chemical processes; process design based on kinetic and stoichiometric principles, e.g., anaerobic digestion for biogas production and aerobic wastewater treatment. Process technologies, equipment, and systems; Industrial Processes; Process technology operations; Quality, Safety, Health, and Environment

6.7.18 MECH 613 Product Development (2,2,3)

Objective: The course introduces students to the product development process. Students will in a team, explore the early phases of conceptual development and product design, from ideation and concept generation through to hands-on prototyping.

Content

Introduction to product development and engineering design; product planning and social-economic-technology (SET) factors; user-centred design and product specification; concept generation and selection methods; system design and embodiment design; hands-on prototyping and prototype planning; material selection in engineering design; product lifecycle and sustainability; design for manufacture and design for additive manufacture.

6.7.19 MECH 511 Reliability and Risk (2,2,3)

Objective: Students will be able to model complex technical systems and critical infrastructures, including their dependencies and interdependencies, with appropriate numerical methods. In the end, they will be able to propose design improvements and protection/mitigation strategies to reduce the risks and vulnerabilities of these systems.

Content

Preamble: Modern technical systems and critical infrastructures are complex, highly integrated and interdependent. Examples of these are highly integrated energy supply, energy supply with high penetrations of renewable energy sources, communication, transport, and other physically networked critical infrastructures that provide vital social services. As a result, standard risk-assessment tools are insufficient in evaluating vulnerability, reliability, and risk levels. This course offers suitable.

- Analytical models and computational methods to evaluate levels of vulnerability, reliability, and risk with scientific accuracy. Introduction to complex technical systems and critical infrastructures; basics of the Markov approach to system modelling for reliability and availability analysis; Monte Carlo simulation for reliability and availability analysis, Markov Chain Monte Carlo for applications to reliability and availability analysis, dependent, common cause and cascading failures; complex network theory for the vulnerability analysis of complex technical systems and critical infrastructures; basic concepts of uncertainty and sensitivity analysis in support of the analysis of the reliability and risk of complex systems under incomplete knowledge of their behaviour.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