THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

CURRICULUM GUIDE

OCCUPATIONAL ASSOCIATE DEGREE IN RENEWABLE ENERGY TECHNOLOGY

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Acknowledgement

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1. Background

Aligned with the goals of the National Development Plan for Jamaica, is the thrust for educational development through opportunities of higher learning and professional development. One element of this thrust is the development and implementation of Occupational Programmes of Study. Occupational Certification is designed to bridge the gap between traditional and TVET education at the tertiary level. Occupational Studies involves the training and assessment to support the development of competence in specific skills/occupations, designed to prepare individuals for employment. Occupational programmes are defined by the methodologies of Competency Based Education and Training (CBET), and the Technical Vocational Education Training (TVET) strategies for the development of competent workforces. A critical operational principle of the CBET Policy is that the development of Training, Assessment and Certification Programmes must be designed upon the occupational competencies of the workplace, that is the needs, demands and requirements of employment.

The term **curriculum r**efers to the lessons and academic content taught in a school or in a specific course or program. The design and development of this Occupational Associate Degree curriculum has incorporated the CBET Principles, the National Vocational Qualification of Jamaica, benchmarked against other international standards and similarly recognized international programmes of like nature. It is also reflective of the Educational, TVET, Social, Cultural and Economic goals of the Vision 2030 Development Plan for Jamaica.

The Occupational Degree Curriculum is designed to aid the professional and competency-based pathway for persons to develop occupational competencies across the specific skill areas at various levels, with an emphasis on academic and personal cognitive development. This parallel pathway will allow persons to have comparable credentials of recognition to those of their counterpart perusing academic studies.

These courses are designed to enable students to develop the requisite knowledge, skills, and attitudes to design, install, maintain and quality control renewable energy systems, namely thermal, wind, micro-hydro, and photovoltaic systems. In addition, students will learn how to perform preparatory activities, research, and collect data, design modifications, prepare costing

and budgets, use required regulations, prepare reports using Standard English, manage related documents and documentation, and obtain design approval. This curriculum is packaged in several discrete courses of employable skills which can be independently delivered and assessed however, there are courses which are competency builders for others. These courses, although independently teachable and assessable, may be prerequisite courses for others and should be attained by the student prior to commencement of the respective course to be pursued.

2. Programme Rationale

Colleges subscribe to the view that a globally competitive workforce must have global competencies and so this programme has been benchmarked against those of international institutions that develop persons with global competencies. The instructional intent of this programme is to facilitate the articulation of graduates at an advanced competency level into the workplace, ongoing learning, and mobility on the job. Courses are aligned with National Vocational Qualification of Jamaica (NVQ-J) competency standards, along with those of international professional associations. We subscribe, also, to the view that participants need to be empowered with competencies that can be applied across subjects, and throughout life, in a diverse and ever-changing environment. These competencies are acquired when participants develop the relevant thinking, learning and personal skills that will allow them to think critically, to communicate effectively with a range of people, and to be confident, creative problem-solvers who are able to work independently and also as part of a team with people of diverse backgrounds and interests to create value. Participants who develop these competencies are able to help to make "Jamaica the place of choice to live, work, raise families and do business". They are also able to make positive contributions to any environment in which they choose to operate.

3. Programme Description

This Renewable Energy Technology Programme Curriculum is an Applied Associate Degree which is designed on workplace competencies and recognized Occupational Standards for this particular occupation. The programme design allows persons who have had prior learning, training and or certification at the minimum Level Two National Vocational Qualification of Jamaica (NVQ-J) in the area of study. This Occupational Associate Degree offers students workplace competencies while they are learning the discipline. The programme is projected for two years with four administrative semesters. The programme design combines related underpinning academic competencies with the practical occupational competencies. The programme allows for a "work-ready" and "employable" graduate who can contribute to and create value to their place of employment, the industry, and the nation. The programme offerings are designed at a level where graduates can not only earn an institutional certification, but in addition, professional and or industry recognitions including license required for professional practice. Another key feature is that of graduates gaining recognition through involvement in Voluntarism. The Renewable Energy Technology industry is expanding locally, regionally, and internationally. Accordingly, there is a high level of employment demand for competent workers in the industry. There is also, on the other hand, the opportunity for self-employment through entrepreneurial ventures.

The holders of this level of qualification in Renewable Energy Technology are likely to perform in occupational roles at the workplace which may include amongst others, the following:

1. Team Leader/Foreman
2. Supervisor for particular specialization, Unit or Department
3. Middle Technical Management positions
4. Contractor
5. Site Supervisor
6. Logistic and Procurement Officer

Thus, the instructional intent of this programme is to facilitate the articulation of graduates at an advanced competency level into the workplace, ongoing learning, and mobility on the job.

4. Programme Goals

Aligned with the goals of the National Development Plan for Jamaica, is the thrust for educational development through opportunities of higher learning and professional development. One element of this thrust is the development and implementation of Occupational Programmes of Study. Occupational Certification is designed to bridge the gap between traditional and TVET education at the tertiary level. Occupational Studies involves the training and assessment to support the development of competence in specific skills/occupations, designed to prepare individuals for employment. Occupational programmes are defined by the methodologies of Competency Based Education and Training (CBET), and the Technical Vocational Education Training (TVET) strategies for the development of competent workforces. A critical operational principle of the CBET Policy is that the development of Training, Assessment and Certification Programmes must be designed upon the occupational competencies of the workplace, that is the needs, demands and requirements of employment.

5. Matriculation Requirements

For matriculation or entry into the Occupational Associate Degree programme applicants must meet/possess at least one of the requirements below:

- NVQJ or CVQ – Level 2 Certification
- Other Academic Entry Requirements – in accordance with CCCJ's entry requirements.
- Prior Learning Assessment Recognition
- Mature Entry

Applicants with relevant experience of service in the sector may seek to pursue this programme. The mature entry status should be further specified and confirmed in accordance with the relevant policies and procedures established at the institution hosting this programme. Applicants who qualify under this category must pass a college readiness test of English and Mathematics and are required to submit a professional portfolio which will be used to determine eligibility. Mature entrants may be required to complete bridging courses prior to enrolment into this programme being guided by the institutional policies and procedures specific to same.

Entry Points

- Entry at the start of the programme: Candidates can enter this OAD Programme at the commencement, year 1 semester 1.
- Entry at the start of year two: Candidates can enter this OAD programme at the commencement of year 2 semester 1, provided the candidate satisfies the minimum proficiency rating of the demonstrated occupational outcomes of all prerequisite and prior sequenced courses in the year 1 or the Occupational Diploma programme, in accordance with the institutions' policy and procedures for matriculation.

Exemptions

- Prior Learning Assessment/Advanced placement may be sought by trainees who have successfully completed courses taken through a recognized technical vocational institution or recognized certifying body. Trainees may apply for credit transfer in accordance with the Transfer Policies and Procedures of the institution offering this programme, in consultation with the COS. Successful applicants will receive exemptions from eligible units of competency once requirements for obtaining credit transfer are satisfied.

6. Target Group

The Occupational Degree Curriculum is designed to target the professional and competency-based pathway persons to develop occupational competencies across the specific skill areas at various levels, with an emphasis on academic, technical training and personal cognitive development. This parallel pathway will allow persons to have comparable qualifications and credentials of recognition to those of their counterpart perusing academic studies. This Curriculum is also being designed to target persons to attain workplaces and industry competencies, and recognized occupational standards, and requires the input and validation of trainers, lecturers, instructors, industry professionals and learning resource for developers and stake holders.

7. Programme Duration

The programme may be offered as follows:

Schedule	Duration	Days Offered
Full-time	Four (4) semesters (2 years)	Weekdays, evenings, and weekends. Flexibility is applied based on preference of target group.
Part-time	Six (6) semesters (3 years or 2 summers)	

8. Programme Structure

Curriculum Courses/ Modules	Modules/ Course Codes	Number of Credits	Theory Hours	Lab/ Practical Hours	Pre-requisites
Analysing D.C. Electrical Circuits	REDC1100	3	45		None
Using HVAC Fundamental Principles	REHP1101	3	45		None
Applying Renewable Energy Principles and Practices (Renewable Energy I)	REPP1103	3	45		None
Communication I	COMM1101	3	45		None
Fundamentals of Information Technology	ITEC1104	3	45		None
Mathematical Operations	OMAT1100	3	45		None
Promoting Customer Service and Workplace Relations	CSWR1104	3	45		None
Performing Engineering Mathematics Calculations I	REMC1202	3	45		None
Performing Engineering Mathematics Calculations II	REMC2101	3	45		Performing Engineering Mathematics Calculations I
Analysing A.C. Electrical Circuits	REAC1201	3	45		None
Applying Thermodynamics	REAT1203	3	45		None
Preparing Drawings (Drafting Designs I)	REPD1204	3	45		None
Using HVAC Applications, I	REHA1201	3	45		None
Internship/Externship (Summer) WORKPLACE	REIE1100	3	240		Completion of year1 courses

Communication II	COMM1202	3	45		None
Curriculum Courses/ Modules	**Modules/ Course Codes**	**Number of Credits**	**Theory Hours**	**Lab/ Practical Hours**	**Pre-requisites**
Working with Electronic Devices and Renewable Energy Systems	REER2100	3	45		Applying Renewable Energy Principles and Practices (R.E 1)
Using AutoCAD Applications and Design (Drafting II)	REAO2101	3	45 (practical)		Preparing Drawings (Drafting Designs 1)
Designing and Installing Renewable Energy Systems I	REDI2103	3	45		Electronic device and Renewable Energy Systems
Auditing Renewable Energy Systems	REAS2200	3	45		Renewable Energy System 1
Using Electrical Power Distribution Systems	REED2200	3	45		None
Small Business Management	MGMT2405	3	45		None
Designing and Installing of Renewable Energy Systems II	REDI2206	3	45		None
Managing Renewable Energy Projects	REMP2212	3	45		Fundamentals of Information Technology
Major Capstone Project	REMC1100	1	45		All courses completed
Acquiring Professional and Industry Recognitions	REPI2213	1	45		Compl.Yr two courses
Internship/External (Workplace)	REIE1100	1	240		Compl. Yr one courses.

9. Programme Semester Table (FULL TIME)

YEAR 1

Semester I

CODE	COURSE	CREDITS (HOURS)
REDC1100	Analysing D.C. Electrical Circuits	(3) 45
REHP1101	Using HVAC Fundamental Principles	(3) 45
REPP1103	Applying Renewable Energy Principles and Practices (Renewable Energy I)	(3) 45
COMM1101	Communication I	(3) 45
ITEC1104	Fundamentals of Information Technology	(3) 75
OMAT1100	Mathematical Operations	(3) 45
Total		(18) 300

Semester II

CODE	COURSE	CREDITS (HOURS)
CSWR1104	Promoting Customer Service and Workplace Relations (Elective)	(3) 45
REMC1202	Performing Engineering Mathematics Calculations I	(3) 45
REAC1201	Analysing A.C. Electrical Circuits	(3) 45
COMM1202	Communication II	(3) 45
REHA1201	Using HVAC Applications, I	(3) 45
REAT1203	Applying Thermodynamics	(3) 45
REIE1100	Internship/Externship (Summer)	(3) 45
Total		(21) 315

YEAR 2

Semester III

CODE	COURSE	CREDITS (HOURS)
REHA2102	Using HVAC Applications II	(3) 45
REER2100	Working with Electronic Devices and Renewable Energy Systems	(3) 45
REAO2101	Using AutoCAD Applications and Design (Drafting II)	(3) 45 (PRACTICAL)
REDI2103	Designing and Installing Renewable Energy Systems I	(3) 45
REMC2101	Performing Engineering Mathematics Calculations II	(3) 45
Total		(15) 225

Semester IV

CODE	COURSE	CREDITS (HOURS)
REED2200	Using Electrical Power Distribution Systems	(3) 45
MGMT2405	Small Business Management	(3) 45
REDI2206	Designing and Installing of Renewable Energy Systems II	(3) 45
REMP2212	Managing Renewable Energy Projects	(3) 45
REMC1100	Major Capstone Project	(3) 45
REAS2200	Auditing Renewable Energy Systems	(3) 45
REPI2213	Acquiring Professional and Industry Recognitions	(3) 45
REIE1100	Internship/External (Workplace)	240
Total		(21) 315

10. Delivery and Learning Strategies

The methods of delivery or modes of instruction and learning are expected to deliver/facilitate content appropriate to the subject area and learning styles of students to ensure that course objectives are met. The teaching-learning strategies to be employed will incorporate relevant and current technologies and will also include but are not limited to:

- Interactive lectures
- Simulations
- Demonstrations
- Project-based learning
- Field-based learning
- Case studies and Analysis
- Role plays
- Research
- Observations
- Presentations
- Laboratory exercises
- Self-directed learning
- Problem solving
- Discussions
- Guided practice
- Guest Lectures

The delivery and learning strategies/modes of instruction are intended to:

1. increase the independence of the learner.
2. create critical thinkers.
3. equip learners to enter the corporate world or start their own business.
4. assist the learner to:
    a. develop research skills
    b. analyze and evaluate data
    c. plan, design and implement projects

Faculty members or teams will determine for themselves the appropriate teaching/learning strategies for each curriculum unit, based on the intended learning outcomes, the needs of their learners and the availability of resources. It is intended that teaching/learning strategies utilized are those which encourage the progressive development of the learners' independent learning skills in all courses.

11. Programme Profile

In addition to core content, there are some components that will be infused into the programme to promote holistic development of graduates. Infusion of these elements will be done through such strategies as presentations, seminars and workshops and will not affect the length of the programme. The programme features the following components: -

- **Work Experience/ Practicum**

  Learners are required to complete six (6) weeks (240 hours minimum) of industry attachment/practicum or work experience during the training. The hands-on nature of the teaching and learning process ensures that learners complement their knowledge with practical skills. This will provide an opportunity for them to apply and strengthen the knowledge, skills and attitudes acquired during their training in the programme.

- **Entrepreneurship**

  The programme aims to continue the development of entrepreneurial competencies of graduates, including their level of creativity and innovation to enable them to successfully operate a business venture and/or create new products/services, which should ultimately lead to the creation of employment and wealth for self and others. The focus of this component will be:

  - Applying knowledge of financial requirements for operating a business.
  - Demonstrating knowledge of production and operations management.
  - Outlining principles and practices of business law.

- **Employability Skills** The programme promotes development of the following Critical employability skills.

    - Communication
    - Professionalism and Ethics
    - Teamwork
    - Problem Solving and Critical Thinking
    - Leadership
    - Planning and Organizing
    - Appreciation of Diversity

- **STEAM** The programme is designed to produce graduates of the highest caliber who are not only able to function effectively and efficiently in the workplace but are also able to make significant contributions to the growth and development of their workplaces and the industry. As such, the courses incorporate relevant aspects of Science, Technology, Engineering, Arts and Mathematics (STEAM) in real-world and problem-based contexts. This supports the development of graduates who possess critical 21st-century skills that drive innovation. The core STEAM Skills include the following:

    - Inquiry
    - Communication
    - Self-direction
    - Problem Solving
    - Creativity and Innovation
    - Collaboration
    - Analysis and Critical Thinking
    - Applications of technology

- **Foreign Language** — The programme includes a conversational course in Spanish, or German, Mandarin, or French. It is intended to introduce learners to the fundamentals of the foreign language (phonics, grammar, syntax, vocabulary, etc.) and culture. The focus of the course is conversational competence. This will equip graduates to communicate competently at this level in a foreign language in current and emerging labour markets.

- **Gender Sensitivity** — The programme is designed to produce graduates who are conscious of the need to avoid gender stereotyping and making gender distinctions that limit the roles of men and women based on sex or gender.

- **Cultural Diversity/Sensitivity** — The programme is designed to produce graduates who are sensitive to the cultural diversity within the wider society. Learners are encouraged to have an appreciation of the need to coexist in an institution with variations in religion, ethnicity, racial and socio-economic situations. Learners should understand how to be tolerant and to be accommodating to persons of other cultures.

- **Sustainable Environmental Practices** — Learners are required to develop awareness of environmental issues and their correlation with sustainable development. Sustainability and current environmental practices must be infused in training and in practice. Examples of areas that should be included are: protection of the environment, optimizing use of resources and ensuring use of environmentally friendly products and methods of waste disposal.

12. Evaluation and Assessment Strategies

Evaluation of student learning is aligned with the stated intended learning outcomes for each course. This involves a multi-faceted approach which is used to assess students' critical thinking as well as attitudinal skills. For this reason, evaluation is a blend of practical and theoretical tasks divided in a pre-defined ratio[1]of coursework to end of semester examination[2]. In some cases, summative assessments will include both a skill assessment and knowledge assessment. The assessment strategies used will include, but are not limited to:

i. Tests	Performance Tasks
ii. Laboratory activities	Demonstrations
iii. Field based assessment	Portfolios
iv. Projects (individual or group)	Oral Reports and Presentations
v. Condensed or summary reports	Graphical Displays
vi. Self and peer evaluations	Interviews

a. Final Examination

In order to improve quality, all applicable General Education courses have a standardized examination. Within an academic year, there are typically three (3) examination sessions: December, May, and August. The end-of-semester exam (Final Examination) will consist of a combination of the following**:**

i. Multiple Choice Questions (MCQs)
ii. Structured Questions (SQs)
iii. Practical Assignments (PAs)

[1] The applicable ratio of coursework to end of semester examination is found in the respective course outline [2]In reference to the end of semester examination (Final Examination), with duration of two (2) hours.

13. Grading Scheme

1. **Grading**

Typically, a student's final grade is calculated by the combination of the course work grade and the final examination grade. The specific course outline can be consulted regarding the applicable grading scheme.

A student who attains a combined grade of:

a. 50% or more is deemed to have passed the course.

b. at least 45% but less than 49% is deemed to have failed the course, and qualifies for a supplemental examination[3]

c. less than 44% is deemed to have failed the course and will be required to repeat the course in its entirety.

[3]The supplemental examination must be done at the next available sitting within the current academic year. The grade received therein shall be the student's final grade for the course. A student who fails a supplemental examination is required to repeat the course in its entirety.

Examination Grades, Points and Distribution

Percentage Scale	Grade	Grade Point	Student Performance Description
90-100	A	4.00	
80-89	A-	3.67	**Excellent**
75-79	B+	3.33	
70-74	B	3.00	
65-69	B-	2.67	**Good**
60-64	C+	2.33	
55-59	C	2.00	**Satisfactory**

50-54	C-	1.67	
45-49	D+	1.33	**Marginal Fail – Re-sit**
40-44	D	1.00	**Fail – Redo**
0-39	U	0.00	**Unsatisfactory**

Effective Academic Year September 2014

LEVELS OF AWARDS

BACHELOR OF SCIENCE		**ASSOCIATE OF ARTS** **ASSOCIATE OF SCIENCE**	
G.P. A	Classification	G.P. A	Classification
3.70 - 4.00	First Class Honours	3.70 - 4.00	Honours
3.30 - 3.69	Second Class Honours (Upper)	2.70 - 3.69	Credit
2.70 - 3.29	Second Class Honours (Lower)		
1.70 - 2.69	Pass	1.70 - 2.69	Pass

14. Graduate Profile

Graduates from the O.A.D. in Renewable Energy Technology programme should be:

1. Technologically competent
2. World-ready workers
3. Self-directed
4. Life-long learners
5. Critical thinkers
6. Problem-solvers
7. Socially and culturally aware
8. Contributors to community and national development
9. Team players
10. Possess excellent communication skills
11. Entrepreneurial
12. Environmentally aware
13. Gender inclusive
14. Ethical and professional

15. Course Description

Acquiring Professional and Industry Certification (REPI2213)

This Professional Recognition Development Programme is designed to provide the students with the opportunity to pursue professional and industrial recognition programmes which will give them the opportunity to acquire professional and/or industry certification, licenses or licensure. Coupled with their educational and/or institutional training, professional certification gives graduates the competitive edge in the employment market within the sector identified for their chosen career path.

The student is to be assigned a workplace mentor and/or programme advisor who will facilitate and guide the student's goal to achieve professional recognition. Students should be encouraged to commence these pursuits before the completion of their course of study.

Analyzing A.C. Electrical Circuits (REAC1201)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to work with alternating current (A.C.) circuits. It will also enable them to read circuits diagram, wire different types of circuits, detect faults, resolve problems and use appropriate regulations and procedure to work safely, efficiently and effectively.

Analysing D.C. Electrical Circuits (REDC1100)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to handle D.C. circuits, detect faults, wire circuits, read diagrams associated with the circuit designs, carry out safety procedures in using circuits and interpret regulations pertaining to the operations of circuits.

Applying Energy Systems Controls (REES2104)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to use control devices and instrumentations, take physical measurements, solve pressure measurement and use regulations governing the professional practices in the sector.

Applying Renewable Energy Principles and Practices (Renewable Energy I) (REPP1103)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to execute work functions such as installations, repairs, testing and maintenance of facilities powered by renewable energy sources.

Applying Thermodynamics **(REAT1203)**

This course is designed to enable students to develop the requisite knowledge, skills, and attitudes to apply the principles and practices of thermodynamics to address issues requiring solutions to thermodynamics and electro-technology problems and to solve problems in static and dynamic system.

Auditing Renewable Energy Systems **(REAS2200)**

This course is designed to enable students to develop the requisite knowledge, skills, and attitudes to conduct residential, commercial and industrial energy audits. They will be exposed to the audit process, audits plans/schedule, organization of resources for conduct of audits, audit traits, manage audit teams and audit process, preparation of audits reports and other related documentation, analyse audit finds, make recommendations and corrective action plans, presentation of reports to stakeholders and execute follow monitoring plan.

Communication I **(COMM1101)**

This course is designed to give the students the knowledge, skills and aptitudes to develop and use standard communication and presentation skills that are important to and necessary in the industry and for their personal and professional development.

Communication II **(COMM1202)**

This course aims to enhance students' communicative competence in the world of work. It explores the communication process, examining the intricacies of technical writing while at the same time promoting critical thinking skills that will allow the students to engage in informative discourse that would be beneficial to their field of expertise and, by extension, the wider society.

Designing and Installing Renewable Energy Systems I **(REDI2103)**

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to design, install, maintain and quality control renewable energy systems, namely thermal, wind, micro-hydro, and photovoltaic systems. In addition students will learn how to perform preparatory activities, research and collect data, design modifications, prepare costing and budgets, use required regulations, prepare reports using Standard English, manage related documents and documentation, and obtain design approval.

Designing and Installing of Renewable Energy Systems II **(REDI2206)**

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to design and install thermal heating systems, Solar System and Wind Systems.

Small Business Management **(MGMT2405)**

This course is designed to provide learners with an understanding of the requisite tools used in small business management. It will expose learners to the concept of entrepreneurship and the techniques used in launching a small business. In addition, this course will enable learners to understand and apply principles that are critical to developing, growing and managing a new business; the learner should demonstrate mastery by development of a business plan.

Fundamentals of Information Technology **(ITEC1104)**

This course is designed to equip students with internet search skills, word processing, spreadsheet and presentation graphics, and database software skills that will allow them to produce documents and perform routine data analysis functions that would be required of an entry-level professional.

Major Capstone Project **(REMC1100)**

This major capstone experience is intended to give students the opportunity to integrate the total body of learning experiences gained throughout the program duration. Students will be required to use knowledge, skills and aptitude acquired to design, develop, and prepare implementation strategies for the project assignments indicated here under.

Managing Renewable Energy Projects **(REMP2212)**

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to manage projects and to work in an environment where the successful management of projects is critical to the meeting of timeline to avoid cost overruns, and to maximize the use of resources and to meet customer satisfaction. Students will be exposed to project management software, project management tools, such as GANTT charts, critical path. Analysis, management of project teams, management of multi-projects, and to manage the projects life cycle.

Mathematical Operations **(OMAT1100)**

This course is designed for students requiring minimal use of mathematical applications as part of their jobs. The course of study includes numeracy, exposure to the consumer arithmetic and statistics as mastery of these basic topics is a useful tool in data presentation and report writing. Students are equipped with basic, yet sufficient knowledge, particularly of consumer/financial mathematics, an asset for advancement at the workplace as well as academically.

Performing Engineering Mathematics Calculations I **(REMC1202)**

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to use trigonometry, determinants, matrices and vectors to solve renewable energy problems.

This course serves to expose the students to more rigorous approach pertaining to the study of mathematics in moving from the secondary level to the intermediary level. In preparation for the

study of calculus and engineering mathematics at a later stage the concepts of logarithm and indices, expansion by the binomial theorem, solution of polynomials using remainder and factor theorems and trigonometry are emphasized whereas most of the other topics serve as revision ones extending the earlier concepts further. There is less reliance on the use of calculators despite an attempt to develop further competence in its use.

Performing Engineering Mathematics Calculations II (REMC2101)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to use trigonometry, determinants, matrices and vectors to solve renewable energy problems. This course serves to expose the students to more rigorous approach pertaining to the study of mathematics in moving from the secondary level to the intermediary level. In preparation for the study of calculus and engineering mathematics at a later stage the concepts of logarithm and indices, expansion by the binomial theorem, solution of polynomials using remainder and factor theorems and trigonometry are emphasized whereas most of the other topics serve as revision ones extending the earlier concepts further. There is less reliance on the use of calculators despite an attempt to develop further competence in its use.

Promoting Customer Service and Workplace Relations (CSWR1104)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to provide good customer service. It focuses on developing awareness of the importance of customer service to the success of renewable energy sector, building and maintaining customer loyalty, dealing with difficult customers, presenting a professional image and participating in teamwork.

Purchasing and Inventory Control (REDI2211)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to purchase materials and equipment and control inventory.

Using AutoCAD Applications and Design (Drafting II) (REAO2101)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to use AutoCAD Application to create advanced drawings. The course augments the principles learnt in Drafting, with focus on complex engineering assembly gadgets, the relevant machining finishes; fabrication drawings with the relevant welding symbols, and pattern drawings for items that are to be casted. Students will also be able to save, store and retrieve these files to use on future projects, which may require modification in some cases.

Using Electrical Power Distribution Systems (REED2200)

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to design, install and maintain A.C. circuits, measure electrical quantities, and select and purchase electrical materials and components according to electrical power specification.

Using HVAC Applications I **(REHA1201)**

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to install ducts, grilles, apply HVAC requirements in treating with air conditioning systems, hydronic systems heat pump systems.

Using HVAC Applications II **(REHA2102)**

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to install ducts, grilles, apply HVAC requirements in treating with air conditioning systems, hydronic systems heat pump systems.

Using HVAC Fundamental Principles **(REHP1101)**

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to handle HVAC components, detect faults, carry out repairs and deal with refrigeration systems, ductwork, air properties, heat systems and airflow systems.

Working with Electronic Devices and Renewable Energy Systems **(REER2100)**

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to design electronic circuits, install electronic circuits, reprogram circuits, detect and correct faults, as well as complying with registration and regulations governing the sector. Emphasis will be placed on PN Junction semiconductor as switch and amplifier.

16. Programme Requirements

Institutions seeking to offer this programme will have to demonstrate that they satisfy the minimum programme requirements indicated in the table below.

#	PREPARATORY PROGRAMME REQUIREMENTS FOR IMPLEMENTATION
1	**Required Facilities**
	Equipped Computer lab
	Equipped Skills training lab
	Adequate Classroom(s)
	Adequate Internet Access
	Equipped SEN facilities, with respect to target group
	Consider flexible learning options, where possible
2	**Learning/Training Resources Requirements (*Please indicate*)**
	Investigate the availability of curriculum, Learner guide, Facilitator's manual
	Investigate the availability of Library materials
	Investigate the availability of multimedia content
	Investigate the availability of repurposed content for flexible learning
	Investigate the availability of repurposed content for SEN
3	**Required training Equipment/Tools/Software/Hardware**
	Determine the delivery material requirements (e.g. Electrical wires)
	Determine the required computer software/hardware
	Determine the required tools/equipment
	Determine the required online simulation resources, if applicable
	Determine the required assistive technologies based on specific SEN
4	**Human Resources Requirements**
	Determine adequacy of skill Instructors
	Determine the Instructor qualification requirements
	Determine the need for Lab Assistants
	Determine the required Assessors
	Determine the need for additional tutors to support flexible learning modality (if required)
	Determine the need for trained Instructor to support selected SEN groups
5	**Required Assessment Strategies to be Approved with accrediting body**
	Determine the requirements for traditional assessment modes
	Determine the requirements for Blended / flexible Assessment modes
	Determine the requirements for Special Education Needs assessment strategies
6	**Required Delivery Modality**
	Determine the requirements for flexible learning/ Blended (Developed content)
	Determine the requirements for Face to Face (Developed delivery content)
	Determine the requirements for SEN Modified Delivery Content
#	PREPARATORY PROGRAMME REQUIREMENTS FOR IMPLEMENTATION
7	**Required Programme Budget/Costs/Fees**
	Calculate Programme delivery costs
	Calculate Student/Trainee fees
	Other costs

16. References

Goodstal, G. (2013). *Electrical theory for renewable energy*. Clifton Park, NY: Delmar.

Human Resources: Lecturers, Circuit material, measuring devices.

Wijeysundera, N. E. (2016). *Principles of Heating, Ventilation and Air Conditioning with Worked Examples*. Singapore: World Scientific Publishing.

COURSE

COURSE

OUTLINES

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	ANALYSING A.C. ELECTRICAL CIRCUITS
COURSE CODE:	REAC1201
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	D.C CIRCUITS
CO-REQUISITE(S):	None
SEMESTER:	II

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to work with alternating current (A.C.) circuits. It will also enable them to read circuits diagram, wire different types of circuits, detect faults, resolve problems and use appropriate regulations and procedure to work safely, efficiently and effectively.

LEARNER OUTCOMES/INSTRUCTIONAL OBJECTIVES:

Upon successful completion of this course, students are competent when they are able to:

1. comply with relevant regulations, codes of practice and OHS requirements in ALL operations.
2. prepare to solve problems in A.C. low voltage systems.
3. identify cause of problems in low voltage A.C. Circuits.
4. slow voltage A.C. Circuit problems efficiently.
5. install A.C. Circuits.
6. measure electrical quantities in A.C. Circuits.
7. document and report problem solving activities.
8. interpret circuit designs and prepare material listings.

UNIT I – A.C. CIRCUIT OPERATIONS (7 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. differentiate between D.C. an A.C. circuits.
2. identify properties of A.C. circuits.
3. interpret relevant OHS regulations and codes of practice.
4. compare and contrast series, parallel and series parallel A.C. circuits.
5. measure electrical quantities in A.C. circuits.
6. wire types of A.C. circuits.

Content:

To include but not limited to:

1. Occupational Health and Safety:

    a. Relevant regulations, codes of practice and Occupational Health and Safety requirements in A.C circuits
    b. Hazards low A.C. circuits
    c. Type of A.C. circuits (parallel, series, series-parallel)
    d. Properties of A.C. circuits

2. Make use of trigonometry ratios and Pythagoras theorem to demonstrate A.C circuit properties:

    a. Sine, Cosine, and Tangent ratios of a right-angle triangle.
    b. Pythagoras theorem to a right-angle triangle.
    c. Sinusoidal voltage generated by a single turn coil rotated in a uniform magnetic field.
    d. Terms 'period', 'maximum value', 'peak-to-peak value', 'instantaneous value', 'average value', 'root-mean-square (R.M.S.) Value', in relation to a sinusoidal waveform.
    e. Purpose of phasor diagrams.
    f. 'In-phase', 'out-of-phase', 'phase angle'' lead' and 'lag'.
    g. Phase angle between two or more alternating quantities from a given sinusoidal waveform diagram.
    h. Convention for representing voltage, current and the reference quantity in a phasor diagram.

UNIT II – MEASURING INDUCTIVE AND CAPACITIVE REACTANCE IN A.C CIRCUIT (7 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. explain inductive and capacitive reaction.
2. explain the impact of inductive and capacitive reaction in A.C. circuits.
3. solve Inductive reactance problem in A. C. circuits.
4. solve capacitive reactance problem in A.C. circuits.
5. determine voltage drop.
6. explain the effects of impedance in A.C. circuits.

Content:

To include but not limited to:

1. Relationship between voltage drops and current in resistive A.C. circuit.
2. Applications of resistive A.C. circuits.
3. Defining inductive and capacitive reactance.
4. Applications of inductive A.C circuits.
5. Applications of capacitive A.C circuits.
6. Impedance and impedance triangle.
7. Examples of capacitive components in power circuits and systems and the effect on the phase relationship between voltage and current.
8. Examples of inductive components in power circuits and systems and describe their effect on the phase relationship between voltage and current.

UNIT III – MEASURING POWER IN A.C. CIRCUIT (7 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. explain the type of power in A.C. circuits.
2. use formulae to calculate power.
3. identify the difference between true power, apparent power, and reactive power A. C. circuits.
4. solve A.C. circuit problems involve single phase and power factor.
5. measure power in A.C. circuits.

6. conduct power factor correction.

Content:

To include but not limited to:

1. Difference:

    a. Difference between true power, apparent power and reactive power and the units in which these quantities are measured.
    b. Defining the term "power factor" and “phase angle”.

2. Solve A.C. problems:

    a. Methods used to measure single phase power, energy, and demand.
    b. Effects of low power factor.
    c. Requirements for power factor improvement.
    d. Methods used to improve low power factor of an installation.
    e. Local supply authority and AS/NZS 3000 wiring rules requirements regarding power factor of an installation and power factor improvement equipment.
    f. Methods used to measure single phase power factor.
    g. Using manufacturers catalogues to select power factor equipment for a particular installation Difference between true power, apparent power and reactive power and the units in which these quantities are measured in a three-phase system.
    h. Methods used to measure three phase power, energy, power factor and demand.
    i. Determining how the power factor of a three-phase installation can be improved.

UNIT IV - MEASURE HARMONICS IN A.C. CIRCUITS (8 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. explain the concepts of harmonic of an A.C. Power system.
2. explain the concepts of resonance of an A.C. circuit.
3. measure harmonic in A.C. circuits.
4. measure resonance in A.C. circuits.

Content:

To include but not limited to:

1. Harmonic:

    a. Term "harmonic" in relation to the sinusoidal waveform of an A.C. Power system.
    b. Sources in A.C. Systems that produce harmonics.
    c. Problems that may arise in A.C. Circuits as a result of harmonics and how these are overcome.
    d. Methods and test equipment used to test for harmonics.
    e. Methods used to reduce harmonics in A.C. Power system.

2. Resonance:

    a. Conditions in a series A.C. Circuit that produce resonance.
    b. Dangers of series resonance circuits.
    c. Conditions in a parallel A.C. Circuit that produce resonance.
    d. Dangers of parallel resonance circuits.
    e. Local supply authority requirements concerning harmonics and resonance effect in A.C. Power systems.

UNIT V - A.C. POWER SYSTEMS – MULTIPHASE SYSTEM (8 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. identify characteristics of multiphase system.
2. determine phase relationship in A.C. circuits.
3. explain the difference between star and delta connection in an A.C. Power system.
4. measure electrical quantities in multiphase system.
5. explain how to balance and unbalance loads in typical power systems.
6. make star and delta connections.
7. determine application of star and delta connections.

Content:

To include but not limited to:

1. Star and delta connection.

    a. Features of a multiphase system.

b. Comparison of voltages generated by single and multiphase alternators.
c. Reasons for the adoption of three phases for power systems.
d. How three phases is generated in a single alternator.
e. Relationship between the phase voltages generated in a three-phase alternator and the conventions for identifying each.
f. Term "phase sequence" (also referred to as "phase rotation").
g. Phase relationship between line and phase voltages and line and phase currents of a star-connected system.

2. Balanced and unbalanced loads:

a. Terms "balanced load" and "unbalanced load".
b. Effect of a reversed phase winding of a star connected alternator.
c. Example of balanced and unbalanced loads in typical power systems.
d. Purpose of the neutral conductor in a three phase four wire system.
e. Determining the effects of a high impedance in the neutral conductor of a three phase four wire system, supplying an unbalanced load where men earthing is employed.
f. Determining the value and phase relationship of neutral current in an unbalanced three phase four wire system, given line currents and power factors.
g. Requirements regarding neutral conductors.
h. Method for determining voltage drop in unbalanced three phase circuits.
i. Phase relationship between line and phase voltages and line and phase currents of a delta-connected system.
j. Limitations and uses of open delta connections effect of a reversed phase winding of a delta connected transformer.
k. Example of loads in typical power systems.
l. Relationship between line and phase voltages and line and phase currents in the typical interconnected systems using star-connections and delta-connections.
m. Purposes for measuring power, energy, power factor and maximum demand of A.C. Power systems and loads.

UNIT VI - RESISTIVE, INDUCTIVE, AND CAPACITIVE CIRCUIT (RLC) (8 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. explain the functions of resistive, inductive, and capacitive circuit.
2. resistors, inductors, and capacitors circuit.

3. connect simple circuits with resistors, inductors and capacitors.
4. calculate electrical quantities for resistor, inductor, and capacitor.
5. select an appropriate meter for measuring electrical quantities.
6. determine rating/sizes of resistor, inductor, and capacitor.
7. test fault crop impedance.

Content:

To include but not limited to:

1. Connect simple circuits:

    a. Practical examples of RLC series circuits
    b. Practical examples of parallel circuits
    c. Comparison of current limiting characteristics of inductors and resistors

2. Selecting appropriate meter:

    a. Using manufacturers catalogues to select measurement equipment for a particular installation.
    b. Fault loop impedance of an A.C. Power system.
    c. Determining fault loop impedance using resistance and reactance values.
    d. Measuring fault loop impedance of typical circuits.
    e. Procedures for testing fault loop impedance.

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Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III,**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Feedback will be in accordance with institutional policies.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role playing, case studies and presentations.

CAPSTONE EXPERIENCE DESCRIPTION

Students will use the skills and knowledge to design and install different types of A.C. circuits. Use measurement to determine electrical quantities and use known laws to calculate electrical quantities.

RESOURCES

- Lecturer:
- Materials, Tools, and equipment
- Measuring instruments: Wattmeter, Voltmeter, Ammeter

RESOURCES

Required:

Verlinden, J. W. (2005) *Critical Thinking and Everyday Argument*. Cengage learning.

Zeuschner, R. *Communicating Today: The Essentials* (2003). California State University Pearson Education, Inc.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	ANALYSING D.C. ELECTRICAL CIRCUITS
COURSE CODE:	REDC1100
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	None
CO-REQUISITE(S):	None
SEMESTER:	I

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills, and attitudes to handle D.C. circuits, detect faults, wire circuits, read diagrams associated with the circuit designs, carry out safety procedures in using circuits and interpret regulations pertaining to the operations of circuits.

COURSE OUTCOMES:

Upon completion of this course, students should be able to apply the principles and practices of Direct Current (D.C.) to work with electrical circuits.

Upon completion of this unit, students are competent when they are able to:

1. comply with relevant regulations and codes of practices.
2. comply with OHS and other safety requirements.
3. describe appropriate selection, preparation and use of materials, tools, equipment, and testing devices.
4. pay attention to detail when identifying, analysing, and solving problems.
5. follow procedures in finding faults and executing repair activities.

UNIT I – APPLY SAFETY AND RELATED REGULATIONS (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. interpret relevant regulations, codes of practice and OHS requirements.
2. comply with relevant regulations, codes of practice and OHS requirements.
3. explain codes of practice that govern D. C. circuits operations.
4. identify relevant risks and hazards.
5. manage risks and hazards according to policies and procedures.
6. follow safety procedures and OHS regulations.
7. report accidents and incidents according to policies and procedures.
8. carry out safety check audits.

Content:

To include but not limited to:

1. Occupational Health and Safety procedure:
    a. Relevant regulations and codes of practice requirements in OHS requirements.
    b. Types of hazards associated with working in D.C. circuits.
    c. Types of risks and risk management policies and procedures.
2. Types and causes of faults in single source, parallel and series-parallel D.C. circuits (current, voltage, resistance, power).

UNIT II - WORK WITH D.C. CIRCUITS (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the basic principles and rules of direct current electricity.
2. explain types, components, and functions of direct current electrical circuits.
3. calculate direct current quantities using Ohm’s Law.
4. outline characteristics and basic rules for D.C. series and parallel circuits.
5. describe situations where direct currents are applicable.
6. build direct current series, parallel and series-parallel circuits.
7. interpret circuit symbols and notations.
8. interpret circuit decisions and layout.

Content:

To include but not limited to:

1. Direct current electrical circuit:

    a. Symbols used to represent an electrical energy source, a load, a switch, and a circuit protection device in a circuit diagram
    b. Purpose of each component in the circuit
    c. Causes and effects of an open circuit, a closed-circuit and a short-circuit
    d. Multiple and sub-multiple circuits

2. Ohm's Law Application in Direct Current circuits:

    a. Types of direct current circuits and notations used for circuit diagrams
    b. Basic D.C. single path circuit
    c. Voltage and currents levels in a basic D.C. single path circuit
    d. Effects of an open circuit, a closed-circuit and a short-circuit on a basic D.C. single path
    e. Relationship between voltage and current from measured values in a simple circuit
    f. Determining voltage, current and resistance in a circuit given any two of these quantities:
        i. Graphical relationships of voltage, current and resistance
        ii. Relationship between voltage, current and resistance

3. Series circuits:

    a. Circuit diagram of a single-source D.C. series circuit
    b. Identification of the major components of a series circuit: power supply, loads, connecting leads and switch
    c. Applications where series circuits are used in the Electro technology industry
    d. Characteristics of a series circuit - connection of loads, current path, voltage drops, power dissipation and effects of an open circuit in a series" circuit"
    e. The voltage, current, resistances or power dissipated from measured or given values of any two of these quantities
    f. Relationship between voltage drops and resistance in a simple voltage divider network
    g. Setting up and connecting a single-source series D.C. circuit
    h. Measurement of resistance, voltage, current values in a single source series circuit
    i. Effect of an open circuit on a series connected circuit

4. Parallel circuits:

    a. Schematic diagram of a single-source D.C. parallel circuit
    b. Major components of a parallel circuit (power supply, loads, connecting leads and switch)
    c. Applications where parallel circuits are used in the Electro technology industry
    d. Characteristics of a parallel circuit (load connection, current paths, voltage drops, power dissipation and effects of an open circuit in a parallel circuit)
    e. Relationship between currents entering a junction and currents leaving a junction
    f. Relationship between branch currents and resistances in a two-branch current divider network
    g. Calculation of the total resistance of a parallel circuit
    h. Calculation of the total current of a parallel circuit
    i. Calculation of the total voltage and the individual voltage drops of a parallel circuit
    j. Setting up and connecting a single-source D.C. parallel circuit
    k. Resistance, voltage, and current measurements in a single-source parallel circuit
    l. Voltage, current, resistance or power dissipated from measured values of any of these quantities
    m. Output current and voltage levels of connecting cells in parallel

UNIT III - COMPONENTS OF DIRECT CURRENT CIRCUITS (12 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. identify components of direct current circuits.
2. explain the function of direct current circuits.
3. comply with codes of practice and OHS requirements when working with components.
4. explain the effects of components in types of direct current circuits.
5. detect faulty components.
6. test components for functionality.

Content:

To include but not limited to:

1. Capacitors in Series and Parallel Modes:

    a. Hazards involved in working with capacitance effects and the safety control measures that should be taken.

b. Safe handling and the correct methods of discharging various size capacitors.
c. Dangers of a charged capacitor and the consequences of discharging a capacitor through a person.
d. Factors which determine the capacitance of a capacitor and explain how these factors are present in all circuits to some extent.
e. Effects of capacitors connected in parallel by calculating their equivalent capacitance.
f. Effects on the total capacitance of capacitors connected in series by calculating their equivalent capacitance.
g. Connecting capacitors in series and/or parallel configurations to achieve various capacitance values.
h. Common faults in capacitors.
i. Testing of capacitors to determine serviceability.
j. Application of capacitors in the Electro technology industry.
k. Control devices – switches, fuses, breakers, capacitors – types, rating capacity
l. Lighting devices.
m. Wires – types and sizes.
n. Methods of securing components to surface.
o. Wiring methods.

UNIT IV - USE MEASURING DEVICES (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the principles of operation for types of direct current measuring devices.
2. identify types of measuring devices.
3. follow safety procedures in using measuring devices.
4. select correct device for measuring specific electrical quantity.
5. follow procedures for care and maintenance of measuring devices.
6. follow procedures for storage/security of devices.
7. read and record readings from devices.
8. use measuring devices in accordance with codes of practice and OHS requirements.
9. select an appropriate meter for measuring electrical quantities.

Content:

To include but not limited to:

1. Selecting an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application.

2. Measuring resistance using direct, voltammeter and bridge methods.
3. Instruments used in the field to measure voltage, current, resistance and insulation resistance and the typical circumstances in which they are used.
4. Hazards involved in using electrical instruments and the safety control measures that should be taken.
5. Operating characteristics of analogue and digital meters.
6. Correct techniques to read the scale of an analogue meters and how to reduce the parallax error.
7. Types of voltmeters used in the Electro technology industry – bench type, clamp meter, multimeter, etc.
8. Purpose and characteristics (internal resistance, range, loading effect and accuracy) of a voltmeter.
9. Types of voltage indicator testers e.g. LED, neon, solenoid, volt-stick, series tester, etc.; explain the purpose of each voltage indicator tester.
10. Operation of various voltage indicator testers.
11. Advantages and disadvantages of each voltage indicator tester.
12. Various types of ammeters used in the Electro technology industry – bench, clamp meter, multimeter, etc.
13. Purpose of an ammeter and the correct connection (series) of an ammeter into a circuit.
14. Reasons why the internal resistance of an ammeter must be extremely low and the dangers and consequences of connecting an ammeter in parallel and/or wrong polarity.
15. Selecting an appropriate meter in terms of units to be measured, range, loading effect and accuracy for a given application.
16. Connecting an analogue/digital voltmeter into a circuit ensuring the polarities are correct and take various voltage readings.
    a. Loading effect of various voltmeters when measuring voltage across various loads
    b. Using voltage indicator testers to detect the presence of various voltage levels
    c. Connecting analogue/digital ammeter into a circuit ensuring the polarities are correct and take various current readings

ASSESSMENT PROCEDURES:

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Feedback will be in accordance with institutional policies.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, small group activities, practical demonstrations, case studies, online activities, research presentations.

CAPSTONE EXPERIENCE DESCRIPTION

Students will be required to:

1. calibrate instruments
2. record readings of quantities in direct current circuits
3. test capacitors
4. build series, parallel and series-parallel direct current circuits

RESOURCES:

Required Text

Goodstal, G. (2013). *Electrical theory for renewable energy*. Clifton Park, NY: Delmar.

Human Resources: Lecturers, Circuit material, measuring devices.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	APPLYING RENEWABLE ENERGY PRINCIPLES AND PRACTICES (Renewable Energy 1)
COURSE CODE:	REPP1103
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	None
CO-REQUISITE(S):	None
SEMESTER:	I

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to execute work functions such as installations, repairs, testing and maintenance of facilities powered by renewable energy sources.

LEARNER OUTCOMES/INSTRUCTIONAL OBJECTIVE

Upon completion of this unit, students are competent when they are able to:

1. interpret relevant regulations, codes of practice and OHS requirements.
2. comply with relevant regulations, codes of practice and OHS requirements.
3. develop engineering solutions for renewable energy problems in accordance.
4. test, document and implement engineering solution for renewable energy problems.
5. recommend appropriate solution for specified Renewable Energy system problems.
6. become competent and qualified persons to implement solutions to renewable energy. problems by pursuing lifelong learning activities and professional development.

UNIT I – INTERPRET REGULATIONS (5 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. interpret relevant regulations, codes of practice and OHS requirements.
2. comply with relevant regulations, codes of practice and OHS requirements.
3. explain the need for regulations in the practice of renewable energy sector.
4. describe the roles and responsibilities of organizations regulating the implementation of renewable energy in Jamaica.
5. obtain permits or certificates to operate in the renewable energy sector.

Content:

To include but not limited to:

1. Legislation and regulation relevant to residential, office and retail premises encompassing:

    a. National Building Code of Jamaica
    b. Jamaican Standards for Energy Auditing
    c. State based legislation for energy management in business
    d. NABERS Tenancy
    e. NABERS Office
    f. Building Energy Efficiency Certificates
    g. Renewable Energy Credits
    h. Small Technology Credits
    i. National Energy Solution Limited

UNIT II – SCIENCE FOR RENEWABLE ENERGY FUNDAMENTALS (8 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. summarise the scientific principles relevant to the practices of renewable energy.
2. explain the scientific nature of matter.
3. perform calculations for mass, volume, force, and temperature.
4. measure quantities using scientific notations.

Content:

To include but not limited to:

1. Concepts encompassing:

    a. Nature of matter - atoms, molecules, inter-molecular forces, molecular motion, states of matter.
    b. Mass and conservation of mass principle, volume density, specific volume, relative density volume, density, specific volume, relative density.
    c. Force, weight, pressure (atmospheric, gauge and absolute).
    d. Temperature (Celsius and Kelvin).

UNIT III – ENERGY SYSTEMS (8 HOURS)

Learner Outcomes:

Students are competent when they are able to:

1. identify characteristics of energy systems.
2. explain the economic roles of energy systems.
3. explain the need for energy and its impact on the standard of living.
4. discuss the environmental impact of energy systems.
5. identify the different types of energy sources.
6. explain the impact of an “open system” and “closed system” and their relationship to the transfer of energy.
7. use energy systems.
8. perform basic calculations.

Content:

To include but not limited to:

1. Energy and humanity encompassing:
    a. Need for energy and relationship between energy usage and standard of living
    b. Energy conversion - typical processes and efficiencies
    c. Sources of energy
    d. Reciprocating piston and cylinder mechanism – pressure ratio and compression ratio
    e. Energy encompassing:
    f. Definition and principles
    g. Kinetic energy

h. Work (linear and rotational), constant and variable force, relationship to pressure and volume change
i. Power (linear and rotational)
j. Sensible heat - specific heat capacity (constant pressure and constant volume)
k. Latent heat
l. Chemical energy - energy content of a fuel
m. Internal energy

2. Energy transfer in closed and open systems encompassing:

a. Definition of a closed system.
b. Calorimetry as an example of a closed system (with or without phase change).
c. Non-flow energy equation - typical applications such as stirring with simultaneous heating or cooling.
d. Definition of an open system.
e. Mass and volume flow rate and continuity equation.
f. Steady flow energy equation (negligible change in kinetic or potential energy) leading to the concept of enthalpy - typical applications such as turbines, compressors, boilers and heat exchangers.

UNIT IV - HANDLE GASES (8 HOURS)

Learner Outcomes:

Students are competent when they are able to:

1. explain the molecular model for gases.
2. identify the types of gases.
3. identify an ideal gas in terms of its molecular model.
4. explain the characteristics of gas equations.
5. identify factors impacting gas equations.
6. use processes related to types of gases.

Content:

To include but not limited

1. Gases encompassing:

a. Definition of a perfect or ideal gas in terms of the molecular model
b. General gas equation
c. Characteristic gas equation (equation of state)
d. Constant pressure process

e. Constant volume process
f. Isothermal process
g. Polytrophic process
h. Adiabatic process

UNIT V – HANDLE HEATS (8 HOURS)

Learner Outcomes:

Students are competent when they are able to:

1. identify the sources of heats.
2. identify the types of heat engines.
3. explain the need for heat engines.
4. differentiate among the types of heat sources.
5. monitor heat engine performance.
6. measure engine quantities.

Content:

To include but not limited to:

1. Heat engines encompassing:

    a. Definition of a heat engine.
    b. Essentials of a heat engine - heat source, heat sink, working substance, mechanical power output, working cycle.
    c. Energy balance for a heat engine (as a black box) and efficiency.
    d. Maximum possible efficiency (carnot efficiency).
    e. Types of heat engines according to working substance, heat source, mechanical arrangement and working cycle.
    f. Typical practical cycles - stirling, otto, diesel, dual, two stroke (spark and compression) ignition, joule cycle.
    g. Thermodynamic

2. Heat engine performance encompassing:

    a. Measurement of torque and power output - rope brake, shoe brake, hydraulic dynamometer, electric dynamometer.
    b. Heat supply rate, efficiency, specific fuel consumption.

c. Measurement of indicated power - mechanical indicator, electric/electronic indicator, Morse test.

UNIT VI – ANALYSE POWER GENERATION AND DISTRIBUTION (8 HOURS)

Learner Outcomes:

Students are competent when they are able to:

1. explain the system of power generation and distribution.
2. explain the purpose of the national grid.
3. determine the utility requirement for the distribution of voltage generated.
4. explain the limitations and factors affecting generation and distribution of renewable energy voltage.

Content:

To include but not limited to:

1. Distributed generation issues:
    a. Utility requirements for interconnection safety of personnel islanding grid stability
    b. Voltage regulation
    c. Potential benefits of "dg"
    d. Limitations in design of distribution circuits (designed for 1-way operation)
    e. Match between supply and demand
    f. Operation: dispatchable and non-dispatchable supplies
    g. Factors affecting the sizing of distributed generation
    h. Use of energy storage
2. Renewable energy supplies issues encompassing:
    a. Limits to penetration
    b. Factors affecting the value of renewable on the grid
    c. Implications of renewable input on power system operation
    d. Connection of energy systems via inverters
3. Factors affecting the uptake of distributed generation encompassing:
    a. Institutional factors
    b. Regulatory factors

c. Policy including mandated targets
d. Green power market
e. Financial issues
f. Contractual issues

ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III,**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK:

Students will be given rubrics and grading schemes within the first contact period of the course. Each student will also be given written and oral feedback. Feedback will be immediate and no longer than one week after a task is assessed. Feedback may be document on assessment evidence.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role playing, case studies and presentations.

CAPSTONE EXPERIENCE DESCRIPTION

Student will be given a major piece of assignment involving the principles of the course.

RESOURCES:

Suggested:

Goodstal, G. (2013). *Electrical theory for renewable energy*. Clifton Park, NY: Delmar

Lecturers, Equipment, tools, component parts, air conditioner unit.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	APPLYING THERMODYNAMICS
COURSE CODE:	REAT1203
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	None
CO-REQUISITE(S):	None
SEMESTER:	II

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to apply the principles and practices of thermodynamics to address issues requiring solutions to thermodynamics and electro-technology problems and to solve problems in static and dynamic system.

LEARNING OUTCOMES AND INSTRUCTIONAL OBJECTIVES:

Upon on completion of this course, students are competent when they are able to:

1. apply thermodynamics laws and principles to develop solutions to electro technology related problems.
2. apply Laws and Principles of Thermodynamics.
3. analyse thermodynamic problems.
4. solve thermodynamics problems.
5. conduct testing of thermodynamics system.
6. prepare to apply thermodynamic laws and principles to develop solutions to electro technology related problems.
7. apply the laws of thermodynamics to develop solutions to electro technology problems.

UNIT I – APPLY LAWS AND PRINCIPLES OF THERMODYNAMICS (25 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. explain the applicability of thermodynamics.
2. explain the laws and principles of thermodynamics.
3. apply the laws and principles of thermodynamics.
4. explain types of gas law and their uses.

Content:

To include by not limited to:

1. Laws and principles of thermodynamics:
    a. Zeroth Law of Thermodynamics
    b. The First Law of Thermodynamics
    c. The Second Law of Thermodynamics
    d. The Third Law of Thermodynamics
2. Gas laws:
    a. Boyles law
    b. Charles's law
    c. Gay-Lussac's law

UNIT II - ANALYSE THERMODYNAMIC PROBLEMS (20 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. identify common thermodynamic problems.
2. solve common thermodynamic problems.
3. analyse thermodynamic problems.
4. conduct testing of thermodynamic systems.

Content:

To include but not limited to:

1. Thermodynamic problems in electro technology systems:

    a. Common thermodynamic problems
    b. Identification of problems
    c. Analysis of problems (using laws and principles of thermodynamics)
    d. Recording problems (written and diagrammatic)

2. Solving thermodynamic problems:

    a. Equipment and testing devices
    b. Application of laws and principles of thermodynamics to solve problems

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III,**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Students will be given rubrics and grading schemes within the first contact period of the course. Each student will also be given written and oral feedback. Feedback will be immediate and no longer than one week after a task is assessed. Feedback may be document on assessment evidence.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role playing, case studies and presentations.

CAPSTONE EXPERIENCE DESCRIPTION

None

RESOURCES

Lecturers, instructional materials, thermodynamic system, tools and equipment, appropriate materials, diagrams.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	PERFORMING ENGINEERING MATHEMATICS CALCULATIONS I
COURSE CODE:	REMC1202
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	None
CO-REQUISITE(S):	None
SEMESTER:	I

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to use trigonometry, determinants, matrices and vectors to solve renewable energy problems.
This course serves to expose the students to more rigorous approach pertaining to the study of mathematics in moving from the secondary level to the intermediary level. In preparation for the study of calculus and engineering mathematics at a later stage the concepts of logarithm and indices, expansion by the binomial theorem, solution of polynomials using remainder and factor theorems and trigonometry are emphasized whereas most of the other topics serve as revision ones extending the earlier concepts further. There is less reliance on the use of calculators despite an attempt to develop further competence in its use.

COURSE OUTCOMES:

Upon successful completion of this course, students are competent when they are able to:

1. perform mathematical computations and calculations with matrices and vectors.
2. explain the application of trigonometry in the renewable energy field.
3. solve renewable energy problems using differential and integral calculus.

UNIT I – TRIGONOMETRY (10 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. solve practical problems using Pythagoras Theorem, Sine and Cosine Rules.
2. derive and use trigonometric identities such as:

    a. Reciprocal and quotient identities
    b. Pythagorean identities
    c. Sums and differences identities
    d. Double-angle identities
    e. Half-angle identities

3. use compound-angle formulae for.
4. use the reciprocal functions of trigonometry.
5. use the exponential form of inverse hyperbolic function.
6. identify and use the properties of right-angle spherical triangles.
7. identify and use the properties of quadrilateral spherical triangles.
8. apply Napier's Rule to spherical triangles.

Content:

To include but not limited to:

1. Trigonometry rules: Pythagoras Theorem, Sine rule, Cosine rule.
2. Trigonometric identities.
3. Compound-angle formulae.
4. Reciprocal trigonometric functions.
5. Inverse hyperbolic trigonometric functions.
6. Right-angle and quadrilateral spherical triangles.
7. Napier's Rule.

UNIT II – DETERMINANTS AND MATRICES (10 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. classify matrices as column, row, null, square, diagonal, and triangular.
2. perform basic matrix algebra: addition, subtraction, transpose and multiplication.

3. operate with conformable matrices, carry out simple operations and manipulate matrices using their properties.
4. evaluate the determinants of matrices.
5. use the properties of determinant.
6. solve a system of linear equations using matrices and determinants.
7. solve a system of linear equations using Cramer's rule.

Content:

To include but not limited to:

1. Types of Matrices
2. Matrix Algebra: addition, subtraction, transpose, and multiplication
3. Determinant of matrices
4. Solution of linear simultaneous equations
5. Cramer's rule

UNIT III - VECTORS (25 HOURS)

Learner Outcomes:

Upon successful completion of this unit, students are competent when they are able to:

1. express a vector in the form where are unit vectors in the direction of axis respectively.
2. define equality of vectors.
3. add and subtract vectors.
4. perform vector multiplication by a scalar quantity.
5. derive and use unit, position and displacement vectors.
6. find the magnitude and direction of a vector.
7 find the angle between two given vectors using scalar (dot) product.
8 perform vector (cross) product of two vectors.
9. perform vector rotation using data.

Content:

To include but not limited to:

1. Vector notation
2. Equality of vectors
3. Addition and subtraction of vectors
4. Vector multiplication by a scalar
5. Position, unit, and displacement vectors
6. Scalar (Dot) Product and Vector (Cross) Product

7. Rotating Vectors

ASSESSMENT PROCEDURES:

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Students will be given rubrics and grading schemes within the first contact period of the course. Each student will also be given written and oral feedback. Feedback will be immediate and no longer than one week after a task is assessed. Feedback may be document on assessment evidence.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role playing, case studies and presentations.

CAPSTONE EXPERIENCE DESCRIPTION

Students will use the skills and knowledge to design and install different types of A.C. circuits. Use measurement to determine electrical quantities and use known laws to calculate electrical quantities.

RESOURCES:

- Lecturer
- Materials, Tools, and equipment
- Measuring instruments: Wattmeter, Voltmeter, Ammeter

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	USING HVAC APPLICATIONS - I
COURSE CODE:	REHA1201
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	USING HVAC FUNDAMENTALS PRINCIPLES
CO-REQUISITE(S):	None
SEMESTER:	II

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills, and attitudes to install ducts, grilles, apply HVAC requirements in treating with air conditioning systems, hydronic systems heat pump systems.

LEARNER OUTCOMES/INSTRUCTIONAL OBJECTIVES:

Upon completion of this course, students are competent when they are able to:

1. select appropriate duct, grilles, for HVAC requirements.
2. apply theory of heat transfer and fluid flow in hydronic systems.
3. apply fundamentals of refrigeration as related to air conditioning and heat pump systems.
4. apply theory of gaseous fuel utilization.

UNIT I – DUCTS AND GRILLES FOR HVAC REQUIREMENTS (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. interpret OHS requirement and other regulations.

2. select appropriate duct and grilles HVAC requirements.
3. determine equipment specifications.
4. test equipment.
5. use energy recovery devices.
6. balance ducts.
7. measurement of system quantities.

Content:

To include but not limited to:

1. Relevant regulations, codes of practices OHS regulations:

    a. Determining and verifying equipment specifications.
    b. Heating and cooling unit.
    c. Evaporative cooler and cooling tower.
    d. Energy recovery devices (including airflow and enthalpy changes).
    e. Air conditioning distribution system.
    f. Heat pumps and spilt AC units.
    g. Duct balancing and measurement of system.

UNIT II – IMPROVE EQUIPMENT OPERATIONAL EFFICIENCY (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. determine the benefits of efficient operation of equipment.
2. identify flow characteristics of pumps.
3. measure static pressure and velocity.
4. layout hydraulic heat and cooling loop piping.
5. improve operational efficiency of equipment.

Content:

To include but not limited to:

1. Pumps
2. Static pressure
3. Velocity readings
4. Head and cooling loop

UNIT III – COOLING AND HEATING LOADS (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. differentiate between heating and cooling loads.
2. use different methods to calculate cooling loads.
3. use different methods to calculate heating loads.
4. calculate percentile of eutectic solution.
5. explain the functions of eutectic solution.
6. determine freezing points.
7. handle LPG equipment.

Content:

To include but not limited to:

1. Eutectic solution
2. Calculating percentile
3. Freezing points
4. Manual method of cooling load
5. Computer programme method of cooling load
6. LPG heaters/stoves/ovens

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III,**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
	IX, X	Written	20%
Total			**100%**

FEEDBACK

Feedback will be in accordance with institutional policies.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role playing, case studies and presentations.

CAPSTONE EXPERIENCE DESCRIPTION

Students will be required to test Duct System Refrigeration System, Air pressure, analyse existing HVAC system and prepare report.

RESOURCES:

1. Lecturers
2. Tools equipment, LPG heaters, stove, oven, meters, split AC Unit

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	USING HVAC FUNDAMENTAL PRINCIPLES
COURSE CODE:	REHP1100
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	None
CO-REQUISITE(S):	None
SEMESTER:	I

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills, and attitudes to handle HVAC components, detect faults, carry out repairs and deal with refrigeration systems, ductwork, air properties, heat systems and airflow systems.

COURSE OUTCOMES:

Upon completion of this unit, students are competent when they are able to:

1. interpret relevant regulations, codes of practice and OHS requirements.
2. comply with relevant regulations, codes of practice and OHS requirements.
3. explain the properties of air and its relationship to the transfer of energy in a facility.
4. apply the theory of basic heat transfer and its application to heat gain/loss calculations and also to fluid flow in hydronic systems.
5. apply the theory of air movement to and its application to the assessment of ventilation principles in a facility.
6. select appropriate duct and grilles for HVAC requirements.
7. explain the fundamentals of refrigeration and its relationship to air conditioning and heat pump systems.
8. analyse methods and strategies for resolving energy usage and developing energy efficiency in HVAC systems.

UNIT I – ANALYZE AIR PROPERTIES (10 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. comply with relevant regulations, codes of practice and OHS requirements.
2. differentiate types of HVAC systems.
3. explain the properties of air as it relates to the transfer of energy in a facility.
4. explain the principles of psychometrics.
5. explain methods of energy transfer.
6. check air quality.
7. measure psychometric variables.

Content:

To include but not limited to:

1. OHS regulations.
2. HVAC Systems (types, functions, components, advantages, disadvantages):
    a. Properties of air.
    b. Key terms and concepts: humidity ratio, specific humidity, absolute humidity, density, relative humidity, degree of saturation, specific volume, dry-bulb temperature, wet-bulb temperature, wet-bulb temperature depression, dew-point temperature.
    c. Properties of air and water vapour mixture.
3. Principles of psychometrics:
    a. Psychometrics processes
    b. Psychometric charts
    c. Methods of measuring psychometric variables
    d. Dalton's Law
    e. Ideal Gas Law

UNIT II – USE HEAT SYSTEMS (10 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain heat properties.
2. describe principles and methods of heat transfer.
3. identify heat exchangers.
4. explain U and R values.

Content:

To include but not limited to:

1. Principles of heat transfer:
    a. Key concepts: transmittance, absorptance, emittance, specific heat, absorber.
    b. Heat transfer mechanisms of conduction, convection and radiation conduction properties, U and R values.
    c. Convection at a flat surface or tube.
    d. Radiation from a flat surface or tube for black or grey bodies.
    e. Combined conduction and convection through single or multiple flat plates thin wall tubes.
    f. Combined convection and radiation.
    g. Combined conduction, convection and radiation such as fluid in a tank (convection to wall), through wall and/or insulation (conduction) to outside air (convection and radiation).
    h. Heat exchangers - parallel, counter flow and cross flow.

UNIT III – MEASURE AIR FLOW SYSTEM QUANTITIES (9 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the principles of air flow.
2. explain the variable related to air flow.
3. identify the different types of pressure associated with air flow.
4. measure air flow.
5. calculate air pressure and other quantities.

Content:

To include but not limited to:

1. Air flow principles:

    a. Conservation of mass
    b. Conservation of energy
    c. Conservation of momentum

2. Key concepts: gauge and absolute pressures, duct pressure, static pressure, velocity.
3. Pressure, total pressure, standard air density, fan capacity.

UNIT IV – INSTALL DUCT WORKS (10 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. identify types of duct works.
2. classify duct work.
3. explain the duct work system.
4. interpret duct designs.
5. explain advantages and disadvantages of combustion and fuels.
6. identify duct components, shape, sizes, duct supply system, fittings terminals.
7. determine pressure losses in air distribution system.
8. install and seal ducts.
9. test ductwork and system performance.

Content:

To include but not limited to:

1. Ductwork design:

    a. Ductwork design principles
    b. Duct components and materials
    c. Duct classification: velocity classification, pressure classification
    d. Duct shapes
    e. Duct sizing
    f. Pressure losses in air distribution system
    g. Fan sizing
    h. The supply duct system

i. Return duct system
j. Duct fitting and terminal units
k. Duct construction and reinforcement
l. Ductwork insulation and sealing
m. Ductwork testing and system performance

2. Combustion and fuels:

    a. The combustion process.
    b. Fuels - desirable and undesirable characteristics, solid, liquid, and gaseous types, their relative advantages and disadvantages and common methods of combustion air/fuel ration - stoichiometric excess or insufficient air.

UNIT V - TEST REFRIGERATION SYSTEM (6 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. describe components of a refrigeration system.
2. explain the vapour compression cycle.
3. explain the basic principles and terminologies of refrigeration.
4. explain the properties, advantages, and disadvantages of the different types of refrigerant.
5. describe methods of testing refrigeration system.
6. test refrigeration levels.

Content:

To include but not limited to:

1. Basic Principles and Terminology.
2. Refrigeration heat pump:
    a. Conditions of a vapour compression cycle.
    b. Describe properties of types of refrigerants - designation, properties advantages and disadvantages.
    c. Energy balance and heat transfers in compressor, evaporator, and condenser
    d. Superheating and sub cooling with or without suction/liquid heat exchanger.

ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK:

Students will be given rubrics and grading schemes within the first contact period of the course. Each student will also be given written and oral feedback. Feedback will be immediate and no longer than one week after a task is assessed. Feedback may be document on assessment evidence.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role playing, case studies and presentations.

CAPSTONE EXPERIENCE DESCRIPTION

Students will be required to:

1. Test Duct System
2. Test Refrigeration System
3. Test Air pressure
4. Analyse existing HVAC system
5. Prepare report

RESOURCES:

Wijeysundera, N. E. (2016). *Principles of Heating, Ventilation and Air Conditioning with Worked Examples*. Singapore: World Scientific Publishing.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	USING HVAC APPLICATIONS II
COURSE CODE:	COSEHVC2301
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	APPLYING RENEWABLE ENERGY PRINCIPLES AND PRACTICES (RENEWABLE ENERGY I)
CO-REQUISITE(S):	None
SEMESTER:	III

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills, and attitudes to install ducts, grilles, apply HVAC requirements in treating with air conditioning systems, hydronic systems heat pump systems.

LEARNING OUTCOMES AND INSTRUCTIONAL OBJECTIVES

Upon completion of this course, students are competent when they are able to:

1. Select appropriate duct, grilles, for HVAC requirements.
2. Apply theory of heat transfer and fluid flow in hydronic systems.
3. Apply fundamentals of refrigeration as related to air conditioning and heat pump systems.
4. Apply theory of gaseous fuel utilization.

UNIT I – HAVC INSTALLATION SPECIFICATIONS (8 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. interpret OHS regulations.
2. Interpret codes of practice that govern the installation HAVC equipment.
3. Apply procedure to determine HAVA Installation Specification.
4. Identify and select components.
5. Follow safety procedure.

Content:

To include but not limited to:

1. Relevant regulations, codes of practice and Occupational Health and Safety Requirements.
2. Determining and verifying equipment specifications:
    a. Heating and cooling unit
    b. LPG heaters/stoves/ovens
    c. Evaporative cooler and cooling tower
    d. Energy recovery devices (including airflow and enthalpy changes)
    e. Air conditioning distribution system
    f. Heat pumps and spilt AC units
    g. Duct balancing and measurement of system

UNIT II – INSTALLATION OF HVAC EQUIPMENT (8 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. read and interpret layout diagrams.
2. select trolls, materials, and equipment for use.
3. prepare location for installation.
4. install HVAC equipment to required specification.
5. inspect and test instillation.

Content:

To include but not limited to:

1. Heating and cooling unit.
2. LPG heaters/stoves/ovens.
3. Evaporative cooler and cooling tower.
4. Energy recovery devices (including airflow and enthalpy changes).
5. Air conditioning distribution system.
6. Heat pumps and spilt AC units.
7. Duct balancing and measurement of system.

UNIT III – TROUBLESHOOTING HVAC EQUIPMENT (8 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the purpose of troubleshooting equipment.
2. follow procedures for troubleshooting.
3. select appropriate tools to troubleshoot HVAC equipment.
4. troubleshoot HVAC equipment.
5. record findings from troubleshooting activities.
6. execute corrective action as necessary.

Content:

To include but not limited to:

1. Heating and cooling unit
2. LPG heaters/stoves/ovens
3. Evaporative cooler and cooling tower
4. Energy recovery devices (including airflow and enthalpy changes)
5. Air conditioning distribution system
6. Heat pumps and spilt AC units
7. Duct balancing and measurement of system

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

INSTRUCTIONAL METHODS:

1. Practical Demonstrations
2. Lectures
3. Discussions
4. Role playing and presentations
5. Case studies

RESOURCES

1. Lecturer
2. Drawings instruments, sample drawings, model of different sectional views, video, drawing papers
3. Tools/Equipment
4. LDG heaters
5. Stove, oven, meters
6. Split AC Unit

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	WORKING WITH ELECTRONIC DEVICES AND RENEWABLE ENERGY SYSTEMS
COURSE CODE:	REER2100
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	APPLYING RENEWABLE ENERGY PRINCIPLES AND PRACTICES (RENEWABLE ENERGY I)
CO-REQUISITE(S):	None
SEMESTER:	III

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to design electronic circuits, install electronic circuits, reprogram circuits, detect and correct faults, as well as complying with registration and regulations governing the sector. Emphasis will be placed on PN Junction semiconductor as switch and amplifier.

LEARNING OUTCOMES AND INSTRUCTIONAL OBJECTIVES

Upon completion of this course, students are competent when they are able to:

1. apply OHS regulations to work procedure.
2. apply legislation relate to renewable energy.
3. apply electronics systems/techniques to wire circuits.
4. design electric system.
5. install electronic circuits.
6. identify and select electronic components.
7. detect faults in electronic circuits.
8. correct faults in electronic circuits.
9. measure electronic qualities in electronic circuits.
10. design different circuits to specifications and in accordance with relevant regulations, codes of practice and OHS requirements.

11. select appropriate electronic components in accordance with relevant regulations, codes of practice and OHS requirements.
12. use suitable repair methods to evaluate and correct circuit performance.

UNIT I – USE BINARY NUMBER SYSTEM (8 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the use of Binary Number System.
2. convert numbering systems.
3. use binary System to design logic gates.
4. develop tables of Specification.

Content:

To include but not limited to:

1. Numbering systems:
    a. Hexadecimal Numbering System
    b. Binary numbering System
    c. Digital versus Analog
    d. Decimal to Binary Conversion
    e. Octal numbering system
2. Truth tables.

UNIT II – CONSTRUCT LOGIC GATES (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the functions of Logic Gates.
2. differentiable between AND OR Gates.
3. explain the operation and use of AND gates and OR gates.
4. draw timing diagrams for logic gates.
5. construct truth tales for two / three inputs.

6. apply troubleshooting techniques.
7. design gates using transistor and / or Integrated Circuits- IC's.

Content:

To include but not limited to:

1. Trouble Shooting Techniques:
    a. and gate/ truth tale
    b. or gate/truth table
    c. and gate/truth table
    d. nor gate/ truth table

UNIT III – USING DESIGN PRINCIPLES (20 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the functions or rectifiers.
2. interpret circuit designs.
3. design circuits for various practical applications.
4. produce rectifier circuits for various practical applications.
5. diagnose faults in components and circuits.
6. remove faulty components and replace components.
7. identify and select components for circuits.
8. use OHS regulations and related regulations.
9. test rectifiers circuits.

Content

To include but not limited to:

1. Design & Produce circuits:
    a. Rectifiers (capacitors, transformer, resistor, coil – purpose, functions, relationship among)
    b. Half-wave, full-wave, bridge (purpose, functions, relationship among, curve)
2. Troubleshooting: testing diodes & transistors to determine faults.
3. OHS policies and regulations.

UNIT IV – INSTALL TRANSISTORS (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explains the functions of transistors.
2. identify types of transistors and their characteristics.
3. design common configuration transistors.
4. identify transistors rating.
5. test transistors.
6. troubleshoot faults in circuit.
7. correct faults in circuits.

Content:

To include but not limited to:

1. Design:
    a. Emitter, Base and Collector legs (identify, purpose, and function).
    b. Common Base, Common Emitter, Common Collector circuits.
2. Reading legs to determine faults (resistance).
3. Determining faults in the circuits (voltage, resistance).

UNIT V – INSTALL OPERATIONAL AMPLIFIERS (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. identify types of amplifiers.
2. explain the operation of amplifiers.
3. explain the importance of amplifiers.
4. design and simulate amplifiers using 555 Timer LM324.
5. identify feedback curves.
6. explain the difference between Digital and Analog circuits.
7. install amplifiers.

Content:

To include but not limited to:

1. The importance of Operational Amplifiers (Differential Amp, Inverting Amp, Non-Inverting Amp.
2. Design & Simulate:
    a. 555 Timer LM324 (purpose, functions, relationship between)
3. Response of curves.
4. The difference between digital and analog (curve, advantages, and disadvantages of each).

UNIT VI – INSTALL FILTER CIRCUITS (15 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain functions of filter circuits.
2. identify the characteristics of filter circuits.
3. design active filters.
4. follow procedures for protection of components.
5. install filter circuits.
6. test designed circuits to ensure performance to specification.
7. apply OHS policies and related regulations.
8. measure electrical quantities.

Content:

To include but not limited to:

1. Design active filters:
    a. Low pass, high pass, band pass (differentiate among them, purpose, functions, relationship between)
2. OHS policies and regulations.
3. Measuring electric quantities.

UNIT VII - MOSFETS AND EMOSFETS APPLICATIONS (6 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the functions of MOSFETS and EMOSFETS.
2. differentiate between MOSFETS and EMOSFETS.
3. explain the operations of depletion modes.
4. use typical drain curve.
5. construction graphs using formulas.

Content:

To include but not limited to:

1. Depletion modes.
2. MOSFET & EMOSFET – (operations of, construction, different parts, schematic symbols).
3. Formulas, constructing graphs from formulae.

UNIT VIII - USE THYRISTORS APPLICATION (8 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the four-layer diode performance.
2. determine how SCR operates in circuits.
3. explain how the Diac and Triac work in circuits.
4. troubleshoot circuit for faults.

Content:

To include but not limited to:

1. Four-layer Diode
2. Closing and Opening Latch
3. 3 SCR

4. Troubleshooting

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III,**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Feedback will be in accordance with institutional policies.

INSTRUCTIONAL METHODS

Video, Handout, and practical demonstration, think pair share.

CAPSTONE EXPERIENCE DESCRIPTION

Design different circuits to specifications and in accordance with relevant regulations, codes of practice and OHS requirements.

RESOURCES

Floyd, T. L. & Buchla, D.M. Electronics Fundamentals circuits, Devices, and Applications (8th Edition).

Malvino, A.P. (PhD.) *Electronic Principles* (5th Edition), E.E. McGraw –Hill.

www.technologystudent.com

Kleitz, W. Digital Electronics- a practical approach (4th Edition).

Tokheim, R. Digital Electronics (3rd Edition)

Equipment: Inventers, Battery monitors, charge controllers.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	USING AUTOCAD APPLICATIONS AND DESIGN (DRAFTING II)
COURSE CODE:	REAO2101
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	PREPARING DRAWINGS (DRAFTING DESIGNS I)
CO-REQUISITE(S):	None
SEMESTER:	III

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to use AutoCAD Application to create advanced drawings. The course augments the principles learnt in Drafting, with focus on complex engineering assembly gadgets, the relevant machining finishes; fabrication drawings with the relevant welding symbols, and pattern drawings for items that are to be casted. Students will also be able to save, store and retrieve these files to use on future projects, which may require modification in some cases.

LEARNING OUTCOMES AND INSTRUCTIONAL OBJECTIVES

Upon completion of this course, students are competent when they are able to:

1. use AutoCAD principles and design.
2. prepare drawings using AutoCAD Software.
3. modify existing drawings to produce new drawings.
4. interpret drawings instructions.
5. explain the role of computers in drafting.
6. use the software to produce simple drawings.
7. apply engineering drawing in the field of renewable energy.

8. determine how emerging technologies in AutoCAD impacts the need for continued development of a professional in the renewable energy field.

UNIT I - PRODUCE BASIC PRODUCTION FABRICATION DRAWINGS (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use principles, terms, symbols codes and conventions used in production fabrication drawings.
2. create different types of detailed and assembly drawings.
3. apply appropriate techniques of detailed and assembly drawings.
4. apply specification and industry standards to produce drawings.

Content:

To include but not limited to:

1. Principles, terms, symbols, codes, and conventions usage in production fabrication drawings.
2. Types and usage techniques of detailed and assembly drawings.
    a. Production fabrication drawings techniques

UNIT II - DETAILING DRAWING (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. apply the principles, concepts, and applications of detailing.
2. use the terms, conventions and codes related to detailing.
3. apply the various detailing types, application, and selection.
4. identify the different fabrication processes and the identification of machine parts.
5. use rules for drawing machine part details.
6. use concepts of units of measurement usage related to detailing.
7. use properties and relationships of triangles and circles to produce geometric shapes related to detailing.

Content:

To include but not limited to:

1. Principles, concepts and applications of detailing.
2. Terms, conventions and codes related to detailing.
3. Detailing types, application and selection.
4. Different fabrication processes and identification of machine parts.
5. Rules for drawing machine part details.
6. Concepts of units of measurement usage related to detailing.
7. Application of properties and relationships of triangles and circles to solve geometric shapes related to detailing.

UNIT III – ASSEMBLY DRAWINGS (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use principles, concepts and applications of assembly drawings.
2. use terms, conventions and codes related to assembly drawings.
3. distinguish between different types of assembly.
4. use processes and identification of machine part assemblies.
5. use rules for drawing assembly drawings.
6. use concepts of units of measurement.
7. use appropriate assembly drawings for engineering components.
8. produce machine assembly drawing - detailed drawings.
9. create drawings for welded component parts.
10. develop parts list development.
11. produce file and/or drawing for CAD/CAM applications.
12. create drawings for Gears and Cams.
13. explain the use and application for threads and fasteners (e.g. Bolts, pins, and keys).
14. produce drawings for metal bending and fabricating.
15. apply standard fits, finishes, and tolerances to a machine drawing.
16. follow manufacturing processes (e.g. Machine, metal forming, and CNC) in assembly drawings.

Content:

To include but not limited to:

1. Principles, concepts and applications of assembly drawings; terms, conventions and codes related to assembly drawings; different assembly.
2. Processes and identification of machine part assemblies; rules for drawing assembly drawings; concepts of units of measurement.
3. Usage related to assembly drawings; application of properties and relationships of triangles and circles to solve geometric shapes related to assembly drawings.
4. Machine assembly drawing production.
5. Detailed drawings.
6. Drawings for welded component parts.
7. Parts list (e.g. Balloons) development.
8. File and/or drawing for CAD/CAM applications.
9. Gears drawings.
10. Cams drawings.
11. Threads and fasteners (e.g. Bolts, pins, and keys) use and applications.
12. Drawings for metal bending and fabricating.
13. Standard fits, finishes, and tolerances to a machine drawing applications.
14. Manufacturing processes (e.g. Machine, metal forming, and CNC).

UNIT IV – DEVELOP PATTERN (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use principles, concepts and purpose of pattern development.
2. use terms, conventions and codes related to pattern development.
3. apply types and usage techniques of pattern development to related drawings.
4. apply pattern development and intersection techniques to related drawings.
5. use intersections of geometric surfaces development techniques and applications.
6. use flat surfaces development techniques and applications.
7. construct patterns from intersection specifications.

Content:

To include but not limited to:

1. Principles, concepts, and purpose of pattern development.
2. Terms, conventions, and codes related to pattern development.
3. Types and usage techniques of pattern development and related drawings.
4. Application of pattern development and intersection techniques.
5. Intersections of geometric surfaces development techniques and applications.
6. Flat surfaces development techniques and applications.
7. Construct of objects from the intersection.

UNIT V – DEVELOP MAPS, PROFILES DESIGNS AND PRODUCTION (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use principles, concepts and applications of maps and profiles design and production.
2. use terms, conventions and codes related to maps and profiles design and production.
3. identify maps and profiles design, production types and uses.
4. use rules for cartography.
5. select components and transit usage.
6. use symbols and applications for topography.
7. use properties and relationships of triangles to solve problems of mathematic nature.

Content:

To include but not limited to:

1. Principals, concepts and applications of maps and profiles design and production.
2. Terms, conventions, and codes related to maps and profiles design and production.
3. Maps and profiles design and production types and uses.
4. Rules for cartography.
5. Components selection and transit usage.
6. Symbols usage and applications for topography.
7. Application of properties and relationships of triangles to solve geometric problems; trigonometric relations to solve right triangles, law of sines and cosines to solve triangles.

UNIT VI – PREPARE BASIC PIPE/PLUMBING DRAWINGS (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use principles, purpose, terms and conventions usage in pipe/plumbing drawings.
2. identify applicable codes, symbols and abbreviations.
3. use piping symbols, fittings, fixtures, and valves.
4. identify types of piping systems and usage techniques in pipe drawings.
5. explain the principles of pneumatics and hydraulics.
6. produce pneumatics and hydraulic schematics drawings.
7. produce Plumbing schematics drawings.
8. apply techniques and applications in creating drawings of piping and systems.

Content:

To include but not limited to:

1. Principles, purpose, terms, and conventions usage in pipe/plumbing drawings.
2. Applicable codes, symbols, and abbreviations.
3. Piping symbols, fittings, fixtures, and valves.
4. Types of piping systems and usage techniques in pipe drawings.
5. Principles of pneumatics and hydraulics.
6. Pneumatics and hydraulic schematics production.
7. Plumbing schematics production.
8. Techniques and applications in creating drawings of piping symbols and systems.

UNIT VII - PRODUCTION BASIC STRUCTURAL STEEL, WELDING AND SHEET METAL DRAWINGS (6 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use principles, terms and conventions usage in structural steel, welding, and sheet metal drawings.
2. classify major structural and welding components.
3. use rules and symbols used in structural and welding drawings.

4. identify structural steel shapes and steel-framing materials.
5. produce details and assembly drawings f or with bill of materials/bills of quantities.
6. produce steel frame plan drawings.
7. apply different types/techniques of structural and welding drawings.
8. use techniques and applications to create structural drawings using measuring, labelling, and symbol procedures.
9. utilize techniques and applications in drafting the processes for joining metal and standard symbols for welding.
10. use appropriate techniques and applications in creating welding drawings complete with weld symbols.
11. apply sheet metal layout methods and procedures.
12. create Representative sheet metal drawings.
13. produce Sheet metal drawings for CAD/CAM applications.

Content:

To include but not limited to:

1. Principles, terms and conventions usage in structural steel, welding and sheet metal drawings.
2. Classification of major structural and welding components.
3. Rules and symbols used in structural and welding drawings.
4. Structural steel shapes.
5. Steel-framing materials.
6. Detail and assembly drawings (including beam connections) with bill of materials.
7. Steel frame plan drawings production.
8. Types and usage techniques of structural and welding drawings.
9. Techniques and applications in creating structural drawings using measuring, labelling, and symbol procedures.
10. Techniques and applications used in drafting the processes for joining metal and standard symbols for welding.
11. Techniques and applications in creating welding drawings complete with weld symbols.
12. Sheet metal layout methods and procedures.
13. Representative sheet metal drawings.
14. Sheet metal drawings for CAD/CAM applications.

UNIT VIII – INK OVERLAY DRAWINGS PRODUCTION (6 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use the principles, concepts, and applications of ink overlay drawings production.
2. use terms, conventions and codes related to ink production.
3. produce drawing specifications, identification, and analysis.
4. use rapid graph equipment usage procedures.
5. produce Ink overlay drawings.

Content:

To include but not limited to:

1. Principals, concepts and applications of ink overlay drawings production.
2. Terms, conventions and codes related to ink production.
3. Drawing specifications identification and analysis.
4. Rapid graph equipment usage procedures.

UNIT IX – DRAWINGS REPRODUCTIONS TO INDUSTRY STANDARDS ? HOURS

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use principles, concepts and applications of drawing reproductions.
2. use terms, conventions and codes related to processes and drawing reproductions.
3. use rules for reproducing drawings.
4. identify the various machines in use and the appropriate selection in the reproduction process.
5. produce drawings to specification.

Content:

To include but not limited to:

1. Principals, concepts, and applications of drawing reproductions.

2. Terms, conventions and codes related to processes related to drawing reproductions.
3. Rules for reproducing drawings.
4. Various machines usage and selection in the reproduction process.

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Students will be given rubrics and grading schemes within the first contact period of the course. Each student will also be given written and oral feedback. Feedback will be immediate and no longer than one week after a task is assessed. Feedback may be document on assessment evidence.

INSTRUCTIONAL METHODS

CAPSTONE EXPERIENCE DESCRIPTION

Students will be required to designed and produce drawings using AutoCAD software for a Renewable Energy Instillation Project.

RESOURCES LECTURERS

AutoCAD Software, Models, sample drawings, tools, and equipment.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	DESIGNING AND INSTALLING RENEWABLE ENERGY SYSTEMS I
COURSE CODE:	REDI2103
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	ELECTRONIC DEVICES AND RENEWABLE ENERGY SYSTEMS
CO-REQUISITE(S):	None
SEMESTER:	III

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills, and attitudes to design, install, maintain and quality control renewable energy systems, namely thermal, wind, micro-hydro, and photovoltaic systems. In addition, students will learn how to perform preparatory activities, research and collect data, design modifications, prepare costing and budgets, use required regulations, prepare reports using Standard English, manage related documents and documentation, and obtain design approval.

LEARNING OUTCOMES/INSTRUCTIONAL OBJECTIVES

Upon completion of this course, students are competent when they are able to:

1. contrast and compare the different types of renewable energy systems.
2. interpret OHS regulations and related regulations governing the renewable energy sector.
3. work with thermal heating system.
4. design and size system.
5. work with hydraulic circuits.
6. work with micro-hydro system.
7. work with photo voltage system.

8. edit system design.
9. carry out quality control system.

UNIT I - RENEWABLE THERMAL HEATING SYSTEMS (4 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the functions of the thermal heating system.
2. interpret codes of practice for thermal heating system.
3. relevant OHS regulations.
4. identify type of renewable thermal heating systems.
5. design and size renewable thermal heating systems.
6. work on commercial water heaters.
7. work on domestic solar water heaters.
8. apply safety and quality control procedures.

Content:

To include but not limited to:

1. Relevant regulations:
    a. Codes of practice
    b. OHS regulations

2. Types of renewable thermal heating systems:
    a. Commercial solar hot water heaters
    b. Domestic solar water heaters
    c. Pool solar hot water heaters

UNIT II - DESIGN AND SIZING SYSTEMS (4 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the functions of designing and sizing systems.

2. follow procedures to design and sizing systems.
3. design renewable thermal heating systems.
4. size renewable thermal heating systems.
5. explain the characteristics of hydraulic circuits.
6. apply STEM in designing and sizing system.

Content:

To include but not limited to:

1. Relevant science, technology, engineering, and mathematical principles:
    a. Heat transfer (modes, conduction, convection, radiation, combined conduction and convection, types of heat exchanges).
    b. Combustion (the combustion process, fuels, air/fuel ration, emissions and pollutants, combustion equations, combustion products).
    c. Steam (importance, steam/water properties, temperature, generation, safety devices and controls, steam plant, heat transfer rates, steam throttling and flash steam).
    d. Daily irradiation.
    e. Heat system technologies (types, application, operating parameters, component parameters and configuration, system performance requirements).
    f. Use refrigeration/heat pump (vapour compression cycle, types of refrigerants, ideal and actual vapour compression cycles, energy balance and heat transfer, Carnot Principle).
    g. Providing energy balance (heat transfer mechanisms, reducing heat losses from collector, providing energy balance).
    h. Solar collector use and performance (factors that affect selection of materials, features of collectors, tests for collector construction, tests for thermal performance).
    i. Hydraulic circuits (function and components, types and size components, safety.
    j. Requirements, requirements to balance flow, water and energy conservation, types and level of insulation).
    k. Considerations.
    l. Design alteration.

UNIT III - PLAN AND MANAGE PROJECTS (4 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. develop plans and schedules.
2. explain the term ‘commissioning’.
3. explain the development of project for installation and commissioning.
4. install and commission renewable thermal heating system.
5. apply various methods to install and commission systems.
6. perform servicing and maintenance of renewable thermal heating systems.
7. tart system.
8. perform site survey for renewable thermal heating systems.
9. prepare reports relate to projects managed in Standard English.

Content:

To include but not limited to:

1. Development and preparation of project for installation and commissioning:
    a. Tasks and activities involved in installation and commissioning of system
    b. Work breakdown planning
    c. Considerations
    d. Responding to unplanned events
2. Installation and commissioning of renewable thermal heating system:
    a. Methods
    b. Technique
    c. Tests
    d. Conducting customer walk-through
3. Servicing and maintenance of renewable thermal heating systems:
    a. Job safety analysis and implementation
    b. Scheduled and unscheduled servicing and maintenance
    c. Solving mechanical and electrical problems
4. Site survey:
    a. Declination angle, reflectance, sunshine hours, extra-terrestrial irradiation
    b. Energy efficiency techniques relevant for domestic dwelling and commercial premises to reduce the electrical energy demand
    c. Energy efficient initiatives that could be implemented by the site owner

d. Estimation of the solar resource for the site

UNIT IV - DESIGN AND INSTALL PHOTOVOLTAIC SYSTEM (4 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the function of a photovoltaic system.
2. identify characteristic photovoltaic system.
3. explain the basic components of a photovoltaic system.
4. identify and select types of batteries used in photovoltaic systems.
5. identify and select the types of inverters used in photovoltaic systems.

Content:

1. Inverter Characteristics encompassing:
    a. The characteristics which distinguish inverters suitable for photovoltaic array application from standard inverters
    b. The six (6) essential inverter specifications
2. PV System Operation encompassing:
    a. operation of PV systems including synchronisation, safety feature, power flow control, passive and active anti-islanding, and metered energy for systems
3. PV inverter selection encompassing:
    a. major installation requirements for all system components which will ensure correct operation, long life, safety and ease of maintenance consistent with local standards and relevant OH&S guidelines
    b. typical installation configurations for PV connection of energy systems via inverters
    c. the function and operation of a "PV protection device" as specified in local standards
    d. installation requirements for PV systems
    e. labelling and signage requirements for switchboards supplied with power from PV inverters, as set out in local standards
    f. the additional requirements for UPS systems as specified in local standards
4. Design of a photovoltaic system:
    a. Use of site survey and design brief
    b. Selecting system components
    c. Considerations including:

d. Safety
e. Functionality
f. Budget
g. Alternative arrangements
h. Environmental impact of design

5. System costing:
    a. Major costs to be considered in the life cycle costing method
    b. External costs that might impact on the cost effectiveness of a photovoltaic system
    c. Most cost effective of a number of options on the basis of life cycle costing analysis
    d. Design techniques

UNIT V – DESIGN AND INSTALL WIND ENERGY SYSTEM (4 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the importance of wind energy.
2. determine appropriate siting of wind energy.
3. apply the relevant local regulations, codes of practice and Occupational Health and Safety requirements.
4. evaluate the wind energy conversion systems.
5. design wind energy conversion system using design techniques.
6. install wind energy system.
7. set up quality control.
8. identify feature of atmospheric boundary lawyer.
9. use site survey and design brief.
10. evaluate environment impact of design/installations.
11. prepare costing and budget related to design/instillation.
12. perform quality control and monitory of systems.
13. prepare required reports and documentations.
14. take wind speed data measurements.

Content:

To include but not limited to:

1. Quality controls.

2. Approval of Designs:
    a. Presentation of design to clients
    b. Negotiation of alterations
3. Relevant local regulations, codes of practice and Occupational Health and Safety requirements.
4. Wind energy conversion systems:
    a. Components
    b. Characteristics
    c. Operational principles
5. Science, technology, engineering and mathematics principles and techniques:
    a. Wind characteristics encompassing:
    b. Definition of the terms: weather charts, isobars, fronts and troughs, cyclone and anti-cyclone, atmospheric boundary layer, geotropic wind, gradient wind, wind shear, wind rose
    c. Major global wind circulations and the formation of major wind flows over your continent
6. Major features of the atmospheric boundary layer including:
    a. Variation of wind speed with height according to logarithmic and power laws, effects of surface roughness
    b. Atmospheric stability and temperature inversions turbulence
    c. Major local winds including: trade winds, sea, and land breezes, katabolic and anabatic winds
    d. Likely effects on the major local winds from local topography, surface roughness, isolated barriers, and temperature inversions
    e. Typical diurnal, monthly and seasonal patterns of winds over the local area
    f. The formation and likely effects of extreme winds and wind shear
7. Wind speed data measurement and analysis encompassing:
    a. Definition of the terms: porosity, internal boundary layer, speed-up factor, Temperature inversion factor, wind speed frequency distribution, lull period, calms
    b. Interpretation of local and regional wind speed and direction data such as local records (E.g. Meteorological Bureau data), ecological indicators and wind speed/energy maps
    c. Wind speed and direction using data logging anemometers
    d. Manufacturer's calibration curves for anemometers to correct recorded data
    e. Calculation at a site, monthly and yearly average wind speed and wind power density from existing, nearby data or on-site measurements, using appropriate software
    f. Estimation of the wind speed at a WECS tower of suitable height and location given: wind speed data recorded at two or more elevations at the site, and wind

speed data recorded at one elevation and appropriate surface roughness, temperature inversion and speed-up factors at the site

8. Design of wind energy conversion system:
    a. Use of site survey and design brief
    b. Selecting system components
    c. Considerations including:
    d. Safety
    e. Functionality
    f. Budget
    g. Alternative arrangements
    h. Environmental impact of design
9. System costing encompassing:
    a. Major costs to be considered in the life cycle costing method
    b. External costs that might impact on the cost effectiveness of a wind energy conversion system
    c. Most cost effective of a number of options on the basis of life cycle costing analysis
10. Design techniques/ Methods.
11. Approval of design:
    a. Presentation of design to clients
    b. Negotiation of alterations

UNIT VI - DESIGN AND INSTALL MICRO-HYDRO SYSTEM (M.H.S) (4 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the importance of micro-hydro system.
2. apply the relevant local regulations, codes of practice and Occupational Health and Safety requirements for the micro-hydro system.
3. evaluate the types of micro-hydro system.
4. design micro-hydro system.
5. install and maintain micro-hydro systems.
6. prepare costing and budget.
7. perform quality control and monitoring.
8. Conduct site-evaluations and prepare report.

Content:

To include but not limited to:

1. MHS systems:
    a. Components
    b. Characteristics
    c. Operational principles
2. Science, technology, engineering and mathematical principles and techniques
    a. Site evaluation:
        i. Definition of the terms: potential and kinetic energy, micro-hydro system, gross head, net head, flow rate
        ii. Available head at a site using a dumpy level or theodolite, altimeter, pressure gauge and contour maps
        iii. The accuracy, advantages, and disadvantages of each method for flow and head assessment
        iv. The flow rate of a given site using each of the following methods - catchment area calculations, water diversion to fill a container, stream velocity/area measurement and/or weir construction method
        v. Advantages and disadvantages of each method of head and flow measurement with particular reference to their accuracy
        vi. Long term usable flow rate from long term stream flow if available, taking into account environmental considerations
        vii. Effects of seasonal variation using long term weather data
        viii. Typical daily and seasonal energy consumption profile at a given site
        ix. Effect of the energy demand profiles both daily and seasonally at the site on the system sizing
        x. Government regulatory requirements such as those covered under environmental or water resource legislation
        xi. Environmental constraints at a site including minimum stream flow rates, ecological impacts, visual and noise impacts
    b. Design of micro-hydro system:
        i. Use of site survey and design brief
        ii. Selecting system components
        iii. Considerations including:
        iv. Safety
        v. Functionality
        vi. Budget
        vii. Alternative arrangements

viii. Environmental impact of MHS and appropriate measures to minimize these impacts

c. System costing encompassing:
    i. Major costs to be considered in the life cycle costing method
    ii. External costs that might impact on the cost effectiveness of a MHS
    iii. Most cost effective of a number of options on the basis of life cycle costing analysis
d. Design techniques:
    i. Suitable MHS characteristics to suit site load, hydraulic head and stream flow rate characteristics and a suitable type of commercially available MHS
    ii. Frictional losses in delivery pipes using manufacturer's data
    iii. Optimising the position of the MHS and size of the MHS
    iv. Suitable balance of system components including delivery pipe and fittings, transmission cable and voltage, voltage and frequency regulation, battery storage type and capacity, battery charger, inverter, back-up generator, and load dump
e. Micro-hydro systems installation and maintenance processes encompassing:
    i. Appropriate methods, using appropriate safety procedures for: dam or weir construction; watercourse construction and/or penstock installation; turbine installation
    ii. Appropriate installation, commissioning, fault diagnosis and rectification procedures and maintenance methods using appropriate safety procedures
    iii. Maintenance schedule for the system
    iv. Safety procedures for the installation, commissioning, fault diagnosis and maintenance of system components
f. Quality controls Methods.
g. Approval of Design:
    i. Presentation of design to clients
    ii. Negotiation of alterations

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III,**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Feedback will be in accordance with institutional policies.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role plays project and presentations and site visits.

CAPSTONE EXPERIENCE DESCRIPTION

Students will be required to conduct research on the systems and prepare designs specification for a particular system, develop budgets and installation implementation plans and quality control systems procedure.

RESOURCES

Lecturers, Training materials, tools, and equipment, drawing and models.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	AUDITING OF RENEWABLE ENERGY SYSTEMS
COURSE CODE:	REAS2200
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	RENEWABLE ENERGY SYSTEM I
CO-REQUISITE(S):	None
SEMESTER:	IV

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills, and attitudes to conduct residential, commercial and industrial energy audits. They will be exposed to the audit process, audits plans/schedule, organization of resources for conduct of audits, audit traits, manage audit teams and audit process, preparation of audits reports and other related documentation, analyse audit finds, make recommendations and corrective action plans, presentation of reports to stakeholders and execute follow monitoring plan.

LEARNING OUTCOMES/INSTRUCTIONAL OBJECTIVES

Upon completion of this unit, students are competent when they are able to:

1. explain the purpose on conducting energy audits.
2. explain the economic benefits of audits.
3. conduct audits, analyse documents findings, and present findings.
4. develop and implement audit plans.
5. use regulation and legislations in conducting audits.
6. develop corrective action Plans.
7. conduct follow-up monitoring to audits.

UNIT I – LEGISLATURE BODIES (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the functions of and need for energy management.
2. interpret energy management plans, legislations, and regulations relevant to Residential, Commercial, and Industrial facilities.
3. explain the purpose of Residential energy audit.
4. explain the purpose Commercial energy audits.
5. explain the purpose Industrial energy audits.
6. use legislations and regulations in conducting audits.
7. identify regulatory bodies responsible for implementation of legislations.

Content:

To include but not limited to:

1. Energy Management Legislation and Regulation Regulatory Bodies:
    a. National Building Code of Jamaica
    b. Jamaican Standards for Energy Auditing
    c. State based legislation for energy management in business
    d. NABERS Tenancy
    e. NABERS Office
    f. Building Energy Efficiency Certificates
    g. Renewable Energy Credits
    h. Small Technology Credits

UNIT II – CONDUCT RESIDENTIAL ENERGY AUDITS (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. develop audit Plan and Scope.
2. prepare audit team.
3. identify the type of air conditioning technologies.

4. explain contributions of Solar PV and Solar Thermal Energy.
5. explain the impact of energy efficiency and energy consumption reduction.
6. apply energy auditing and practice for residential building.
7. apply Lighting Services Theory and efficient design.
8. water heating services and efficient design.

Content:

To include but not limited to:

1. Residential energy audits
2. Air conditioning technologies:
    a. High efficiency AC system types
    b. Heat load reduction
    c. Cold storage technologies
    d. Refrigerated type air conditioning
    e. inverter type air conditioning
    f. reverse cycle air conditioning
    g. evaporative air conditioners
    h. breeze power systems
    i. digital scroll compressors

3. Contributions of solar PV and solar thermal energy to energy efficiency and/or energy consumption reduction
4. Building construction technology encompassing:
    a. Masonry, poured concrete, wood and metal wall, foundation and roof structure construction techniques and resultant R values
    b. Air leakage sources and leak reduction techniques
    c. Window frame and glazing technologies, window films and resultant solar heat gain coefficient and R values
    d. Impact of building geometry and orientation on solar heat gain and wind heat loss/gain impacts
    e. Impact of exterior roof and wall colours on solar heat gain and night radiation losses
    f. Impact of thermal mass
5. Energy auditing and practice encompassing:

a. Scope of Jamaican Standards for energy auditing
b. Energy audit process in relationship to data collection, analysis and the communication of results
c. Accounts, bills and data, tariff structures

d. Risks and hazards associated with conducting residential or small commercial/institutional energy audit
e. Power rating of equipment and metering and measurement in residential or small commercial/institutional facilities energy audit
f. Understand the implications of data recording intervals for monitoring equipment
g. Options for improved lighting efficiency and operating cost reduction
h. Illumination terms: lux and lumens
i. Characteristics of light sources including efficacy, colour temperature and colour rendering index
j. Ballast types, their efficiency and benefits
k. Incandescent lamps, LED, induction lamps, halogen lighting, commercial fluorescent lighting, metal halide, mercury vapour
l. Refrigerator and freezer star ratings

6. Residential cooking appliance efficiencies and options for improved efficiency and cost savings.
7. Water reduction and water savings methodology.
    a. Water auditing services theory:
        i. Water flow rate of taps, showers and irrigation, toilets, washing machines, dishwashers and filtration and top up water use for pool systems
        ii. Trends of water use and charges
        iii. Water efficiency labelling (WELS) scheme as it relates to water auditing
        iv. Operation of a greywater system
        v. Factors that impact on garden water demand
8. Water heating services and efficient design:
    a. Water heaters including electric and gas storage, gas instantaneous (continuous flow), electric heat pump and solar hot water heaters
    b. Solar water heater configurations and characteristics including passive (or thermo siphon) systems and active (or pumped) systems solar collector types, one shot booster
    c. Factors that influence water heater energy use including pipe work and fitting insulation, atmospheric conditions, water efficiency, temperature setting and maintenance & operation
9. Lighting services theory and efficient design:
    a. Fundamental illumination design for domestic and small business
    b. Illumination in terms of light output, light level and brightness
    c. Determining target light levels for differing tasks
    d. Characteristics of light sources including efficacy, colour temperature and colour rendering index
    e. Ballast types, their efficiency and benefits

f. Incandescent lamps, halogen lighting, domestic fluorescent lighting and comparisons between these and applications for the domestic and small business sector
g. Application of lighting methodology for best practice energy efficiency design
h. Energy saving lighting opportunities in the domestic and small business sector

UNIT III - CONDUCT COMMERCIAL ENERGY AUDITS (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. develop audit plan and scope.
2. prepare audit team.
3. explain energy auditing and practice for commercial building.
4. apply the Lighting Services Theory and efficient design.
5. identify factors that impact on refrigerator energy usage.
6. evaluate the food storage services and efficient design.
7. evaluate the water heating services and efficient design.

Content:

To include but not limited to:

1. Commercial energy audits.
    a. Water supply and use encompassing:
        i. Collecting and analysis of information for commercial facilities water use and methods to improve water efficiency in the home
        ii. Ability to analyse the water consumption index for different commercial sectors
        iii. Ability to analyse commercial facilities water use and ways to minimize the use of water
        iv. Understanding on the methodology applied to water savings
        v. Calculating water star rating
2. Energy auditing and practice encompassing:
    a. Scope of Jamaican Standards for energy auditing
    b. Energy audit process in relationship to data collection, analysis and the communication of results
    c. Accounts, bills and data, tariff structures and the identification of commercial tariff types

d. Calculating energy and energy balance including power calculations, usage time calculations, power factor calculations and energy conversions from kwh to MJ
e. Process involved in onsite assessment in a commercial facilities energy audit
f. Gathering information on commercial facilities energy use and costs
g. Risks and hazards associated in a commercial facilities energy audit
h. Calculate energy and power
i. Power rating of equipment and metering and measurement in a commercial facilities energy audit
j. Calculating energy balance for commercial facilities
k. Advice on ways to improve energy efficiency
l. Calculating greenhouse emission, emissions factors, carbon intensity of electricity vs. natural gas and LPG and global warming potential and CO2 equivalents
m. Financial analysis in terms of simple payback and simple payback period and return on investment or rate of return
n. Reporting and communication of energy audit results
o. Understanding and explaining the operation of the seven different power and energy monitoring equipment available
p. Understanding the implications of data recording intervals for monitoring equipment
q. Developing a power and energy monitoring strategy for a commercial facility
r. Deploying commercial facility power and energy monitoring strategy
s. Drawing conclusions and report on power and energy data collection in a commercial facility

3. Lighting services and efficient design encompassing:
    a. Fundamental illumination design for commercial facilities
    b. Illumination terms: light output, light level and brightness
    c. Determining target light levels for differing tasks
    d. Characteristics of light sources including efficacy, colour temperature and colour rendering index
    e. Ballast types, their efficiency and benefits
    f. Incandescent lamps, LED, Induction Lamps, halogen lighting, commercial fluorescent lighting, metal halide, mercury vapour and comparisons between these and applications for the commercial facilities
    g. Application of lighting methodology for best practice energy efficiency design
    h. Energy saving lighting opportunities in the commercial facilities
4. Food storage services and efficient design encompassing:
    a. Refrigeration system basics operation
    b. Different refrigeration models
    c. Refrigeration characteristics including operation, automatic defrost, cooling temperature control, ice maker, ice and water dispenser, door seals and hinges

d. Factors that impact on refrigerator energy use including size, configuration temperature setting, clearance around cabinet and ambient conditions, making ice, ice and water and sweat heaters, seals, insulation, compressor efficiency and age
e. Refrigerator and freezer star ratings
f. Cold room and freezer room energy saving opportunities
g. Food storage saving opportunities
h. Food preparation services and efficient design encompassing:
i. Different food preparation appliances
j. Different operation of gas and electric hot plates and ovens and the advantages and disadvantages of each
k. EMI food preparation methodology
l. Food preparation saving opportunities
m. Food preparation services and efficient design

5. Water heating services and efficient design encompassing:
    a. Different water heaters including electric and gas storage, gas instantaneous (continuous flow), electric heat pump and solar hot water heaters
    b. Solar water heater configurations and characteristics including passive (or thermo siphon) systems and active (or pumped) systems solar collector types, one shot booster
    c. RECs and STCs and how these relate to solar water heater STCs
    d. Factors that influence water heater energy use including pipe work and fitting insulation, atmospheric conditions, water efficiency
6. Temperature setting and maintenance & operation:
    a. Water heating / cooling calculations
    b. EMI water heating methodology
    c. Commercial water heating saving opportunities
    d. Types of entertainment and administration appliances found in commercial residences

UNIT IV – CONDUCT INDUSTRIAL ENERGY AUDITS (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. develop audit plan and scope.
2. prepare audit team.
3. identify energy management legislations and regulations.
4. explain Water supply and use for industrial properties and enterprises.

5. evaluate the food storage services and efficient design.
6. evaluate the water heating services and efficient design.
7. explain Smart Metering Solutions used in industrial properties and enterprises.
8. conduct Industrials Energy Audits.
9. analyse findings, determine correct actions, prepare, and present reports.

Content:

To include but not limited to:

1. Industrial energy audits.
    a. Energy Management Legislation and Regulation
    b. National Building Code
    c. Standards for Energy Auditing
    d. National based legislation for energy management in business
    e. Energy Efficiency Opportunities Act
    f. National energy reporting schemes
    g. Minimum Renewable Energy
    h. Renewable Energy Credits
    i. Small Technology Credits
2. Water supply and use encompassing:
    a. Collecting and analysis of information for industrial facilities water use and methods to improve water efficiency in the industrial facilities
    b. Ability to analyse the water consumption index for different industrial sectors
    c. Ability to analyse industrial facilities water use and ways to minimize the use of water
    d. Understanding on the methodology applied to water savings
    e. Calculating of water star rating
3. Energy management encompassing:
    a. Energy management strategies
    b. Practice based energy management
    c. Technology based energy management
    d. Interaction between human resources and practice based control
    e. Application of technology-based energy management
    f. Identify potential energy savings from application of energy management
4. Power and energy data recording encompassing:
    a. Identifying the structure and purpose of power and energy data recording for whole systems and equipment
    b. Reviewing or develop single line schematic of electrical system of an industrial facility

c. Establishing the power and energy data gap from the energy audit to achieve standard compliant energy audits
d. Identifying electrical loads that need to contribute more than 5% of energy use
e. Understanding and explaining the operation of the seven different power and energy monitoring equipment available
f. Understanding the implications of data recording intervals for monitoring equipment
g. Developing a power and energy monitoring strategy for an industrial facility
h. Deploying industrial facility power and energy monitoring strategy
i. Drawing conclusions and report on power and energy data collection in an industrial facility

5. Water auditing services and design encompassing:
    a. Water flow rates of taps, showers and irrigation, toilets, washing machines, dishwashers, filtration and top up water use for cooling towers and pool systems
    b. Industrial facility water meter reading
    c. Trends of water use and charges for industrial facilities
    d. Water Efficiency Labelling (WELS) Scheme relating to water auditing
    e. Identification of water efficiency
    f. Opportunities in industrial facility
    g. Assessments
    h. Operation of a rainwater and grey water systems
    i. Factors that impact on landscape water demand
    j. Thermal performance and climate control encompassing:
6. Thermal performance of a building impacts on heating, ventilation and air conditioning energy use including:
    a. Orientation, thermal mass, insulation, glazing, shading and ventilation
    b. Air conditioning designs including central, ducted systems, split-system air conditioners, multi-headed split systems, individual room air conditioners (rac), through wall / window and portable units
    c. Improvement to air movement systems in industrial facilities including diffusers
    d. Improvement to ventilation systems in industrial facilities
    e. Improvement of thermal performance of an industrial building envelop elements
    f. Application of climate zones
    g. Air conditioning technologies including refrigerated type air conditioning, inverter type air conditioning, reverse cycle air conditioning, evaporative air conditioners, breeze
    h. power systems and digital scroll compressors
    i. Application of Energy Efficiency Ratio (EER) and Coefficient of Performance (COP) and show proficiency in EER and COP calculations
    j. Application of the Air Conditioning Star Ratings to Industrial facilities

k. Gas and electric heating options and air (ducted) heating
l. Operation of an air conditioning system and describe each component including the compressor, evaporator, condenser, expansion valve and fan coil
m. Ceiling and pedestal fans and ventilation climate control
n. Factors that impact on climate control energy consumption
o. Best practice climate control methodology as applied to the Industrial facilities
p. Industrial facilities climate control saving opportunities
q. Conducting thermal performance assessment of Industrial facilities
r. Entertainment and administration services and efficient design encompassing:
s. Appliance standby power including the different mode, passive and active standby
t. Appliance energy star ratings
u. MEPS and labelling requirements for televisions
v. Network standby management strategies

7. Computer energy consumption including computer power management, entertainment and administration saving opportunities
8. Industrial services and efficient design encompassing:
    a. Compressed air, hydraulic and steam systems
    b. Overview of industrial services in relation to industrial sector
9. Compressed air, hydraulic and steam system selection and design.
    a. Compressed air, hydraulic and steam system theory, energy balance for a typical systems in industrial processes
    b. Energy efficiency pumping compressed air, hydraulic and steam systems design methodology
    c. Energy efficiency compressed air, hydraulic and steam systems
    d. Industrial pumping compressed air, hydraulic and steam systems saving opportunities
    e. Smart metering solutions encompassing:
    f. Benefits of the different metering available to the industrial sector
    g. Metering opportunities relation to industrial sector
    h. Renewable energy (solar PV) encompassing:
    i. Design of solar PV systems and different panel types including mono-crystalline, poly-crystalline and amorphous
    j. Solar panel characteristics and choice of selection
10. Solar power system utility approval process.
    a. Balance of systems, rules of thumb, shading, orientation and shading of strings in an on grid solar power system
    b. Solar PV energy calculations and calculate rec entitlement for a small solar PV system
    c. Different feed-in tariff schemes and how they apply to solar PV

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Students will be given rubrics and grading schemes within the first contact period of the course. Each student will also be given written and oral feedback. Feedback will be immediate and no longer than one week after a task is assessed. Feedback may be document on assessment evidence.

INSTRUCTIONAL METHODS

Field visits to sites, formal lectures, online activities, Resource Persons, research, and group presentation.

CAPSTONE EXPERIENCE DESCRIPTION

Students will be given assignment to plan and conduct Audits for Residential Energy System and Commercial Energy System. Analyse findings, prepare and present report.

RESOURCES

Lecturers, Resource Persons

On site – Visits, Audit specifications, samples of audit reports, reading materials

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	USING ELECTRICAL POWER DISTRIBUTION SYSTEMS
COURSE CODE:	REED2200
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	None
CO-REQUISITE(S):	None
SEMESTER:	IV

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to design, install and maintain A.C. circuits, measure electrical quantities, and select and purchase electrical materials and components according to electrical power specification.

LEARNING OUTCOMES/INSTRUCTIONAL OBJECTIVES

Upon completion of this course, students are competent when they are able:

1. explain system for generation and distribution of A.C. power.
2. interpret regulations OHS and codes of practices.
3. design and install electrical circuits.
4. measure electrical quantities detect and correct faults.
5. detect and correct faults.
6. use formulae to calculate electrical quantities.

UNIT I - WORK PERFORM ON MULTIPLE PATH CIRCUITS (4 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the functions of multiple path circuits.
2. identify characteristics of multiple path circuits.
3. apply the relevant regulations, codes of practice and Occupational Health and Safety in working on complex multiple path circuits.
4. select and use tools, equipment, and testing devices to work on complex multiple path circuits.
5. identify types of hazards and mitigate risks.
6. identify faults and implement corrective actions.
7. test and record findings on circuits.
8. work on complex circuits following procedures.

Content:

To include but not limited to:

1. Hazards associated with working in complex multiple path circuits.
2. Tools, equipment, and testing devices:
    a. Functions
    b. Preparation
    c. Use
    d. Care and maintenance
3. Testing and fault finding in complex multiple path circuits.

UNIT II - ELECTRICAL POWER GENERATION AND DISTRIBUTION (4 HOURS)

Learner Outcomes:

Upon completion of this unit students are competent when they are able to:

1. explain the system of power generation and distribution.
2. explain Laws and regulations.
3. identify the electrical phases for distribution of electricity.

4. identify the type of power distribution for different facilities.

Content:

To include but not limited to:

1. Jamaican System of Power Generation
2. Distribution Phases: Single, Two, and Three
3. Electrical Laws
4. Different Facilities: Residential, Industrial, Commercial

UNIT III – ANALYSE A.C. CIRCUITS (6 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the function of A.C. circuits.
2. differentiate between A.C. circuits and D.C. circuits.
3. explain the characteristics of A.C. circuits.
4. solve electrical problems using the properties of A.C circuits.
5. use terms connected with A.C circuits.
6. analyse structure of A.C. circuits.
7. calculate electrical quantities of A.C. circuits.
8. measure quantities in A.C. circuits.
9. connect series circuits, parallel circuits and series parallel.
10. interpret OHS and other regulations.

Content:

To include but not limited to:

1. Function and operation of an electronics circuit simulation program
2. Networks containing up to three nodes
3. Using mesh analysis to find currents in A.C. Networks of up to two loops
4. Time domain and frequency domain
5. Frequency, angular frequency and units of measurement
6. Defining RMS and convert between time domain and RMS phasor values for a sine wave

7. Representing A.C. Voltages on a phasor diagram
8. Defining impedance, resistance, and reactance
9. Defining admittance, conductance, and susceptance
10. Series equivalent impedance
11. Parallel equivalent impedance

UNIT IV - APPLY A.C. CIRCUITRY CONSTRUCT AND LAWS (4 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the functions of A.C. circuit thrones concepts.
2. explain the use of electrical current laws.
3. solve problems using, Kirchhoff's laws, Voltage divider and current divider rules.
4. explain the Mesh, Node and Nodal analysis of circuitry.
5. calculate power values of A.C. circuits.
6. measure power in A.C. circuits.
7. use mesh and nodal equations for A.C. Network containing up to three loops.
8. explain functions and operations electronic circuit simulation programme.
9. solve problems using the Star-delta transformation formula equations.
10. explain difference between true power, reactive power and apparent power in A.C. circuitry.

Content:

To include but not limited to:

1. Kirchhoff's laws
2. Voltage divider and current divider rules
3. Function and operation of an electronics circuit simulation program
4. Mesh analysis
5. Node voltages and nodal analysis
6. Matrix representation
7. Method of determinants
8. Writing mesh equations for A.C. Networks containing up to three loops
9. Writing nodal equations for A.C. Networks containing up to three nodes
10. Star-delta transformation formula equations
11. Selection of appropriate conversion
12. True power, reactive power, and apparent power

13. Maximum power transfer
14. Transients in R-C and R-L circuits' growth and decay 2

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III,**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Feedback will be in accordance with institutional policies.

INSTRUCTIONAL METHODS

Video, Handout, and practical demonstration, think pair share.

CAPSTONE EXPERIENCE DESCRIPTION

Students will conduct experiments on types of A.C. circuits' measure and record quantities use electrical formulae to determine electrical quantities prepare reports using Standard English on findings and recommendations.

RESOURCES

Required Texts:

Photovoltaics: Design and Installations.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	DESIGNING AND INSTALLING RENEWABLE ENERGY SYSTEMS II
COURSE CODE:	REDI2206
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	DESIGNING AND INSTALLING RENEWABLE ENERGY SYSTEMS I
CO-REQUISITE(S):	None
SEMESTER:	IV

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to design and install thermal heating systems, Solar System and Wind Systems.

LEARNING OUTCOMES AND INSTRUCTIONAL OBJECTIVES

Upon completion of this course, students are competent when they are able to:

1. Install Thermal Heating System
2. Install Wind System
3. Solar System

UNIT I - INSTALL THERMAL HEATING SYSTEM (6 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain relevant OHS regulations and codes of practice that govern the installation thermal heating systems.
2. install different type of renewable thermal heating systems.

3. design and sizing of renewable thermal heating systems.

Content:

To include but not limited to:

1. Relevant regulations, codes of practice and Occupational Health and Safety requirements.
2. Types of renewable thermal heating systems:
    a. Commercial solar hot water heaters
    b. Domestic solar water heaters
    c. Pool solar hot water heaters
3. Design and sizing of renewable thermal heating systems
    a. Relevant science, technology, engineering, and mathematical principles:
        i. Heat transfer (modes, conduction, convection, radiation, combined conduction and convection, types of heat exchanges)
        ii. Combustion (the combustion process, fuels, air/fuel ration, emissions and pollutants, combustion equations, combustion products)
        iii. Steam (importance, steam/water properties, temperature, generation, safety devices and controls, steam plant, heat transfer rates, steam throttling and flash steam)
        iv. Daily irradiation
        v. Heat system technologies (types, application, operating parameters, component parameters and configuration, system performance requirements)
        vi. Use refrigeration/heat pump (vapour compression cycle, types of refrigerants, ideal and actual vapour compression cycles, energy balance and heat transfer, Carnot Principle)
        vii. Providing energy balance (heat transfer mechanisms, reducing heat losses from collector, providing energy balance)
        viii. Solar collector use and performance (factors that affect selection of materials, features of collectors, tests for collector construction, tests for thermal performance)
        ix. Hydraulic circuits (function and components, types and size components, safety requirements, requirements to balance flow, water and energy conservation, types and level of insulation)
        x. Considerations
        xi. Design alteration

4. Development and preparation of project for installation and commissioning:
    a. Tasks and activities involved in installation and commissioning of system
    b. Work breakdown planning
    c. Considerations
    d. Responding to unplanned events
5. Installation and commissioning of renewable thermal heating system:
    a. Methods
    b. Techniques
    c. Tests
    d. Conducting customer walk-through
6. Servicing and maintenance of renewable thermal heating systems:
    a. Job safety analysis and implementation
    b. Scheduled and unscheduled servicing and maintenance
    c. Solving mechanical and electrical problems

UNIT II - INSTALL SOLAR SYSTEM (10 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain relevant OHS regulations and codes of practice that govern the installation solar systems.
2. install different type of solar systems.
3. design and sizing of solar systems

Content:

To include but not limited to:

1. Designs
2. Methods
3. Legal requirements
4. Costs

UNIT - III INSTALL WIND SYSTEM (10 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain relevant OHS regulations and codes of practice that govern the installation solar systems.
2. install different type of solar systems.
3. design and sizing of solar systems.

Content:

To include but not limited to:

1. Designs
2. Methods
3. Legal requirements
4. Costs

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Students will be given rubrics and grading schemes within the first contact period of the course. Each student will also be given written and oral feedback. Feedback will be immediate and no longer than one week after a task is assessed. Feedback may be documented on assessment evidence.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role plays project and presentations.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	MANAGING RENEWABLE ENERGY PROJECTS
COURSE CODE:	REMP2212
CREDITS:	3
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	Fundamentals of Information Technology
CO-REQUISITE(S):	None
SEMESTER:	IV

COURSE DESCRIPTION:

This course is designed to enable students to develop the requisite knowledge, skills and attitudes to manage projects and to work in an environment where the successful management of projects is critical to the meeting of timeline to avoid cost overruns, and to maximize the use of resources and to meet customer satisfaction. Students will be exposed to project management software, project management tools, such as GANTT charts, critical path. Analysis, management of project teams, management of multi-projects, and to manage the projects life cycle.

LEARNING OUTCOMES AND INSTRUCTIONAL OBJECTIVES

Upon completion of this course, students are competent when they are able to:

1. develop and scope project activities.
2. schedule and timeline project activities.
3. implement and monitor projects.
4. manage multi-projects.
5. use project management software and tools.
6. do critical path analysis.
7. use resources efficiently.
8. avoid cost overruns.
9. manage project teams.

10. prepare and implement contingency plan.
11. follow project procedures.
12. motivate project team.
13. interface successfully with stakeholders of projects.
14. manage risk associated with projects implemented.

UNIT I - PREPARE PRE-PROJECT SETUP/INITIATION (9 HOURS)

Learner Outcomes:

Upon completion of this course, students are competent when they are able to:

1. define project management.
2. identify the characteristics of a project.
3. interpret the requirements to complete a pre-project setup/initiation.
4. apply the steps in validating a project.
5. explain the contents of a project charter.
6. summarize the project life cycle.
7. conduct feasibility arrays.
8. align project to strategic plan.
9. develop a project charter.

Content:

To include but not limited to:

1. Definition of Project Management
    a. The planning, organizing, and managing of tasks and resources to accomplish a defined objective, usually with constraints on time and cost.
2. The Definition and Characteristics of a Project:
    a. Temporary endeavour
    b. Delivers a unique product or service
    c. Bound by time
    d. Resources and quality
3. Completing a Pre-Project Setup/Initiation:
    a. Identify the project
    b. Validate the project
    c. Prepare a project charter
    d. Obtain approval for a project charter

4. Validating a Project:
    a. Validate business case: Feasibility analysis, Justification for project, Alignment to strategic plan
    b. Identify and analyse stakeholders
5. Project Charter:
    a. Key project deliverables
    b. High level milestones
    c. High level cost estimates
    d. Identify stakeholders
    e. General project approach
    f. Problem statement
    g. High level assumptions
    h. High level constraints
    i. High level risks
    j. Project objectives
6. Project Life Cycle:
    a. Initiating/Pre-project setup
    b. Planning
    c. Executing
    d. Monitoring/controlling
    e. Closing project

UNIT II - PLANS PROJECT PLANNING (25 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. prepare a project scope document based on an approved project charter.
2. use a Work Breakdown Structure (WBS) and WBS dictionary to organize project planning.
3. outline a process for managing changes to the project.
4. develop a project schedule based on WBS, project scope and resource requirements.
5. create a project schedule using Project Management Software.
6. evaluate a desired deliverable, apply the appropriate tool and/or method to produce the appropriate outcome.
7. interpret the results of using project management tools and/or methods in a given scenario.
8. identify components of an internal/external communication plan.
9. outline the components of a risk management plan.

10. identify roles and resource requirements based on WBS and resource availability.
11. identify components of a quality management plan.
12. identify components of a cost management plan.
13. follow the procurement process for a project implantation.
14. explain the purpose and common components of a transition plan.

Content:

To include but not limited to:

1. Project Scope Document
    a. Key Performance Indicators (KPIs)
    b. Scope boundaries
    c. Constraints
    d. Assumptions
    e. Detailed objectives
    f. Final project acceptance criteria
    g. Validate scope statement with stakeholders
2. Work Breakdown Structure and Work Breakdown Structure Dictionary
    a. Explain the benefits of WBS
    b. Explain the levels of a WBS
    c. Explain the purpose of a WBS
    d. Identify the planning processes which utilize the WBS as an input
    e. Critique a given WBS
    f. Explain the purpose of a WBS dictionary
3. Project Update Management
    a. Approvals required
    b. Forms needed
    c. Turnaround times
    d. Document routing
    e. Communication flow
4. Project Scheduling
    a. Listing and sequencing project tasks according to job requirements
    b. Estimation of task duration
    c. Schedule to milestones
    d. Analyze Gantt chart
    e. Identify dependency types
    f. Determine the critical path of a project schedule
    g. Establish schedule baselines

5. Tool Selection for Appropriate Deliverable Handling
    a. Tools: - PERT, Gantt
    b. Methods, CPM
    c. Result Interpretation
    d. Tools: GERT
    e. Methods - Network diagram (ADM, PDM, CDM, CCM)
6. Project Management Software (Lab component)
    a. Inserting new and recurring tasks
    b. Deleting, moving tasks
    c. Sub-tasks (Indent and Outdent)
    d. Viewing the Gantt chart & PERT chart (identifying the critical path, milestones)
    e. Reports – task usage, costs, over allocated staff, completed tasks
    f. Resource levelling
    g. Updating tasks
    h. Change non-working time (e.g. public holidays)
7. Internal / External Communication:
    a. Frequency
    b. Format (formal, informal, written and verbal)
    c. Method of distribution
    d. Distribution list
8. Risk Management Plan:
    a. Initial risk assessment
    b. Risk matrix
    c. Risk register
    d. Risk response strategies
    e. Stakeholder risk tolerance
9. Roles and Resource Requirements:
    a. Identify existing resource availability
    b. Identify training needs / outsourcing requirements
    c. Assign resources to scheduled tasks
10. Quality Management Plan:
    a. Quality metrics, control limits, and frequency of measurement
    b. Quality assurance processes
    c. Quality control processes
    d. Quality baseline
11. Cost Management Plan:
    a. Control limits
    b. Assign costs
    c. Chart of accounts
    d. Project budget

e. Cost estimates (bottom up, top down, parametric, expert judgment, analogous)
f. Cost baseline

12. Procurement Process:
    a. Project needs assessment / gap analysis
    b. Make or buy decision
    c. RFI, RFQ, RFP (Request for: Information, Quote, Proposal)
    d. Request seller response
    e. Evaluate seller response
    f. Vendor selection
    g. Contract development
13. Transition plan:
    a. Ownership
    b. Transition dates
    c. Training
    d. Extended support
    e. Warranties

UNIT III - LEAD PROJECT MANAGEMENT TEAM 9 HOURS

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. evaluate different leadership styles.
2. evaluate the impact of the different leadership styles.
3. demonstrate the characteristics of effective project leader.
4. differentiate between leadership and motivation.
5. select the most appropriate leadership style given particular scenario.
6. select the most appropriate method to motivate the project team given a particular scenario.
7. coordinate human resources to maximize project performance.
8. explain the importance of a project kick-off meeting.
9. conduct the project kick-off meeting.
10. explain the purpose and influence of organizational governance on a project's execution.
11. select components of a project plan affected by governance and determine actions to be taken.
12. explain the different types of projects organizational structures.
13. select the most appropriate way to manage a project given an organizational structure.

Content:

To include but not limited to:

1. Leadership and Motivation
    a. Definition of leadership.
    b. Leadership styles: Task oriented, Participative, Autocratic, Reward based, Laissez faire, Situational.
    c. Definition of motivation.
    d. Motivation Theories: Maslow's hierarchy, David C McClelland's motivational needs theory, Frederick Herzberg's Motivation – Hygiene (Two Factor) Theories
    e. Coordinating Human Resources.
    f. Assemble and develop project team, build team cohesiveness, perform individual performance appraisals.
    g. Identify common causes of conflict: Competing resource demands, Expert judgment, Varying work styles.
    h. Detect conflict and apply conflict resolution techniques: Smoothing, Forcing, Compromise, Confronting, Avoiding, Negotiating.
2. Project Kick-off Meeting:
    a. Communicates stakeholder expectations, high level timeline, project goals and objectives, roles, and responsibilities to the project team.
3. Organizational Governance:
    a. Standards compliance: Local, state, federal, ISO
    b. Internal process compliance: Audit trails, retention, version control
    c. Decision oversight: Change Control Board, committee consulting
    d. Phase gate approval: Tollgate approval, project phase transition
4. Components of Project Plan Affected and Actions:
    a. Actions: Schedule meetings, manage scope, Follow communications plan, Manage project quality, Manage risks, Issue management, Prepare performance
    b. reports, receive work performance information, manage costs within budget, Implement approved changes
    c. Components: Risk register, Communications plan, Issues log, Change management form, Quality management metrics, Project schedule, WBS, Budget, Resource requirements, Scope statement
5. Types of Organizational Structures:
    a. Functional
    b. Weak matrix
    c. Matrix
    d. Strong matrix
    e. Project Based

UNIT IV - MANAGE PROJECTS (9 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain project management procedures.
2. follow project management procedures in execution of projects.
3. manage projects according to project plan, scope and time lines.
4. implement change management procedures given a scenario.
5. evaluate the impact of potential changes to triple constraint.
6. use risk management plan to determine appropriate response to potential risks or opportunity events.
7. execute appropriate resource levelling techniques.
8. apply the appropriate steps to ensure quality of project deliverables.
9. identify tools to use when a project deliverable is out of specifications.
10. calculate and interpret the results of Earned Value Measurements (EVM).
11. manage and implement information distribution based on communication plans.
12. address the special communication needs internal and/or external project team members.

Content:

To include but not limited to:

1. Project Management Procedures:
    a. Identify change
    b. Document using the appropriate change control forms
    c. Perform impact analysis
    d. Coordinate with the appropriate stakeholders to select the course of action
    e. Update the appropriate project plan components based on the approved change request
2. Triple Constraint:
    a. Time / Schedule
    b. Cost / resources
    c. Quality
    d. Scope

3. Risk Management Plan
    a. Perform qualitative and quantitative risk analysis
    b. Opportunities: Sharing, Exploiting, Enhancing
    c. Threats: Avoidance, Acceptance, Mitigation
    d. Update risk register with appropriate changes
4. Resource Levelling Techniques:
    a. Fast tracking
    b. Crashing
    c. Delaying
    d. Optimizing: Use of tools as necessary
5. Ensuring Quality of Project Deliverables:
    a. Monitor work performance
    b. Analyze performance information
    c. Identify variances
    d. Generate change requests
    e. Implement change requests
6. Tools to use when a project deliverable is out of specification:
    a. Pareto charts
    b. Histograms
    c. Run charts
    d. Ishikawa diagram
7. Earned Value Measurement (EVM):
    a. EV
    b. PV
    c. CPI
    d. SPI
    e. EAC
    f. ETC
    g. VAC
    h. BAC
8. Information Distribution based on Communications plan:
    a. Manage stakeholders' expectations
    b. Schedule effective project meetings
    c. Periodic stakeholders' updates
9. Special Communication Needs:
    a. Time zones
    b. Language barriers
    c. Technology barriers
    d. Cultural differences
    e. Communication preferences

f. Functional or hierarchical barrier

UNIT V - CLOSE OUT PROJECT (5 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. differentiate the types of closure of Projects.
2. explain the importance of and benefits of formal project closure.
3. determine circumstances in which project closure may occur.
4. implement the various closing tasks.
5. identify the components and purpose of closing documentation.
6. prepare closing documents.
7. close out projects following approved procedures.

Content:

To include but not limited to:

1. Types of closure:
    a. Definition of closure/termination
    b. Termination by extinction
    c. Termination by addition
    d. Termination by integration
    e. Termination by starvation
2. Formal Project Closure:
    a. Importance and benefits
3. Phase Closure:
    a. Phase closure
    b. Project completion
    c. Stage completion
    d. Component completion
    e. Project cancellation – change in environment, lack of funds, better alternatives
4. Closing Tasks:
    a. Ensure that tasks have been completed
    b. Confirm and document objectives that were completed/not completed
    c. Meet with stakeholders to get their final approval
    d. Finalize contractual commitments - to vendors, suppliers etc.
    e. Transfer responsibilities (e.g. maintenance tasks)

f. Reassign people
g. Conduct performance appraisals
h. Release and reassign resources
i. Ascertain any product support requirements
j. Complete final accounting
k. Provide historical information for future use
l. Standards compliance: Document retention compliance
m. Document the results
n. Have a formal meeting to acknowledge completion.
o. Review the results – what went right/wrong

5. Closing Documentations:
    a. Lessons learned: Strengths / weaknesses
    b. Close report: Historical data, Summary of costs
    c. Post-mortem analysis: Documents reasons for early closure and impact
    d. Final individual performance appraisals
    e. Transition plan

UNIT VI – EVALUATE PROJECT MANAGEMENT TOOL/METHODOLOGIES (3 HOURS)

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. use the features of the latest tools used in project management.
2. explain the latest methodologies used in project management.
3. follow up and analyse trends and development.

Content:

To include but not limited to:

1. Project management tools:
    a. Charting tools
    b. Collaboration tools
    c. Cloud based tools
2. Project management methodologies:
    a. Agile project management
    b. Remote team management

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ASSESSMENT PROCEDURES

Students will take responsibility for their own academic achievement. Students will demonstrate their commitment to their own goal of educational advancement by attending classes, completing assigned work, and complying with existing copyright legislations. To successfully complete this course, a student must pass **ALL** the different components of the course.

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1	**I, II, III**	Oral Assignment	20%
2	**IV, V**	Written Assignment	20%
3	**VI, VII, VIII**	Group Project	40%
4	**IX, X**	Written	20%
Total			**100%**

FEEDBACK

Feedback will be in accordance with institutional policies.

INSTRUCTIONAL METHODS

This course will be taught using a combination of formal lectures, discussions, role plays project and presentations.

CAPSTONE EXPERIENCE DESCRIPTION

Students will be given assignment using project management software and tools to plan, implement, and monitor projects.

RESOURCES

Lecturer, Resource persons, models, Project Management Software and tools, materials, tools and equipment.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	MAJOR CAPSTONE PROJECT
COURSE CODE:	REMC1100
CREDITS:	1
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	ALL COURSES COMPLETED
CO-REQUISITE(S):	None
SEMESTER:	IV

CAPSTONE EXPERIENCE DESCRIPTION:

This major capstone experience is intended to give students the opportunity to integrate the total body of learning experiences gained throughout the program duration. Students will be required to use knowledge, skills and aptitude acquired to design, develop, and prepare implementation strategies for the project assignments indicated here under.
The student will select one of following project assignment they will:
Assignment 1. Identify and select an organization in which they will plan, organize and energy audit.

Scope of assignment activities:

1. Develop formal relationship with an organization and obtain permission to conduct an energy audit of their organization.
2. Develop audit scope and plan.
3. Conduct research on the company (Ownership, staffing, systems, nature of business and so on).
4. Assemble and train audit team.
5. Appoint lead auditor.
6. Schedule audit activities.
7. Obtain companies approval of audit plans and schedules.
8. Assign audit responsibility team members.
9. Prepare audit documentation/materials.
10. Plan and schedule audit briefing meeting with host company representatives.

11. Conduct audits, collect audit data, analyse data, prepare findings.
12. Conduct de-briefing meeting with host company and communicate findings and recommendations.
13. Prepare and submit formal audit reports and recommendation to host company.
14. Develop follow-up monitoring plan for implementation.
15. Develop budget for audit activities.
16. Audit documentation and reports are prepare using standard English.

Assignment 2

Research different types of Renewable systems being implemented in Jamaica, select from amongst one of the following renewable energy sources, develop and design a renewable energy project for:

1. A commercial company
2. An industrial company
3. A residential property

The renewable energy from which a choice is to be made are:

1. Wind
2. Solar
3. Thermal
4. Biogas
5. Biofuel

Scope of assignment activities:

1. Justify reasons for the choice made in terms of the renewable energy and the types of facilities.
2. Indicate their knowledge of issues impacting on the environment and the ways in which renewable energy can provide solution to environmental imbalances.
3. Posit on the implication of renewable energy sources on the economy and social imperatives.
4. Prepare detail drawings and/or specification for project selected.
5. Develop resource plans.
6. Develop budgets associated with plans.
7. Prepare project management strategic plans.
8. Develop project schedules for implementation.
9. Present research data on project activities selected for development.
10. Prepare reports using standard English.

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ASSESSMENT PROCEDURES

Students are required to select an assignment. Prepare a proposal for execution of the assignment selected and discuss with lecturer or advisor. The assessment factors for consideration are:

1. Use of group activities where applicable.
2. Planning an organization of assignment activities
3. Use of supporting research available on the particular subject matter
4. Technical content, completeness, logics and factual data
5. Form of documentation, writing styles and use of grammar
6. Use of drawings and other specifications

The institutions assessment policies and procedures in regard to research and or thesis and any other related assessment requirement will be re-enforced.

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	ACQUIRING PROFESSIONAL AND INDUSTRY
COURSE CODE:	REPI2213
CREDITS:	1
CONTACT HOURS:	45 HOURS
PRE-REQUISITE(S):	COMPLETION OF YEAR TWO COURSES
CO-REQUISITE(S):	None
SEMESTER:	IV

PROGRAMME DESCRIPTION:

This Professional Recognitions Development Programme is designed to provide the students with the opportunity to pursue professional and industrial recognitions' programmes which will lead them acquiring professional and or industry certification, licenses' or licensure. These types of recognitions will in addition, to their educational and or training institutional certification gives them a high level of employment standing and competitiveness in their sector of employment and career paths.

The student should be assigned a workplace mentor and or programme advisor who will facilitate and guide the student's goal achievements towards professional recognitions. The students should be encouraged to commence these pursuits before the completion of their course of study.

PROGRAMME OBJECTIVES COMPETENCY OUTCOME

The recognitions programme is integral to the implementation of the delivery of the Fitness Management Programme. Institutions are encouraged to use creative strategies in administering its implementation. There are varieties of teaching and learning modalities that may be used in attaining the programme's objectives.

The programme objectives are:

1. Expose students to the need for accuracy professional and/or industry recognitions.

2. Enhance students understanding of the social-economic and cultural impacts of Professional and Industrial Recognitions.
3. Develop in students' professional ethics, business protocols, good personality traits, habits and professionalism.
4. Pursue Professional Recognitions as part of their life-long learning strategies.
5. Use Professional Recognitions to continuously improve work processes, productivity, and value creation.
6. Use Professional Recognitions for competitive advantages in the workplace.
7. Comply with legislations, regulations and related conventions governing occupational professional practices.
8. Recognize the aims of Professional Recognitions on the public's health, safety and security.
9. Recognize the intent of Professional Recognitions to enhance compliance with requirements of the Fair-Trading Act, Consumer Protection Act, and the provision of Quality Customer Services.
10. Recognize the becoming involved in Voluntarism.

LEARNING OUTCOMES AND INSTRUCTIONAL OBJECTIVES:

Upon completion of this attachment programme students will be able to relate to concepts, theories and techniques, which are studied, to develop and practice a range of technical competencies, personal competencies and social competencies; help students to identify and develop career paths with in their industry. It will also encourage students to develop important employability skills make contacts with potential employers and to construct work experience profiles commensurate with the demands of future employers and or explore entrepreneurial opportunities.

Upon successful completion of this attachment programme, students are competent when they are able to:

1. practice theoretical principles.
2. follow work instructions.
3. adhere to organizations policies.
4. comply with relevant legislation, regulations, and codes of practice.
2. comply with safety requirements.
3. acquire/develop competencies in their occupational area.
4. apply procedures for work processes.
5. analyze work plans and implement as instructed.
6. manage area of specialization.
7. plan, organize and implement tasks/assignments according to given instructions and or procedures.

8. work effectively as part of a team:
    a. Practice employability skills on the job.
    b. Be productive, efficient, effective, cost controlled and quality focused
    c. Provide excellent customer service
    d. Adhere to Dress Codes and Interpersonal Relations Standards
    e. Conduct research industry trends, document lessons learned, prepare career development plan, prepare, and submit report

UNIT I - VALUE THE ROLE OF REGULATORS AND PROFESSIONAL ORGANZIATIONS IN PROFESSIONAL/INDUSRTIAL RECOGNITIONS

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. analyze the role of professional organizations and regulations in professional and industrial recognitions.
2. determine the impact of professional/ industrial recognitions on socio-economic and cultural variables.
3. recognize the value of regulations in achieving societal and/or commercial objectives.
4. recognize the function of various organizations involved in Health and Wellness.
5. recognize the functions of various government agencies responsibility for Health and Wellness.
6. analyze the potential impact of Professional and Industry Certification.

Content:

To include but not limited to:

1. Legislations, regulation and policies relating to Renewable Energy Sector and other related Sectors and encompassing:
    a. Management System Certification ISO 5001:20011
    b. Health and Wellness Policies
    c. Ministry of Health
    d. Ministry of Education
    e. Licensing Requirements for Fitness Professionals
2. Local, Regional and Internationally Fitness/Wellness Organizations
3. Local, Regional and International Professional Certification
4. Local, Regional and International Fitness Competitions
5. Jamaica Body Builders Association

UNIT II - ACQUIRE PROFESSIONAL RECOGNITION FOR INDUSTRIAL PRACTICE

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the importance of having professional recognition for industry practice.
2. identify and differentiate types of professional/ industry recognitions.
3. seek and determine requirements for professional/industry recognitions.
4. enroll in training programmes for professional/industry recognitions.
5. access and complete programs of study for professional/ industry recognitions.
6. apply to appropriate awarding bodies for registration and professional/industry recognitions.
7. adhere to professional ethics code of preface and quality of service requirements of the recognition.
8. adhere to recertification requirements.

Content:

To include but not limited to:

1. Types of recognitions:
    a. Licensing
    b. Permits
    c. Licensure ship
    d. Industry awards
    e. ISO certification
    f. Other international recognitions/awards
    g. Other local recognitions/awards
2. Recognition Awarding Bodies:

a. South West University	Fitness Certification Certified Fitness Instructor
b. University of Texas at Austin	Leadership in Sport, Fitness and Wellness
c. University of Florida	Certification in Fitness Management
d. CompTIA	Project Management
e. CEFF for	Entrepreneurship

UNIT III - ACQUIRE TRAINING AND OR RECOGNITION IN APPLY FIRST AID

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. explain the importance of applying first aid.
2. adhere to the principle of first aid when addressing issues requiring first aid.
3. acquire first aid training and certification.
4. follow procedures in applying first aid techniques.
5. evaluate situation above own competence level and seek appropriate assistance and seek appropriate assistance.
6. contact relevant to authorities in event of serious emergencies.
7. report and/or document incidents/accidents and actions taken.
8. follow up with persons who have had first aid treatment and/or resolution to their problems.

Content:

To include but not limited to:

1. Basic first aid procedure
2. Sources of assistance
3. Company nurse/doctor
4. Employees with first aid training/certification
5. Emergency Agencies:
    a. Fire brigade
    b. Police
    c. Ambulance/ Paramedics
    d. First Aid procedures
6. Red Cross of Jamaica Training and Certification Programmes: CPR/First Aid Certification

UNIT IV - PARTICIPATE IN ACTIVITIES OF PROFESSIONAL ORGANIZATION

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. conduct research on professional organization of interest.
2. interview person having connections with the particular organization.
3. analyze data/information obtained on organization of interest.
4. evaluate the compatibility level of own professional goals with that of the organization.
5. collect information on procedures for membership in the organization.
6. apply for membership in organization of interest.
7. participate and contribute to the activities of the organization of interest.
8. take opportunities to exchange learning with other members.
9. take actions to grow and develop professional internally and externally to the organization.
10. transfer knowledge gained from association with the organization to the workplace and other colleagues.

Content

To include but not limited to:

1. Research on organization:
    a. Vision. Mission and Goals
    b. Membership categories (Full, Associate, Affiliate, Students)
    c. Professional Development Programmes
    d. Fee Structure
    e. Application Procedures
    f. Programme of Activities
    g. Organization Structure
2. Transfer of Learning
3. Life Long Learning Opportunities
4. Compatibility Evaluation

UNIT V - BUILD PROFESSIONAL RECOGNITION THROUGH VOLUNTARISM

Learner Outcomes:

Upon completion of this unit, students are competent when they are able to:

1. investigate the role of voluntarism in developing communities.
2. explore the roles of voluntarism building and developing competencies.
3. investigate voluntarism as a vehicle for transfer of leering and life category.
4. use voluntarism to develop appropriate values and attributes.
5. interview person who has been awarded natural honors for voluntarism and public service.
6. identify and acquire critical knowledge, skills, and attributes through voluntarism.
7. use voluntarism to seek motivation and inspiration of others.
8. prepare and present report on voluntary project/activities.

Content:

To include but not limited to:

1. Role of voluntarism
    a. Building
    b. Building personal, social and technical competencies
2. Interview National Awardees
3. Acquire knowledge skills and attributes
    a. socio-cultural skills
    b. leadership skills
    c. economic skills
    d. Organizational Skills
    e. Negotiation Skills
    f. Mediation skills
    g. Historical knowledge
    h. Counseling skills
    i. Social justice
4. Motivational and Inspirational Group
    a. Youths
    b. Young adults
    c. Adults
5. Development Nature of Voluntarism
6. Benefits of Voluntarism
7. Values and Attitudes

8. Love of Country
9. Self-Empowerment
10. Gleaner Annual National Award for Voluntarism

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On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1		Student Daily Logs	10%
2		Appraisal by employer and tutor	20%
3		Written report on experience	100%
4		Hands-on Experience	60%
Total			**100%**

THE COUNCIL OF COMMUNITY COLLEGES OF JAMAICA

COURSE NAME:	INTERNSHIP/EXTERNSHIP (WORKPLACE ATTACHMENT)
COURSE CODE:	REIE1100
CREDITS:	1
CONTACT HOURS:	**2**40 HOURS
PRE-REQUISITE(S):	COMPLETION OF YEAR ONE COURSES
CO-REQUISITE(S):	None
SEMESTER:	I

COURSE DESCRIPTION:

This Externship/Workplace Attachment Programme is designed to provide the students with industrial /business placement commensurate with their chosen career. The placement is 240 hours in duration and is intended to give students on-the-job experience appropriate to their occupational area(s) of study. During this period the students are to receive at least one visit from the Tutor and or the Programme Coordinator/Advisor. The student should be assigned a workplace mentor who will facilitate the student's integration into and work experiences in the organization.

LEARNING OUTCOMES AND INSTRUCTIONAL OBJECTIVES

Upon completion of this attachment programme students will be able to relate to concepts, theories and techniques, which are studied, to develop and practice a range of technical competencies, personal competencies and social competencies; help students to identify and develop career paths within their industry. It will also encourage students to develop important employability skills make contacts with potential employers and to construct work experience profiles commensurate with the demands of future employers and or explore entrepreneurial opportunities.

Upon successful completion of this attachment programme, students are competent when they are able to:

1. practice theoretical principles.
2. follow work instructions.

3. adhere to organizations policies.
4. comply with relevant legislations, regulations, and codes of practices.
5. comply with safety requirements.
6. acquire/develop competencies in their occupational area.
7. apply procedures for work processes.
8. analyse work plans and implement as instructed.
9. manage area of specialization.
10. plan, organize and implement tasks/assignments according to given instructions and or procedures.
11. work effectively as part of a team.
12. practice employability skills on the job.
13. be productive, efficient, effective, cost controlled and quality focused.
14. provide excellent customer service.
15. adhere to Dress Codes and Interpersonal Relations Standards.
16. conduct research industry trends, document lessons learned, prepare career development plan, prepare and submit report.

ASSESSMENT

On-going Assessment Requirements			
No.	**Suggested Unit/Unit Cluster**	**Assessment Strategy**	**Weight**
1		Student Daily Logs	10%
2		Appraisal by employer and tutor	20%
3		Written report on experience	100%
4		Hands-on Experience	60%
Total			**100%**

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