Associate Degree Program

Specialization	**Renewable Energy Engineering**
Course Number	020300111
Course Title	Electrical circuits
Credit Hours	3
Theoretical Hours	3
Practical Hours	0

Short Description:

Circuits and circuit elements. DC and AC current. Circuit variables: Voltage, Current, Energy,

Power factor, Power, Active power, Reactive power, Apparent power. Connection of circuit elements: series, parallel and compound connections. Energy sources. Basic calculations: Equivalent resistance, impedance, current, voltage, power and energy calculations.KVL, KCL, Superposition principle. Resonance. Measurements of circuit variables.

Course Objectives:

1. Define and study current and voltage sources.
2. Use Ohm and kirchoff's laws for analyzing DC electrical circuits.
3. Study the elements of AC circuits.
4. Study the RLC in AC circuits.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Voltage, Current, and Resistance	Atomic Structure, Electrical Charge, Voltage, Current, andResistance, Voltage and Current Sources, Resistors, The Electric Circuit, DC Circuit Measurements	6
2	Ohm's Law, Energy and Power	The Relationship of Current,Voltage, and Resistance, calculation of Current, Voltage and Resistance, Power and Energy, Power in an Electric Circuit, Energy Conversion and Voltage	6

No.	Unit Title	Unit Content	Hours
		Drop in Resistance, Power Supplies	
3	Series Circuits	Series Resistor connection, Current and voltage in a Series Circuit, equivalent Series Resistance, Application of Ohm's Law, Series connection of voltage Sources, Kirchhoff's Voltage Law, Voltage dividers, Power in Series Circuits.	3
4	Parallel Circuits	Parallel Resistor connection, Current and voltage in a Parallel Circuit, Kirchhoff's Current Law, equivalent Parallel Resistance, Application of Ohm's Law, Current Sources in Parallel, Current division, Power in Parallel Circuits.	3
5	compound Circuits	Series-ParallelResistor connection, current and voltage incompound connection. Voltage Dividers with ResistiveLoads, Wheatstone Bridge, Superposition Theorem	9
6	Introduction to Alternating Current and Voltage	The Sinusoidal Waveform, Sinusoidal Voltage Sources, Sinusoidal Voltage and Current Values, Angular Measurement of a SineWave, The Sine Wave Formula, Analysis of AC Circuits, Superimposed DC and ACVoltages, Non-sinusoidal waveforms, The Oscilloscope, Introduction to Phasors, complexnumbers, rectangular and polarforms of complex numbers, mathematical operations.Three-phase voltage and current, Δ and Y and □□connections, Line and phase voltages and currents, Power calculations in three-phasecircuits, Active, reactive and apparent power, AC circuit measurement	9

No.	Unit Title	Unit Content	Hours
7	Capacitors	The Basic Capacitor, Types of Capacitors, Series Capacitors, Parallel Capacitors, Capacitors in DC Circuits, Capacitors in AC Circuits	3
8	Inductors	The Basic Inductor, Types of Inductors, Series and Parallel Inductors, Inductors in DC Circuits, Inductors in AC Circuits	3
10	RLC Circuits and Resonance	RC Circuits, RL Circuits, RLC Circuits, Resonance circuit	6

Teaching Methods:

1. Lectures
2. Power point presentations
3. Discussion

Books and references:

1. Thomas L. Floyd " principles of electric circuits" ,Prentice Hall, 2014, ISBN-10: 0132383519

2. Robert L. Boylested "introductory circuit analysis" prentice-hall Inc 1997

3. Thomas L. Floyd " principles of electric circuits" charlese, Merrill publishing company,1981

4. Noel M. Morris and Frank W.Senior "electric circuits analysis" USA NY,1977

Associate Degree Program

Specialization	**Renewable Energy Engineering**
Course Number	020300112
Course Title	Electrical circuits lab
Credit Hours	1
Theoretical Hours	0
Practical Hours	3

Short Description:

DC and AC circuit construction and measurements. Resonance. Measuring devices

Course Objectives:

1. Measure voltages and currents to verify KVL and KCL. 2. Identify shorts and opens in a malfunctioning circuit, and define and verify theequivalent resistance of a given network 3. Measure the inductance of an inductor. 4. Measure the capacitance of a capacitor. 5. To be familiar with an AC oscilloscope measurement 6. Identify resonance circuit.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Resistor and color code	Resistor color code, Calculation and measurements of carbon resistors, tolerance and resistor range	6
2	Series DC circuits	Series resistors, equivalent resistance measurement, voltage and current measurement	6
3	Series and parallel DC circuits	parallel resistors, compound resistors, equivalent resistance measurement, voltage and current measurement	6
4	Superposition principles	Circuits with multiple voltage sources, source canceling, voltage and current measurements.	6
5	The Oscilloscope	Function generator and oscilloscope, frequency, time period, amplitude peak, peak-to-peak and RMS values	6
6	RLC components	Capacitor and inductor charging and discharging	6
7	Resonant circuits	RLC resonance frequency, voltage and current measurements in RLC circuits.	6

Teaching Methods:

1. Practical Applications in Lab

3. Discussion

Books and references:

1. Lab sheets.

1. Thomas L. Floyd "principles of electric circuits" ,Prentice Hall, 2014, ISBN-10: 0132383519

2. Robert L. Boylested "introductory circuit analysis" prentice-hall Inc 1997

3. Thomas L. Floyd "principles of electric circuits" charlese, Merrill publishing company,1981

4. Noel M. Morris and Frank W.Senior "electric circuits analysis" USA NY,1977. E John Finnemore and Joseph B Franzini, Fluid Mechanics With Engineering Applications,10th Edition.

Associate Degree Program

Specialization	**Renewable Energy Engineering**
Course Number	020400111
Course Title	Electronic circuits and devices
Credit Hours	3
Theoretical Hours	3
Practical Hours	0

Short Description:

Semiconductor devices. Diodes: classification, characteristics and applications. Transistors:Classification, characteristics and applications. Amplifiers. Oscillators. Logic gates and Integrated circuits: Basic functions, symbols and applications. Introduction to electronic measurements: Oscilloscope applications.

Course Objectives:

Upon the completion of the course, the student will be able to:

1. Explain the basic structure of atoms.
2. Define and discuss semiconductors, conductors, insulators.
3. Identify the bias and applications of diode, zener, varactor, and other special diodes.
4. Study of BJT & FET, oscillators,and other devices
5. To be familiar with number systems and its conversion.
6. To understand logic functions, gates, and Boolean algebra.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction to Semiconductors	Atomic structure, Semiconductors, Conductors, Insulators, Covalent bonds, Conduction in semiconductors, Intrinsic and extrinsic semiconductors, N-type and p- type semiconductors	6
2	The Diode	P-N junction, diode biasing, Voltage – current characteristic, DC load line, Operating point, DC and AC resistance, Comparison between silicon and germanium diodes, Data sheet of diode	9

No.	Unit Title	Unit Content	Hours
3	Special – Purpose Diode	Zener diode: symbol,structure, principle of operation. Zener diode applications: regular and limiter, Varactor diode. Light- emittingdiode (LED), photodiode	6
4	Diode Applications	Half – wave and full – wave rectifiers, Filters and regulators in power supply circuits.	3
5	Bipolar Junction Transistor (BJT)	Introduction, Structure and principle of Operation, Characteristics and parameters. Regions of operation, The DC operation point (load line), BJT as an amplifier and as switch, Voltage divider biasing and other biasing methods, common emitter, common collector and common base amplifiers, Data sheet of a BJT, junction field effect transistor (JFET). metal oxide semiconductor field effect transistor (MOSFET).	9
6	Oscillators	Introduction, Negative and positive feedback, (basic circuit, principle of operation, oscillation frequency. Phase – shift oscillator, Colpitts and Hartley oscillators	6
	Logic Gates	Introduction Decimal, binary, octal and hexadecimal numbers system, Number system conversion, Binary arithmetic, 1's and 2's complement of binary number, binary coded decimal (BCD), The inverter, AND gate, OR gate, NAND gate, NOR gate, Exclusive-OR and Exclusive-NOR gates, Application of logic gates Boolean operation and expressions, Laws and rule of Boolean algebra, De Morgan's theorem	6
7	Introduction to Electronic	Applications of oscilloscope in electronic measurements	3

No.	Unit Title	Unit Content	Hours
	Measurements		

Teaching Methods:

1. Lectures
2. Power point presentations
3. Discussion

Books and references:

1. Electronics fundamental and Experiments, Cynthia B. Leshin, David Buchla, TjomasL. Floyd, prentice hall international ,1999.

2. William Kleitz, "Digital Electronics a practical approach" third edition, prentice-Hall career &technology Englewood Clifts, NJ.,USA, 1993.

3. Tomas Floyd "Digital Fundamentals" sixth edition, Prentice-Hall, Inc.NJ.,USA,1997

Associate Degree Program

Specialization	**Renewable Energy Engineering**
Course Number	020400112
Course Title	Electronic circuits and devices lab
Credit Hours	1
Theoretical Hours	0
Practical Hours	3

Short Description:

Use of oscilloscope in measurements. Investigation of characteristics of semiconductor devices.

Construction and study of electronic circuits. Experiments in electronics have to cover the main electronic devices (diode, zener diode, diode applications, BJT, FET, op – amp, oscillator, SCR)

Course Objectives:

Upon the completion of the course, the student will be able to:

1. Become familiar with electronics devices and using data sheet.
2. Demonstrate how to test electronic devices by using AVO meter or through DCmeasurements.
3. Construct electronic circuit.
4. Investigate characteristics curves.
5. Calculate the value the values of currents and voltage and compare them withmeasured values

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	The diode	Forward and reverse biasing. Characteristic curve. Data sheet.	6
2	Zener Diode.	Breakdown voltage. Voltage Regulation. Characteristic curve. Data sheet	6

No.	Unit Title	Unit Content	Hours
3	Rectification Circuits	Half- wave and full- wave rectifiers. Ripple factor. Line and load regulation. Filtering and Regulation	6
4	BJT Transistors	BJT testing by using AVO meter, and how to determine the specifications of transistor through data sheets, BJT biasing	6
5	BJT applications	BJT as a switch Common emitter, common base and common collector amplifier	6
6	Operational Amplifier	Inverting and Noninverting Amplifier, Differentiator and Integrator	6
7	SCR and Oscillator	SCR as a switch, RC phase-shift Oscillator	6

Teaching Methods:

1. Practical Applications in Lab

3. Discussion

Books and references:

1. Instructional Lab. Sheets

2. Thomas L. Floyd – " Principles of electric circuits" Electron flow version – prenticehall International – eighth edition 2006.

3. Robert L. Boy listed – Introductory circuit analysis – prentice hall International 1997.

4. Experiments in electronics Fundamentals and electric circuits fundamentals – DavidBuchla –. prentice hall 2000.

Associate Degree Program

Specialization	**Renewable Energy Engineering**
Course Number	٠٢٠٢٠٠١١٥
Course Title	Fluids and Hydraulic Machines
Credit Hours	3
Theoretical Hours	3
Practical Hours	0

Short Description:

Fluid properties, fluid static's, fluid motion, continuity equation, momentum principle, energy principle, Fluid flow in pipes, pipe friction, introduction to Pumps, Types ,Selection and application of pumps.

Course Objectives:

1- Develop competence in use of conservation laws (mass, energy, momentum) for analysis, design, selection, and operation of flow measuring devices, of open and closed water and waste water conveyance systems, and of hydraulic machines (pumps, turbines). 2- Utilize methods for risk and reliability analysis along with engineering economics in selecting components and systems. 3- Strengthen understanding of phenomena (e.g., cavitation, pressure/flow relations, losses), devices, components and systems with laboratory experiments and field trips. 4- Improve communication skills through report writing. 5- Development of dimensionally consistent equations. Competence with both SI and British Gravitational system of units.

6- Development of mass, momentum, and energy balance.

7- Application of conservation equations for pipe flow, pumping, and simple open channel flow application

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction	Introduction Units of measurement Fluid physical properties, Density, specific weight, viscosity, surface tension, compressibility	
2	Hydrostatics	fluid pressure, Pascal's law, Pressure variation in static fluid, pressure head, Gage and absolute pressure Pressure measurements (barometer, Manometers, Piezometer, Bourdon tube Engineering applications of hydrostatics	
3	Equilibrium of Floating Bodies	Archimedes principle Met center and met centric height Condition of Equilibrium	

No.	Unit Title	Unit Content	Hours
		Oscillation f floating body	
4	Fluid Flow Concept	Types of flow, Laminar and turbulent flow, uniform flow, steady and unsteady flow, incompressible and Compressible flow Fluid energy: internal energy, Kinetic energy, potential energy, pressure energy Fluid motion equations: Continuity, equation of motion for steady flow, Bernoulli equation and its applications Flow measurement: Flow through Orifice, venture, flow over notches, Pitot tube, Rota meter, discharge coefficients	
5	Flow through pipes	Types of flow in pipes, Reynolds number, boundary layer and flow in pipe, loss head in pipes Darcy–Wies formula of head in pipe, relation between friction coefficient and Reynolds Friction loss in sudden contraction and expansion Friction loss in fittings and valves Velocity distributions in pipe flow, Positive displacement pumps, Gear and screw pumps, Centrifugal pumps. Pumps performance and characteristics curves Power and efficiency calculations	

No.	Unit Title	Unit Content	Hours
6	Pumps	Types of Pumps, Principle of operation Pump power and efficiency Net positive section head Reciprocating pumps: Construction, reducing flow fluctuations	
7	Compressors	Types of Air compressors Reciprocating compressors Centrifugal compressors	

Teaching Methods:

1. Lectures
2. Power point presentations
3. Discussion

Books and references:

1. Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines by R.S. Khurmi, Publisher: S Chand, New Delhi (May 1987), ISBN: 8121901626.

2. Franzini, Fluid Mechanics with Engineering Applications, 10th Edition, McGraw Hill, 2002.

3. Giles R V et al, "Schaum's Outline of Theory and Problems of Fluid Mechanics and Hydraulics", 3rd Edition, McGraw-Hill, 1994.

4. E John Finnemore and Joseph B Franzini, Fluid Mechanics With Engineering Applications, 10th Edition.

Associate Degree Program

Specialization	**Renewable Energy Engineering**

Course Number	٠٢٠٢٠٠١١6
Course Title	Fluids and Hydraulic machines Lab
Credit Hours	1
Theoretical Hours	0
Practical Hours	3

Short Description:

Measuring of physical properties of fluids, force on immersed plate, Jet force on plate,

Bernoullis equation, Reynolds experiments, flow through orifices, and nozzle venture friction

factor.

Course Objectives:

At the completion of this course, each student is expected to be able to: 1. Validate Bernoulli's equation. 2. Measure the fluid Density and viscosity. 3. Determine the Force of pressure on immersed plate. 4. Study the Energy loss and friction coefficient. 5. Perform Flow rate measurements (by orifice and venture). 6. Study the performance of Reciprocating, gear, and centrifugal pumps. 7. Connect pumps in series and parallel and investigate the performance of each configuration.

Detailed Description:

No.	Unit Content	Hours
1	Density and viscosity measurements	
2	Force of pressure on immersed plate	
3	Demonstrating of Bernoulli's equation	
4	Flow rate measurements (flow through 1 orifice and venture)	
5	Energy loss and friction coefficient 1 measurements	
6	Head loss in smooth and rough pipes	
7	Pipe flow, Reynolds number, laminar 1 and turbulent flow in pipes	
8	Flow over notches and Weirs	
9	Pump Testing in Series	
10	Reciprocating pump performance	
11	Gear pump efficiency	
12	Performance of Reciprocation air 1	

No.	Unit Content	Hours
	compressor	
13	Centrifugal Pump Testing	

Teaching Methods:

Laboratory

Specialization	**Renewable Energy Engineering**
Course Number	020200101
Course Title	Principles of Thermal Engineering
Credit Hours	3

Theoretical Hours	3
Practical Hours	0

Short Description:

Concepts and definitions, Properties of a pure substance, Work and heat, the first law of thermodynamics, the second law of thermodynamics, entropy, Principles of heat transfer, Steady state conduction, convection, Radiation, Heat exchangers.

Course Objectives:

1. To familiarize the student with basic concepts in thermodynamics and heat transfer and develop an intuitive grasp the subject matter
2. Develop an ability to apply these basic concepts to engineering design problems
3. To provide the student with necessary analytical skills to solve various engineering problems in the field of Thermal Science, such as Power Generation, Heating, and Air conditioning

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Concepts and definitions	Conceptsanddefinitions:System,controlvolume,properties,stateofsubstance,processes,cycles,specificvolume,pressure,temperaturescales,zerothlawofthermodynamics,units	
2	Properties of a pure substance	Propertiesofapuresubstance:vaporliquidsolidphaseequilibriuminapuresubstance,equationofstate,tablesofthermodynamicproperties.	
3	Work and heat	Workandheat:definitionandunitesofwork,workdoneatthemovingboundaryofasimplecompressiblesystem,definitionandunitesofheat,relationbetweenworkandheat.	

No.	Unit Title	Unit Content	Hours
4	The first law of thermodynamics	The first law of thermodynamics :Thefirstlawforthechangeinstateofasystem,internalenergy,enthalpy,constantvolumeandpressurespecificheats,internalenergyandenthalpyandconstantvolumeandpressurespecificheatsforidealgases,thefirstlawofthermodynamicsforacontrolvolume,thesteadystate,steadyflowprocess.	
5	The second law of thermodynamics	The second law of thermodynamics: the engines and refrigerators, reversible process, Carnot cycle, entropy, entropy change of an ideal gas, ploy tropic and adiabatic reversible process.	
6	Principles of heat transfer	Principles of heat transfer: conduction heat transfer, plane wall, plane wall in series and parallel, electro analog for conduction, contact resistance, thermal conductivity, convection heat transfer, radiation heat transfer, combined heat transfer mechanisms.	
7	Steady state conduction	Steady state conduction: steady one–dimensional conduction equation without generation in rectangular coordinates, cylindrical coordinates, steady one–dimensional conduction equation with generation, fins, types of fins, fin efficiency, transient conduction with negligible internal resistance.	
8	Radiation	Radiation: physics of radiation, black body, planks law, Stefan Boltzmann law, radiation properties, kirchoff's law, gray body, shape factor, radiative exchange between black surfaces.	

No.	Unit Title	Unit Content	Hours
9	Heat exchangers	Heat exchangers: types, overall heat transfer coefficient, the log mean temperature difference, heat exchanger effectiveness.	

Teaching Methods:

1. Lectures
2. Power point presentations
3. Discussion

Books and references:

1. Y.A.Cengel,IntroductiontoThermodynamicsandHeatTransfer,Irwin/McGraw2Hill, 1997.
2. Fundamentals of Engineering Thermodynamics,M.J.Moran,H.N.Shapiro5thEd,JohnWiley&Sons,Inc.,2004,ISBN:0247122747122.
3. J.B.JonesandG.A.Hawkins,EngineeringThermodynamics,SecondEdition,JohnWiley& Sons,1986

Course Book:

أساسيات الديناميكا الحرارية الكلاسيكية، الطبعة الثانية ، وايلن وسونتاج، مركز الكتب الأردني

Associate Degree Program

Specialization	**Renewable Energy Engineering**
Course Number	020200102
Course Title	Principles of Thermal Engineering Lab.
Credit Hours	1

Theoretical Hours	0
Practical Hours	3

Short Description:

- Pressure–Temperature relation in the saturation region ;Compressor cycles and analyses ; Heat pump performance ; Conduction heat transfer ;Radiation heat transfer ; and Heat exchanger performance

Course Objectives:

At the completion of this course, each student is expected to be able to:

1. To study the relation between the Saturation Pressure- Saturation Temperature relation
2. To investigate the main factors affecting the heat pump performance
3. To study the performance of reciprocating air compressor

Detailed Description:

No.	Unit Content	weeks
1	Saturation Pressure . Saturation Temperature relation	1
2	Heat losses in Heat pump condenser Energy balance of Heat pump	1
3	Coefficient of performance of heat pump Air compressor polytropic work	2
4	Isothermal efficiency of reciprocating air compressor Volumetric	2

No.	Unit Content	weeks
	efficiency of reciprocating air compressor longitudinal Condition in simple bar	
5	Radial Condition in simple bar Conduction in composite bar	2
6	Effect of insulation on conduction heat transfer	2
7	Forced convection heat transfer	2
8	Performance of parallel and counter flow heat exchangers performance of cross flow heat exchangers	2

Teaching Methods:

Laboratory

Books and references: lab Sheets.

Associate Degree Program

Specialization	**Renewable Energy Engineering**
Course Number	٠٢٠٢٠٥٢٦١
Course Title	Instrumentation and control systems
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

Measurement and Pneumatics control, Temperature measurement and control devices, Electrical control devices, Domestic Air conditioner control circuit, Air conditioning and heating control system, Temperature control system, Heating system control system,

Course Objectives:

Upon successful completion of this course, the student should be able to:

1. Understand the basic concepts and components of control loop
2. Draw the block diagram of control system
3. Explain the method of temperature, pressure, flow rate, level and humidity measurements and control
4. Discuss the difference between the various types of control system
5. Understand the function of overload, relays and defrost timer

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Measurement and Pneumatics control	Testing of Measuring and Pneumatic control devices (Pressure measurements and regulators, Pneumatic relays	
2	Temperature measurement and control devices	Operation and Testing of Temperature measurement and control devices such as different types of thermostat, Different temperature measurement devices	
3	Electrical control devices	Operation and testing of Electrical control devices: electronic controller, amplifiers, electrical motors, automatic cutouts, relays, Fuses, magnetics witches	
4	Domestic Air conditioner control circuit	Control loop elements, Control loop construction Defects diagnostic in the control loop: short circuit, winding cutout, relays contact melting	

No.	Unit Title	Unit Content	Hours
5	Heating system control system	Control loop elements, Control loop construction Defects diagnostic in the control loop	
6	Temperature control system	Control loop elements, Control loop construction, Open and closed loop control systems, Defects diagnostic in the control loop	
7	Air conditioning and heating control system	Control loop elements, Switching between heating and Air conditioning, Manual control, Different types of automatic control systems.	

Teaching Methods:

1. Lectures
2. Power point presentations
3. Discussion

Books and references:

1. John I. Levenhagen, HVAC Control System Design Diagrams, ISBN0207023812921.
2. Christopher Under wood, C.P. Underwood, HVAC Control Systems: Modelling, Analysis, and Design, ISBN0241922098028.

3. John I.L evenhagen, Donald H. and Spethmann, HVAC Controls and Systems, 1st Edition, McGraw2 Hill1993, ISBN0070375097.
4. S. Don Swenson, HVAC Controls and Control Systems, Prentice Hall, 1994, ISBN21020130453609

Associate Degree Program

Specialization	**Renewable Energy Engineering**
Course Number	٠٢٠٢٠٥٢٦٢
Course Title	Instrumentation and control systems Lab.
Credit Hours	1
Theoretical Hours	0
Practical Hours	3

Short Description:

Measuring and control elements, Temperature, pressure, flow rate and humidity measurement and control, Control system of cooling, heating and A/C processes ,Adjustment. Monitoring & troubleshooting

Course Objectives:

Upon successful completion of this course, the student should be able to:

1. Conduct temperature, pressure, humidity and Air-Fuel ratio measurements and control
2. Test pressure regulator and Thermostat
3. Installation and using of overload, relays and defrost timer
4. Test the Solenoid Valve
5. Differentiate between different type of directional valves used in pneumatic control systems

Detailed Description:

No.	Unit Content	Hours
1	Pressure measurements	
2	Pressure regulators	
3	Temperature measurements Thermostat	
4	Flow rate measurement and control humidity measurement and control	
5	Electricalcontrollingelements(Relay,overload,contractor)ExpansionDevice	
6	Temperature and pressure controllers	
7	Three way controllers	
8	Air ventilation and air conditioning control system	
9	Solenoid Valve Controller	

Teaching Methods:

Laboratory

Books and references: lab Sheets

Associate Degree Program

Specialization	Renewable Energy Engineering
Course Number	٠٢٠٢٠٥٢٥١
Course Title	Bio energy
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

This course present a knowlgment of the basic of bioenergy, where the bioenergy is a form of renewable energy derived from biomass to generate biofuel, heat and electricity.

Course Objectives:

- 1: Identify bio energy sources and the students should be able to know how to classified these sources upon the their energy.
- 2: Students should be understood stages of biomass treatment and biofuel production
- 3: knowing the conversion process to convert biomass and waste to biofuel.
- 4: identify the biofuel types and the main sources for each specific type

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction to energy and bioenrgy	Identify the main sources of traditional energy, bioenergy concept	3
2	Bioenergy sources	Organic material energy, solar energy and crops field	3
3	Biomass to biofuels	Wood energy, waste energy and microalgae energy	3
4	Improving biomass energy	Food security, biomass treatment, increasing crops field to increase biofuel	6
5	Waste to energy	MW, OFMW, sewage sludge characteristics. Implementation of waste to produce biofuel, Evaluate the energy of substances through appling different method	9
6	Main conversion process	Thermal process, gasification, pyrolysis and anaerobic digestion process	12

Teaching Methods:

Books and references:

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Associate Degree Program

Specialization	Renewable Energy Engineering
Course Number	٠٢٠٢٠٥١٢١
Course Title	Thermal Solar Energy
Credit Hours	3
Theoretical Hours	3
Practical Hours	0

Short Description:

Basics of thermal solar radiation, available solar energy, thermal solar heating/cooling deign and control, passive and active solar systems, solar ventilation, solar water heating systems, solar collectors, concentrated solar collector, solar pumps.

Course Objectives:

This course aims to introduce students to the basics and concepts of thermal solar energy and its various applications in water heating, heating, cooling, and ventilation of buildings.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	The basics of solar thermal radiation	Solar thermal radiation	
2	Thermal solar water heating systems	-Passive solar water heating. -Active solar water heating	
3	Thermal solar heating systems	-Passive thermal solar heating systems. -Active thermal solar heating systems	
4	Thermal solar cooling systems	-Passive thermal solar cooling systems. -Active thermal solar cooling systems	
5	Solar thermal power plants	Components, work principles, types.	
6	Solar pumps and solar energy control devices	-Solar pumping and solar pumps. -Solar control devices	

Teaching methods:

- ✓ *Lectures: Three hours-lectures- per week will be given to students.*
- ✓ *Demonstration*

- ✓ *Tutorials*
- ✓ *Case Study: Some practical case studies will be given during the course.*

Learning Out comes:

1. *Knowledge and understanding: This could be tested throughout exams and discussion in the class.*
2. *Intellectual skills: During the course many oral quizzes and discussions may take place.*
3. *Subject specific skills: Every topic in this course is a specific skill in analyzing solar engineering system.*
4. *Transferable skills: This includes instructors teaching, working and research experiences.*

Books and references:

Textbook: Soteris Kalogirou, **"Solar Energy Engineering: Processes and Systems"**, 1st edition, 2009.

References:

1. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", Wiley-Interscience; 2nd edition.
2. Frank Kerth, Jan F. Kreider ,**"Principles of Solar Engineering"**, 1978.
3. مبادىء الطاقة الشمسية و تطبيقاتها" ، د. سهيل فاضل و د. الياس الكبه. "
4. مقدمة في الطاقة الشمسية" ، سول وايدر "

Associate Degree Program

Specialization	Renewable Energy Engineering
Course Number	٠٢٠٢٠٥١٢٢
Course Title	Thermal Solar Energy Workshop
Credit Hours	
Theoretical Hours	
Practical Hours	

Short Description:

The sun's rays and thermal devices, conversion of radiant energy, measurement of solar radiation. Solar collectors, the efficiency of solar collectors. Effect of shading, temperature, and the dust on the performance of solar thermal collectors. The sun's rays and optical devices, conversion of radiant energy.

Course Objectives:

This course aims to introduce students to the basics and concepts of thermal solar energy devices, installations, and its various applications.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Trainning on health and safety workshop tools		
2	Training on solar measurements tool***s***		
3	Solar collectors	Breif description to solar collectors -types, installations.	
4	Connection of solar collectors	-Parallel connection -Series connection	
5	Water solar heating system installation	- open cycle system - closed cycle system	
6	Evacuated tube solar collector installation an inspection		
7	Integrated solar collector installation an inspection		

Teaching methods:

- ✓ *Lectures: Three hours-training workshop- per week will be given to students.*
- ✓ *Demonstration*
- ✓ *Tutorials*
- ✓ *Case Study: Some practical case studies will be given during the course.*

Learning Out comes:

5. *Knowledge and understanding: This could be tested throughout exams and discussion in workshop.*

6. *Intellectual skills: During the workshop course many oral quizzes and discussions may take place.*
7. *Subject specific skills: Every topic in this course is a specific skill in analyzing solar engineering system.*
8. *Transferable skills: This includes instructors teaching, working and research experiences.*

Books and references:

Textbook: Soteris Kalogirou, **"Solar Energy Engineering: Processes and Systems"**, 1st edition, 2009.

References:

5. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", Wiley-Interscience; 2nd edition.
6. Frank Kerth, Jan F. Kreider **,"Principles of Solar Engineering"**, 1978.
7. مبادىء الطاقة الشمسية و تطبيقاتها" ، د. سهيل فاضل و د. الياس الكبه. "
8. مقدمة في الطاقة الشمسية" ، سول وايدر "

Associate Degree Program

Specialization	Renewable Energy Engineering
Course Number	٠٢٠٢٠٥٢٥٢
Course Title	Bio energy **and Geothermal Energy** LAB
Credit Hours	1
Theoretical Hours	0
Practical Hours	3

Short Description:

learning the ISO process of international sampling method, identify the pH value, fixed carbon, volatile sold and humidity of different material especially of organic substances.knowing pyrolysis process and applying it through TGA analyser, also studying the relationship between temperature and the heat rate. identify the C, H & N value through CHN analyiser and it energy through calorimeter.

Course Objectives:

- 1: learning how to make sampling according to ISO methods. Students should be able to know suitable method to sample of solid material, liquid and gas material.
- 2: Understanding and applied suitable process for main analysis such as PH value and how to calibrate Hanna meter.
- 3: knowing and identify by the students how to use TGA analyzer, in order to fined different essential value and how the pyrolysis process can be carried out through TGA. Also how to calculate energy and C, H and N through different methods

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	1	Applied and studing ISO sampling methods,	3
2	2	general analysis of the substances (eg:temperature, pH value, ...)	3
3	3	Thermogravimetric analysis (measuring the humidity ratio, Fixed carbon,..)	3
4	4	Thermogravimetric analysis (viscosityand volatile solid)	3
5	5	Evaluate the energy of substances through applingpyrolsis process by TGA (1)	3
6	6	Evaluate the energy of substances through applingpyrolsis process by TGA (2)	3
7	7	Calculate the value of carbon, hydrogen and nitrogen through CHN analysers(1)	3
8	8	Calculate the value of carbon, hydrogen and nitrogen through CHN analyser (2)	3
9	9	Measuring the values of HHV and LHV of different materiales	3
10	10	identify the component of the digester and the biogas production process	3
11	11	Project 1	9

Teaching Methods:

Books and references:

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Associate Degree Program

Specialization	Renewable Energy Engineering
Course Number	٠٢٠٢٠٥٢٢١
Course Title	photovoltic solar systems
Credit Hours	3
Theoretical Hours	3
Practical Hours	0

Short Description:

Recognizing the basic of PV operation, PV manufacturing, how to produce the current through n-p type of silicon in both mono and poly silicon crystalline. energy concepts and its use, available solar radiation energy, solar cell types and solar cell technologies, parameters of solar cells, factors affecting electricity generated by PV, PV power curve and efficiency, charge controller concepts, inverter of PV system basics, calculation maximum power point, shadow effects, PV models..

Course Objectives:

- 1: Identify cell, module and array and the component of PV net work

A: Students should be able to know and identify solar system, PV types

B: Students should be understood stages of electricity production stages through n-p type.

- 2: calculate power, current and voltage of the solar system with different factors.

A: Students should be learning how to calculate the power, voltage and

B: Students should be learning how to identify the perfect factors for high efficiency.

- 3: Describe the principles of basic of charge controller and inverter use in the solar PV system.

A: identifies the charge controller required for different PV system technologies

B: students should identify the inverter types and its efficiency required

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction topv systems	Introduction to energy and solar Photovoltaic energy, n-p type of silicon, PV contents, Photovoltaic Solar Cell Types and Technologies, .	6
2	PV parameters	Measurements of electrical current quantities, voltage and power of DC, estimate PV energy requirement, Solar cell technologies, parameters of PV, The Solar Photovoltaic Array	6
3	Technical efficiency	Curve of Power, current and voltage produced by PV system and the maximum power point.	6
4	Component of PV network and modelling	Basic of charge controller and inverter, calculate the dimensions and length of connection cables use in PV system	6
5	Effects of PV technology types	Monocrystalline silicon cells, Crystalline silicon cell technology, Multicrystalline silicon cells, Amorphous silicon cells, Other types of cells	6
6	Critical factors affectinefficiency of Maximum power	Module temperature, the atmospheric parameters, shadow, technology parameter	6

Teaching Methods:

Books and references:

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Solar Photovoltaic Basics, 1st edition, Earthscan. 2015 New York-Sean White.

- Solar Electricity Handbook: 11th Edition: A simple, practical guide to solar energy designing and installing solar photovoltaic systems.Michael Boxwell, 2017 Green stream.

Associate Degree Program

Specialization	Renewable Energy Engineering
Course Number	٠٢٠٢٠٥٢٢٢
Course Title	photovoltic solar systems workshop
Credit Hours	2
Theoretical Hours	0
Practical Hours	6

Short Description:

Study of Cells, Modules, & Arrays, identify PV system type, evaluat PV network in series and in parallele, study the shading effect , calculate maximum power point, measuring current and voltage curve,

Course Objectives:

- 1: Identify cell, module and array and the component of PV net work

A: Students should be able to know and identify solar system, PV types

B: Students should be understood stages of electricity production stages through n-p type.

- 2: calculate power, current and voltage of the solar system with different factors.

A: Students should be learning how to calculate the power, voltage and

B: Students should be learning how to identify the perfect factors for high efficiency.

- 3: Describe the principles of basic of charge controller and inverter use in the solar PV system.

A: identifies the charge controller required for different PV system technologies

B: students should identify the inverter types and its efficiency required

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	1	Studing of cell Modules and array, identify type of module :mono-Si, poly-Si & thin film	3
2	2	Calculate voltage of open circuit and current of close circuit and calculate power produced by PV system	3
3	3	Shading effect on the performance of pv modules	3
4	4	Calculating maximum instantaneous power of a PV module under direct sunlight	3
5	5	Measuring IV curve for a PV module under direct sunlight	3
6	6	Evaluate the performance for gride connected pv systems, using inverter , CC the type of battary	3
7	7	Studing the PV traking system	3
8	8	Studing the pathfinder works	3
9	9	Project 1	6
10	9	Project 2	6

Teaching Methods:

Books and references:

Associate Degree Program

Specialization	Renewable energy engineering
Course Number	٠٢٠٢٠٥٢٣١
Course Title	**Wind Energy**
Credit Hours	3
Theoretical Hours	3
Practical Hours	0

Short Description:

الرياح نوعية و سرعة قياس و تحليل الرياح، طاقة مبادئ
الشبكة كهرباء وتوليد الطاقة إمدادات المياه ضخ آلات .الرياح طاقة محولات من مختلفة أنواع وتشغيل تصميم
؛ بيانات الرياح وتحليل ورصد ، الموقع اختيار ؛ الرياح طاقة لمحولات الاقتصادي التحليل و التصميم .النائية المناطق في
.الشبكة أو الهجين الطاقة أنظمة في وإدماجها الرياح مولدات من الناتج تقدير

Principles of wind energy; analysis and measurements of wind energy characteristics, wind resources assessment

The design and operation of different types of wind energy converters. Machines for water pumping; remote area power supply and grid electricity generation. Design and economic analysis of wind energy converters; including site selection; monitoring and analysis of wind data; estimating output from wind generators and their integration into hybrid power systems or the grid.

Course Objectives:

- Understand the origin and development of windmills and wind turbines.
- Understand the first attempts of electrical power generation from wind
- Understand the main components of wind energy system and its functions
- Understand the equations used to convert the air kinetic energy into mechanical energy
- Able to know the different types of wind turbines
- Understand rotor aerodynamics

Detailed Description:

No	Unit Title	Unit Content	Hours
1	Wind energy today	- Advantages - Disadvantages	6
2	Wind: origin and local effect	- Origin and global availability - Local effects on wind flow - Selecting a turbine site.	9
3	Physics of wind energy	- Energy content in wind - Energy conversion at the blade - Power coefficient and principles of design	9
4	Component of a wind energy convertor	- Rotor blades - Gear boxes - Generators - Towers	9
5	Design	- Rotor area of turbines	9

No	Unit Title	Unit Content	Hours
	considerations	- Number of blades - Horizontal or vertical axis turbines	

Teaching Methods:

The methods of instruction may include:

1. Lectures
2. Discussion and problem solving
3. Individual assignments
4. Any active learning method such as: small group.

Books and references:

- J. F. Manwell, J. G. McGowan, and A. L. Rogers, Wind Energy Explained –Theory, Design, and Applications, John Wiley & Sons, 2010, ISBN: 978-0-470-01500-1.

-1. Sathyajith Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer, 2006, ISBN 3540309055

-2. T. Burton, N. Jenkins, D. Sharpe and Ervin Bossanyi, Wind Energy Handbook, second edition, John Wiley & Sons, Ltd, 2011, ISBN: 978-0-470-69975-1

-3. Wind turbines: fundamentals, technologies, application, economics. By Erich Hau.

Associate Degree Program

Specialization	Renewable energy engineering
Course Number	٠٢٠٢٠٥٢٤١
Course Title	**Geothermal Energy**
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

مقدمة في مصادر الطاقة الجوفية . مناقشة الية انتقال الحرارة . دراسة أنظمة التبادل الحراري المختلفة . تطبيقات الديناميكا الحرارية في التحليل والتصميم والتحكم لأنظمة التدفئة والتبريد .

Introduction in geothermal energy sources. The mechanism of heat transfer. Study the different heat exchange systems. Applications of thermodynamics in the analysis, design and control of heating and cooling systems.

Course Objectives:

- Understand geothermal resources
- Deals with heat transfer mechanisms
- Use different heat exchange systems
- Be able to understand thermodynamics applications in analysis, design and control heating

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Basics	- What is geothermal energy - Different ways in using geothermal energy	3

No.	Unit Title	Unit Content	Hours
2	Current use	- Homes uses geothermal power plant - Geothermal electricity current supplied	6
3	different heat exchange systems	- Types of heat exchangers - Applications of heat exchangers using geothermal system	9
4	thermodynamics applications analysis, design and control heating and cooling systems	- Heating uses - Geothermal Heat pumps - Flash Power Plant - Dry steam power plant - Binary power plant	9
5	Environment	- How Geothermal energy consider to be renewable - How do Geothermal energy compare to fossil fuel - How Geothermal energy impacted the environmental	9
6	Power plant Costs	- Cost of geothermal power	6

No.	Unit Title	Unit Content	Hours
		plant Factors influence the cost of geothermal power plant - How does the cost of Geothermal energy compare to the cost of fossil fuel	

Teaching Methods:

The methods of instruction may include:

5. Lectures
6. Discussion and problem solving
7. Individual assignments
8. Any active learning method such as: small group.

Books and references:

-Geothermal Energy: Sustainable Heating and Cooling Using the Ground 1st Edition , by Marc A. Rosen (Author), Seama Koohi-Fayegh

Associate Degree Program

Specialization	Renewable energy engineering
Course Number	٠٢٠٢٠٥٢٣2
Course Title	**Wind Energy** lab
Credit Hours	1
Theoretical Hours	0
Practical Hours	3

Short Description:

- أساسيات الخصائص الهوائية من الرياح؛ التصرف الديناميكي لمتحركات توربينات الرياح و الطاقة المتولدة، اجهزة تحليل و قياس سرعة و نوعية الرياح.
- مقدمة في مصادر الطاقة الجوفية وطرق انتقال الحرارة، دراسة أنظمة التبادل الحراري المختلفة . تطبيقات الديناميكا الحرارية في أنظمة التدفئة والتبريد.

- The basics of aerodynamic characteristics of wind; dynamic behavior of wind turbine rotors and the generated wind energy, wind energy measurements.
- Introduction in heat transfer mechanisms, geothermal resources, heat exchange systems.

Course Objectives:

- To be familiar with wind energy
- Understand the main components of wind energy system and its functions
- Able to know the different types of wind turbines
- To be familiar with wind energy components system

Detailed Description:

No.	Unit Title	Hours
1	Wind energy system (rotor blades, the tower, Mechanical Drive, Electrical System, etc.)	
2	Basic concepts of wind energy Converters (turbines)	
3	applications of wind energy	
4	Wind Spectra and meteorology	
5	Electrical Power from the Wind	
6	Aerodynamics of turbines	
7	geothermal resources	
8	Introduction into heat transfer mechanisms	

Teaching Methods:

The methods of instruction may include:

9. Laboratory notes and manual
10. Any active learning method such as: small group.

Books and references:

- J. F. Manwell, J. G. McGowan, and A. L. Rogers, Wind Energy Explained –Theory, Design, and Applications, John Wiley & Sons, 2010, ISBN: 978-0-470-01500-1.

- Geothermal Energy: Sustainable Heating and Cooling Using the Ground 1st Edition , by Marc A. Rosen (Author), Seama Koohi-Fayegh