ANNEX III - COURSE SPECIFICATIONS
Bachelor of Science in Electrical Engineering

I. TECHNICAL COURSES

A. MATHEMATICS

Course Name	**COLLEGE ALGEBRA**
Course Description	Algebraic expressions and equations; solution sets of algebraic equations in one variable: linear, quadratic, polynomial of degree *n*, fractional, radical equations, quadratic in form, exponential and logarithmic equations; decomposition of fractions into partial fractions; solution sets of systems of linear equations involving up to three variables.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Operate and simplify algebraic expressions; 2. Determine the solution sets of all types of algebraic equations, exponential and logarithmic equations; and inequalities; 3. Use the manipulative and analytical skills acquired in Objectives 1 to 2 to solve word problems; and 4. Identify the domain and range of a given relation/function.
Course Outline	1. The Set of Real Numbers 1.1. Integer Exponents 1.2. Polynomials, Operations, Special Products 1.3. Binomial Expansion (Binomial Theorem) 1.4. Factoring Polynomials 2. Rational Expressions 2.1. Rules of Exponents; Simplification of Rational Expressions; Operations on Rational Expressions 2.2. Properties of Radicals; Simplification of Radicals 2.3. Operations on Radicals 2.4. Complex Numbers 3. Equations in One Variable 3.1. Linear Equations; Literal Equations 3.2. Quadratic Equations in One Variable 3.3. Word Problems 3.4. Other Equations in One Variable: Radical, Fractional, Quadratic in Form 3.5. Polynomial Equation of Degree *n* 4. Functions 4.1. Inverse Functions 4.2. Exponential and Logarithmic Functions 4.3. Exponential and Logarithmic Equations 5. Systems of Linear Equations (by Elimination Methods) 6. Decomposition of Rational Expressions into Partial Fractions
Laboratory Equipment	None

Course Name	**ADVANCED ALGEBRA**
Course Description	Matrices and determinants; arithmetic and geometric series; solution sets of different types of inequalities and systems involving quadratics; solution of linear equations using determinants and matrices.

Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisites	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Determine the solution sets of inequalities; 2. Determine the solution sets of systems involving quadratics; 3. Use the manipulative and analytical skills acquired in Objective 2 to solve word problems; 4. Operate and manipulate matrices and determinants; 5. Solve systems of linear equations using matrices and determinants; and 6. Determine the indicated sum of the elements in an arithmetic and geometric sequence.
Course Outline	1. Inequalities 1.1. Linear, Quadratic, and Polynomial Inequality 1.2. Linear Inequalities with Absolute Value 2. Ratio, Proportion, and Variation 3. Determinants 3.1. Expansion by Minors 3.2. Solution of Linear Systems by Cramer's Rule 4. Matrices 4.1. Identity Matrix 4.2. Cofactor Matrix 4.3. Transpose of a Matrix 4.4. Adjoint Matrix 4.5. Inverse of a Matrix 4.6. Algebra on Matrices (Sum and Difference, Scalar Multiplication, Matrix Multiplication) 4.7. Solution of Linear Systems Using Matrices 5. Sequence and Series 5.1. Arithmetic and Geometric Means 5.2. Arithmetic and Geometric Sequences 5.3. Arithmetic and Geometric Series 5.4. Infinite Series 6. Combinatorial Mathematics 6.1. Sequences 6.2. The Factorial of a Number 6.3. Fundamental Principles of Counting, Permutation, and Combination 6.4. Binomial Theorem 6.5. Mathematical Induction
Laboratory Equipment	None

Course Name	**PLANE AND SPHERICAL TRIGONOMETRY**
Course Description	Trigonometric functions; identities and equations; solutions of triangles; law of sines; law of cosines; inverse trigonometric functions; spherical trigonometry
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	None

Course Objectives	After completing this course, the student must be able to: 1. Define angles and how they are measured; 2. Define and evaluate each of the six trigonometric functions; 3. Prove trigonometric functions; 4. Define and evaluate inverse trigonometric functions; 5. Solve trigonometric equations; 6. Solve problems involving right triangles using trigonometric function definitions for acute angles; and 7. Solve problems involving oblique triangles by the use of the sine and cosine laws.
Course Outline	1. Trigonometric Functions 1.1. Angles and Measurement 1.2. Trigonometric Functions of Angles 1.3. Trigonometric Function Values 1.4. The Sine and Cosine of Real Numbers 1.5. Graphs of the Sine and Cosine and Other Sine Waves 1.6. Solutions of Right Triangle 2. Analytic Trigonometry 2.1. The Eight Fundamental Identities 2.2. Proving Trigonometric Identities 2.3. Sum and Difference Identities 2.4. Double-Measure and Half-Measure Identities 2.5. Inverse Trigonometric Functions 2.6. Trigonometric Equations 2.7. Identities for the Product, Sum, and Difference of Sine and Cosine 3. Application of Trigonometry 3.1. The Law of Sines 3.2. The Law of Cosines 4. Spherical Trigonometry 4.1. Fundamental Formulas 4.2. Spherical Triangles
Laboratory Equipment	None

Course Name	**ANALYTIC GEOMETRY**
Course Description	Equations of lines and conic sections; curve tracing in both rectangular and polar coordinates in two-dimensional space.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisites	College Algebra Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Set up equations given enough properties of lines and conics; 2. Draw the graph of the given equation of the line and the equation of the conic section; and 3. Analyze and trace completely the curve, given their equations in both rectangular and polar coordinates, in two-dimensional space.

Course Outline	1. Plane Analytic Geometry 1.1. The Cartesian Planes 1.2. Distance Formula 1.3. Point-of-Division Formulas 1.4. Inclination and Slope 1.5. Parallel and Perpendicular Lines 1.6. Angle from One Line to Another 1.7. An Equation of a Locus 2. The Line 2.1. Point-Slope and Two-Point Forms 2.2. Slope-Intercept and Intercept Forms 2.3. Distance from a Point to a Line 2.4. Normal Form 7.3. Relationships Between Rectangular and Polar Coordinates 3. The Circle 3.1. The Standard Form for an Equation of a Circle 3.2. Conditions to Determine a Circle 4. Conic Sections 4.1. Introduction 4.2. The Parabola 4.3. The Ellipse
	4.4. The Hyperbola 5. Transformation of Coordinates 5.1. Translation of Conic Sections 6. Curve Sketching 6.1. Symmetry and Intercepts 6.2. Sketching Polynomial Equations 6.3. Asymptotes (Except Slant Asymptotes) 6.4. Sketching Rational Functions 7. Polar Coordinates 7.1. Polar Coordinates 7.2. Graphs in Polar Coordinates
Laboratory Equipment	None

Course Name	**SOLID MENSURATION**
Course Description	Concept of lines and planes; Cavalieri's and Volume theorems; formulas for areas of plane figures, volumes for solids; volumes and surfaces areas for spheres, pyramids, and cones; zone, sector and segment of a sphere; theorems of Pappus.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	College Algebra, Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Compute for the area of plane figures; 2. Compute for the surface areas and volumes of different types of solids; and 3. Determine the volumes and surface areas of solids using other methods such as the theorems of Pappus.

Course Outline	1. Plane Figures 1.1. Mensuration of Plane Figures 2. Lines and Planes in Space 2.1. Typical Proofs of Solid Geometry 2.2. Angles 3. Solids for which V = Bh 3.1. Solid Sections 3.2. Cubes 3.3. Rectangular Parallelopiped 3.4. Cavalieri's Theorem 3.5. Volume Theorem 3.6. Prism 3.7. Cylindrical Surface 3.8. Cylinder (Circular and Right Circular) 4. Solids for which V = ⅓Bh 4.1. Pyramids 4.2. Similar Figures 4.3. Cones 4.4. Frustum of Regular Pyramid 4.5. Frustum of Right Circular Cone 5. Sphere 5.1. Surface Area and Volume 5.2. Zone 5.3. Segment 5.4. Sector 6. Theorems of Pappus
Laboratory Equipment	None

Course Name	**DIFFERENTIAL CALCULUS**
Course Description	Basic concepts of calculus such as limits, continuity and differentiability of functions; differentiation of algebraic and transcendental functions involving one or more variables; applications of differential calculus to problems on optimization, rates of change, related rates, tangents and normals, and approximations; partial differentiation and transcendental curve tracing.
Number of Units for Lecture and Laboratory	4 units lecture
Number of Contact Hours per Week	4 hours lecture
Prerequisites	Analytic Geometry, Solid Mensuration, Advanced Algebra
Course Objectives	After completing this course, the student must be able to: 1. Have a working knowledge of the basic concepts of functions and limits; 2. Differentiate algebraic and transcendental functions with ease; 3. Apply the concept of differentiation in solving word problems involving optimization, related rates, and approximation; and 4. Analyze and trace transcendental curves.
Course Outline	1. Functions 1.1. Definitions 1.2. Classification of Functions 1.3. Domain and Range of a Function 1.4. Graph of a Function 1.5. Functional Notation 1.6. Evaluation of a Function 1.7. Combinations of Functions

	1.8. One-Valued and Many-Valued Functions 1.9. Odd and Even Functions 1.10. Special Function Types 1.11. Functions as Mathematical Models 2. Continuity 2.1. Definition 2.2. Properties of Continuous Functions 3. Limits 3.1. Notion of a Limit 3.2. Definition 3.3. Properties of Limits 3.4. Operations with Limits 3.5. Evaluation of Limits 3.6. One-Sided Limits 3.7. Unbounded Functions 4. The Derivative 4.1. Notion of the Derivative 4.2. Definition 4.3. Determination of the Derivative by Increments 4.4. Differentiation Rules 5. The Slope 5.1. Definition of Slope as the Derivative of a Function 5.2. Determination of the Slope of a Curve at a Given Point 6. Rate of Change 6.1. Average Rate of Change 6.2. Instantaneous Rate of Change 7. The Chain Rule and the General Power Rule 8. Implicit Differentiation 9. Higher-Order Derivatives 10. Polynomial Curves 10.1. Generalities About Straight Lines 10.2. Tangents and Normal to Curves 10.3. Extrema and the First Derivative Test 10.4. Concavity and the Second Derivative Test 10.5. Points of Inflection 10.6. Sketching Polynomial Curves 11. Applications of the Derivative: Optimization Problems 12. Applications of the Derivative: Related Rates 13. The Differential 13.1. Definition 13.2. Applications of the Differential—Comparison of Δx and dx 13.3. Error Propagation 13.4. Approximate Formulas 14. Derivatives of Trigonometric Functions 14.1. Elementary Properties 14.2. Definition 14.3. Graphs of Trigonometric Functions 14.4. Applications 15. Derivatives of Inverse Trigonometric Functions 15.1. Elementary Properties 15.2. Definition 15.3. Graphs of Inverse Trigonometric Functions 15.4. Applications 16. Derivatives of Logarithmic and Exponential Functions 16.1. Elementary Properties 16.2. Definition 16.3. Graphs of Logarithmic and Exponential Functions 16.4. Applications 17. Derivatives of Hyperbolic Functions

	17.1. Elementary Properties 17.2. Definition 17.3. Graphs of Hyperbolic Functions 17.4. Applications 18. Solution of Equations 18.1. Newton's Method of Approximation 18.2. Newton-Raphson Law 19. Transcendental Curve Tracing 19.1. Logarithmic and Exponential Functions 20. Parametric Equations 21. Partial Differentiation
Laboratory Equipment	None

Course Name	**INTEGRAL CALCULUS**
Course Description	Concept of integration and its application to physical problems such as evaluation of areas, volumes of revolution, force, and work; fundamental formulas and various techniques of integration applied to both single variable and multi-variable functions; tracing of functions of two variables.
Number of Units for Lecture and Laboratory	4 units lecture
Number of Contact Hours per Week	4 hours lecture
Prerequisite	Differential Calculus
Course Objectives	After completing this course, the student must be able to: 1. Properly carry out integration through the use of the fundamental formulas and/or the various techniques of integration for both single and multiple integrals; 2. Correctly apply the concept of integration in solving problems involving evaluation of areas, volumes, work, and force; 3. Sketch 3-dimensional regions bounded by several surfaces; and 4. Evaluate volumes of 3-dimensional regions bounded by two or more surfaces through the use of the double or triple integral.
Course Outline	1. Integration Concept / Formulas 1.1. Anti-Differentiation 1.2. Simple Power Formula 1.3. Simple Trigonometric Functions 1.4. Logarithmic Function 1.5. Exponential Function 1.6. Inverse Trigonometric Functions 1.7. Hyperbolic Functions 1.8. General Power Formula 1.9. Constant of Integration 1.10. Definite Integral 2. Integration Techniques 2.1. Integration by Parts 2.2. Trigonometric Integrals 2.3. Trigonometric Substitution 2.4. Rational Functions 2.5. Rationalizing Substitution 3. Application 3.1. Improper Integrals 3.2. Plane Area 3.3. Areas Between Curves 4. Other Applications

	4.1. Volumes 4.2. Work 4.3. Hydrostatics Pressure and Force 5. Surfaces Multiple Integral as Volume 5.1. Surface Tracing: Planes 5.2. Spheres 5.3. Cylinders 5.4. Quadratic Surfaces 5.5. Double Integrals 5.6. Triple Integrals 6. Multiple Integral as Volume 6.1. Double Integrals 6.2. Triple Integrals
Laboratory Equipment	None

Course Name	**DIFFERENTIAL EQUATIONS**
Course Description	Differentiation and integration in solving first order, first-degree differential equations, and linear differential equations of order *n*; Laplace transforms in solving differential equations.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Integral Calculus
Course Objectives	After completing this course, the student must be able to: 1. Solve the different types of differential equations; and 2. Apply differential equations to selected engineering problems.
Course Outline	1. Definitions 1.1. Definition and Classifications of Differential Equations (D.E.) 1.2. Order Degree of a D.E. / Linearity 1.3. Solution of a D.E. (General and Particular) 2. Solution of Some 1st Order, 1st Degree D.E. 2.1. Variable Separable 2.2. Homogeneous 2.3. Exact 2.4. Linear 2.5. Equations Linear in a Function 2.6. Bernoulli's Equation 3. Applications of 1st Order D.E. 3.1. Decomposition / Growth 3.2. Newton's Law of Cooling 3.3. Mixing (Non-Reacting Fluids) 3.4. Electric Circuits 4. Linear D.E. of Order *n* 4.1. Standard Form of a Linear D.E. 4.2. Linear Independence of a Set of Functions 4.3. Differential Operators 4.4. Differential Operator Form of a Linear D.E. 5. Homogeneous Linear D.E. with Constant Coefficients 5.1. General Solution 5.2. Auxiliary Equation 6. Non-Homogeneous D.E. with Constant-Coefficients 6.1. Form of the General Solution

	6.2. Solution by Method of Undetermined Coefficients 6.3. Solution by Variation of Parameters
Laboratory Equipment	None

Course Name	**PROBABILITY AND STATISTICS**
Course Description	Basic principles of statistics; presentation and analysis of data; averages, median, mode; deviations; probability distributions; normal curves and applications; regression analysis and correlation; application to engineering problems.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Define relevant statistical terms; 2. Discuss competently the following concepts: 2.1. Frequency distribution 2.2. Measures of central tendency 2.3. Probability distribution 2.4. Normal distribution 2.5. Inferential statistics 3. Apply accurately statistical knowledge in solving specific engineering problem situations.
Course Outline	1. Basic Concepts 1.1. Definition of Statistical Terms 1.2. Importance of Statistics 2. Steps in Conducting a Statistical Inquiry 3. Presentation of Data 3.1. Textual 3.2. Tabular 3.3. Graphical 4. Sampling Techniques 5. Measures of Central Tendency 5.1. Mean 5.2. Median 5.3. Mode 5.4. Skewness and Kurtosis 6. Measures of Variation 6.1. Range 6.2. Mean Absolute Deviation 6.3. Variance 6.4. Standard Deviation 6.5. Coefficient of Variation 7. Probability Distributions 7.1. Counting Techniques 7.2. Probability 7.3. Mathematical Expectations 7.4. Normal Distributions 8. Inferential Statistics 8.1. Test of Hypothesis 8.2. Test Concerning Means, Variation, and Proportion 8.3. Contingency Tables

	8.4. Test of Independence 8.5. Goodness-of-Fit Test 9. Analysis of Variance 10. Regression and Correlation
Laboratory Equipment	None

B. NATURAL/PHYSICAL SCIENCES

Course Name	**GENERAL CHEMISTRY**
Course Description	Basic concepts of matter and its classification; mass relationships in chemical reactions; properties of gases, liquids, and solids; concepts of thermochemistry; quantum theory and electronic behavior; periodic relationship of elements in the periodic table; intramolecular forces; and solutions.
Number of Units for Lecture and Laboratory	4 units: 3 units lecture, 1 unit laboratory
Number of Contact Hours per Week	6 hours: 3 hours lecture, 3 hours laboratory
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Apply significant figures and appropriate units in all measurements and calculations; 2. Classify matter; distinguish between physical and chemical properties/changes; 3. Define and explain the concepts of atomic mass, average atomic mass, mole, molar mass and perform calculations involving these; 4. Balance and interpret chemical equations and perform stoichiometric calculations; 5. Write, explain and apply the gas laws; 6. Discuss the kinetic molecular theory (KMT) of gases and use the KMT to qualitatively explain the gas laws; argue the differences between ideal and non-ideal gas behavior; 7. Define enthalpy; classify common processes as exothermic or endothermic and know the sign conventions; 8. Trace the various atomic theories; discuss the Bohr model; and explain the line spectra of hydrogen; Discuss the concept of electron density; contrast the Bohr's orbits with orbitals in the quantum theory; 9. Write electron configurations and orbital diagrams for multi electron atoms; 10. Use the periodic table to classify elements and predict trends in properties; 11. Write Lewis dot symbols and Lewis structure; 12. Explain valence bond theory, hybrid orbitals, and hybridization in common compounds 13. Distinguish between inter- and intramolecular forces; give examples of intramolecular forces and how they relate to physical properties; 14. Distinguish between crystalline and amorphous solids 15. Discuss various physical changes and interpret phase diagrams; 16. Distinguish different types of solutions; work with different concentration units; Understand the effect of temperature and pressure on solubility; and 17. Explain and apply colligative properties to determine molar mass.
Course Outline	1. The Study of Change 1.1. Introduction to Chemistry 1.2. Matter: Classification, States, Physical, and Chemical Properties 1.3. Measurement and Handling of Numbers

	2. Atoms, Molecules, and Ions 2.1. The Atomic Theory 2.2. The Structure of the Atom 2.3. Atomic Number, Mass Number, Isotopes 2.4. The Periodic Table 2.5. Molecules and Ions 2.6. Chemical Formulas 2.7. Naming Compounds 3. Mass Relationships in Chemical Reaction 3.1. Atomic Mass 3.2. Molar Mass of an Element and Avogadro's Number 3.3. Molecular Mass 3.4. Percent Composition of Compounds 3.5. Chemical Reactions and Chemical Equations 3.6. Amounts of Reactants and Products 3.7. Limiting Reagents 3.8. Reaction Yield 4. Gases 4.1. Substances That Exist as Gases 4.2. Pressure of a Gas 4.3. The Gas Laws 4.4. The Ideal Gas Equation 4.5. Gas Stoichiometry 4.6. Dalton's Law of Partial Pressure 4.7. The Kinetic Molecular Theory of Gases 4.8. Deviation from Ideal Behavior 5. Thermochemistry 5.1. Energy Changes in Chemical Reactions 5.2. Introduction to Thermodynamics 5.3. Enthalpy 6. Quantum Theory and the Electronic Structure of Atoms 6.1. From Classical Physics to Quantum Theory 6.2. Bohr's Theory of the Hydrogen Atom 6.3. The Dual Nature of the Electron 6.4. Quantum Mechanics 6.5. Quantum Numbers 6.6. Atomic Orbitals 6.7. Electron Configuration 6.8. The Building-Up Principle 7. Periodic Relationships Among the Elements 7.1. Periodic Classification of the Elements 7.2. Periodic Variation in Physical Properties 7.3. Ionization Energy 7.4. Electron Affinity 8. Chemical Bonding: Basic Concepts 8.1. Lewis Dot Structure 8.2. The Ionic Bond 8.3. The Covalent Bond 8.4. Electronegativity 8.5. Writing Lewis Structure 8.6. The Concept of Resonance 8.7. Bond Energy 9. Chemical Bonding: Molecular Geometry and Hybridization 9.1. Molecular Geometry 9.2. Dipole Moments 9.3. The Valence Bond Theory 9.4. Hybridization of Atomic Orbitals 9.5. Hybridization in Molecules Containing Double and Triple Bonds 10. Intermolecular Forces in Liquids and Solids

	10.1. The KMT of Liquids and Solids 10.2. Intermolecular Forces 10.3. Properties of Liquids 10.4. Crystalline vs. Amorphous Solids 10.5. Phase Changes 10.6. Phase Diagrams 11. Physical Properties of Solutions 11.1. Types of Solutions 11.2. A Molecular View of the Solution Process 11.3. Concentration Units 11.4. Effect of Temperature and Pressure on Solubility 11.5. Colligative Properties
Laboratory Equipment	Chemistry Laboratory (see attached)

Course Name	**PHYSICS 1**
Course Description	Vectors; kinematics; dynamics; work, energy, and power; impulse and momentum; rotation; dynamics of rotation; elasticity; and oscillation.
Number of Units for Lecture and Laboratory	4 units: 3 units lecture, 1 unit laboratory
Number of Contact Hours per Week	6 hours: 3 hours lecture, 3 hours laboratory
Prerequisites	College Algebra, Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Differentiate a vector from a scalar; 2. Determine the resultant of concurrent vectors; 3. Solve problems in kinematics; 4. Apply Newton's Laws of Motion; 5. Determine the gravitational force between different masses; 6. Solve problems involving centripetal force for horizontal and vertical curves; 7. Compute the work done on a given body; 8. Relate work and energy; 9. Solve problems by applying the law of conservation of energy; 10. Solve problems in impulse and momentum and collisions; 11. Determine the stress and strain on a body; and 12. Determine the period of a body in simple harmonic motion.
Course Outline	1. Work, Energy and Power 1.1. Definition of Work, Energy and Power 1.2. Conservation of Energy 2. Impulse and Momentum 2.1. Definition of Impulse and Momentum 2.2. Conservation of Momentum 3. Vector 3.1. Vectors and Scalars 3.2. Graphical Method 3.3. Analytical Method 4. Vector Subtraction 5. Kinematics 5.1. Equations of Kinematics 5.2. Freely Falling Bodies 5.3. Projectile Motion 6. Dynamics 6.1. Newton's Laws of Motion 6.2. Friction 6.3. First Condition of Equilibrium

	7. Work, Energy and Power 7.1. Definition of Work, Energy and Power 7.2. Conservation of Energy 8. Impulse and Momentum 8.1. Definition of Impulse and Momentum 8.2. Conservation of Momentum 8.3. Collisions, Coefficient of Restitution 9. Rotation 9.1. Definition of torque 9.2. Second Condition of Equilibrium 9.3. Center of Gravity 10. Dynamics of Rotation 10.1. Kinematics of Rotation 10.2. Dynamics of Rotation 10.3. Center of Gravity 11. Elasticity 11.1. Hooke's Law 11.2. Stress and Strain 11.3. Modulus of Elasticity 12. Oscillations 12.1. Definition of Vibration Motion and Simple Harmonic Motion 12.2. Kinematics of Simple Harmonic Motion 12.3. Simple Pendulum
Laboratory Equipment	Physics Laboratory

Course Name	**PHYSICS 2**
Course Description	Fluids; thermal expansion, thermal stress; heat transfer; calorimetry; waves; electrostatics; electricity; magnetism; optics; image formation by plane and curved mirrors; and image formation by thin lenses.
Number of Units for Lecture and Laboratory	4 units: 3 units lecture, 1 unit laboratory
Number of Contact Hours per Week	6 hours: 3 hours lecture, 3 hours laboratory
Prerequisite	Physics 1
Course Objectives	After completing this course, the student must be able to: 1. Describe the characteristics of fluids at rest and in motion; 2. Compute the buoyant force on an object immersed in a fluid; 3. Compute the pressure and flow speed of a fluid at any point in a flow tube; 4. Determine the amount of expansion of a given material in relation to temperature change; 5. Determine the change in temperature of a given amount of material that loses or gains; 6. Solve problems about the law of heat transfer; 7. Describe the three methods of heat transfer; 8. Discuss the properties of waves; 9. Describe the modes of vibration of strings and air columns; 10. Solve problems on Doppler Effect; 11. Compute the electric force between electric charges; 12. Compute the electric field due to electric charges; 13. Compute the electric potential due to a charge and electric potential energy of charges; 14. Define electric current, electric resistance and voltage; 15. Solve problems on resistance and cells in series and parallel;

	16. State Kirchhoff's rules and apply them in a given circuit; 17. Compute the magnetic field of a given current-carrying conductors; 18. Compute the magnetic torque on a current conductor in a magnetic field; and 19. Describe image formation by mirrors and lenses.
Course Outline	1. Fluids 1.1. Pressure, Specific Gravity, Density 1.2. Archimedes' Principle 1.3. Rate of Flow and Continuity Principle 1.4. Bernoulli's Principle 1.5. Torricelli's Theorem 2. Thermal Expansion, Thermal Stress 3. Heat Transfer 4. Calorimetry 4.1. Specific Heat 4.2. Law of Heat Exchange 4.3. Change of Phase 5. Waves 5.1. Types of Waves and Their Properties 5.2. Sounds 6. Electrostatics 6.1. Charge 6.2. Coulomb's Law 6.3. Superposition Principle 6.4. Electric Field Intensity 6.5. Work and Potential 6.6. Capacitors, Dielectrics 7. Electricity 7.1. Current 7.2. Resistance 7.3. EMF 7.4. Ohm's Law 7.5. Energy and Power in Circuits 7.6. Series and Parallel Connections 7.7. Kirchhoff's Rules 8. Magnetism 8.1. Magnetic Field of Moving Changes 8.2. Magnetic Filed of Current Element 8.3. Motion of a Charge in a Magnetic Field 8.4. Biot-Savart Law 8.5. Force on a Moving Charge in a Magnetic Field 8.6. Torque on a Current-Carrying Loop 9. Optics 9.1. Light as Electromagnetic Waves 9.2. Properties of Reflection and Refraction 10. Image Formation by Plane and Curved Mirrors 10.1. Graphical Methods 10.2. Mirror Equation 11. Image Formation by Thin Lenses 11.1. Graphical Methods 11.2. Lens Equation
Laboratory Equipment	Physics Laboratory

C. BASIC ENGINEERING SCIENCES

Course Name	**ENGINEERING DRAWING**
Course Description	Practices and techniques of graphical communication; application of drafting instruments, lettering scale, and units of measure; descriptive geometry; orthographic projections; auxiliary views; dimensioning; sectional views; pictorial drawings; requirements of engineering working drawings; and assembly and exploded detailed drawings.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Understand the importance of technical drawing knowledge and skills as applied to the various areas of engineering; 2. Apply the basic concepts of technical drawing and sketching; and 3. Prepare technical drawings.
Course Outline	1. Engineering Lettering 2. Instrumental Figures 3. Geometric Construction 4. Orthographic Projection 5. Dimensioning 6. Orthographic Views with Dimensions and Section View 7. Sectional View 8. Pictorial Drawing 9. Engineering Working Drawings 10. Assembly and Exploded Detailed Drawings
Laboratory Equipment	1. Drafting table 2. Drawing instruments 2.1. One 30-60 degree triangle 2.2. One 45 degree triangle 2.3. One technical compass 2.4. One protractor

Course Name	**COMPUTER FUNDAMENTALS AND PROGRAMMING**
Course Description	Basic information technology concepts; fundamentals of algorithm development; high-level language and programming applications; computer solutions of engineering problems.
Number of Units for Lecture and Laboratory	2 units laboratory
Number of Contact Hours per Week	6 hours laboratory
Prerequisite	Second Year Standing

Course Objectives	After completing this course, the student must be able to: 1. Understand basic information technology concepts; 2. Use application software and the Internet properly; 3. Acquire proficiency in algorithm development using a high-level programming language; 4. Use the computer as a tool in engineering practice.
Course Outline	1. Introduction to Computers 1.1. Computer Organization 1.2. Number Systems and Data Representation 1.3. Application Software: Word Processing and Spreadsheet 1.4. The Internet 2. Programming 2.1. Algorithm Development 2.2. Programming Fundamentals
Laboratory Equipment	1. Personal computer with: 1.1. Operating system 1.2. Word processing software 1.3. Spreadsheet software 1.4. High-level programming language 1.5. Internet browser and Internet connection

Course Name	**COMPUTER-AIDED DRAFTING**
Course Description	Concepts of computer-aided drafting (CAD); introduction to the CAD environment; terminologies; and the general operating procedures and techniques in entering and executing basic CAD commands.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Define the terms related to computer-aided drafting systems; 2. Identify the important tools used to create technical drawings in CAD; 3. Create electronic drawings (e-drawing) using CAD; and 4. Appreciate the usefulness of the knowledge and skills in computer aided drafting as applied in his/her professional development.
Course Outline	1. Introduction to CAD Software 2. CAD Drawing 3. Snapping, Construction Elements 4. Dimensioning 5. Plotting, Inputting Images 6. 3D and Navigating in 3D 7. Rendering
Laboratory Equipment	1. Personal computer with: 1.1. Operating system 1.2. CAD software 2. Printer or plotter

Course Name	**STATICS OF RIGID BODIES**
Course Description	Force systems; structure analyses; friction; centroids and centers of gravity; and moments of inertia.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisites	Physics 1 Integral Calculus
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles of equilibrium of particles; 2. Undertake vector operations such as vector cross and dot product; 3. Determine forces of 2D and 3D structures; 4. Understand the principles of static, wedge and belt friction; 5. Determine centroids, center of mass and center of gravity of objects; 6. Determine moment of inertia, mass moment of inertia; and 7. Analyze the stresses of trusses, beams and frames.
Course Outline	1. Introduction to Mechanics; Vector Operations 2. Force Vectors and Equilibrium of Particles 3. Vector Cross and Dot Product 4. Moment of a Force 5. Couples; Moment of a Couple 6. Equivalent Force Systems in 2D and 3D 7. Dry Static Friction, Wedge and Belt Friction 8. Centroid; Center of Mass; and Center of Gravity 9. Distributed Loads and Hydrostatic Forces; Cables 10. Moment of Inertia; Mass Moment of Inertia 11. Trusses; Frames and Machines; Internal Forces 12. Beams; Shear and Bending Moment Diagrams
Laboratory Equipment	None

Course Name	**DYNAMICS OF RIGID BODIES**
Course Description	Kinetics and kinematics of a particle; kinetics and kinematics of rigid bodies; work energy method; and impulse and momentum.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	Statics of Rigid Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles governing the motion of particles, velocity and acceleration; 2. Understand the principles of Newton's Second Law and its applications; 3. Understand kinetics of particles in particular energy and momentum methods; and 4. Understand kinematics of rigid bodies, its energy and momentum.
Course Outline	1. Introduction to Dynamics 2. Position, Velocity, and Acceleration 3. Determination of the Motion of the Particles 4. Uniform Rectilinear Motion 5. Uniformly Accelerated Rectilinear Motion 6. Position Vector, Velocity, and Acceleration

	7. Derivatives of Vector Functions 8. Rectangular Components of Velocity and Acceleration 9. Motion Relative to a Frame in Translation 10. Tangential and Normal Components 11. Radial and Transverse Components 12. Motion of Several Particles (Dependent Motion) 13. Kinetics of Particles: Newton's Second Law 13.1. Newton's Second Law of Motion 13.2. Linear Momentum of the Particle, Rate of Change of Linear Momentum 13.3. System of Units 13.4. Equation of Motion 13.5. Dynamic Equilibrium 13.6. Angular Momentum of Particle, Rate of Change of Angular Momentum 13.7. Equations in Terms of Radial and Transverse Components 13.8. Motion Under a Central Force 14. Kinetics of Particles: Energy and Momentum Methods 14.1. Work of Force 14.2. Kinetic Energy of a Particle, Principle of Work and Energy 14.3. Applications of the Principle of Work and Energy 14.4. Potential Energy 14.5. Conservative Forces 14.6. Conservation of Energy 14.7. Principle of Impulse and Momentum 14.8. Impulsive Motion 14.9. Impact 14.10. Direct Central Impact 14.11. Oblique Central Impact 14.12. Problems Involving Energy and Momentum 15. Systems of Particles 15.1. Application of Newton's Second Laws to Motion of a System of Particles 15.2. Linear and Angular Momentum of a System of Particles 15.3. Motion of Mass Center of a System of Particles 15.4. Angular Momentum of a System of Particles About Its Mass Center 15.5. Conservation of Momentum for a System of Particles 15.6. Kinetic Energy of a System of Particles 15.7. Work-Energy Principle. Conservation of Energy for a System of Particles 15.8. Principle of Impulse and Momentum for a System of Particles 16. Kinematics of Rigid Bodies 16.1. Translation 16.2. Rotation About a Fixed Axis 16.3. Equations Defining the Rotation of a Rigid Body About a Fixed Axis 16.4. General Plane Motion 16.5. Absolute and Relative Velocity in Plane Motion 16.6. Instantaneous Center of Rotation in Plane Motion 16.7. Absolute and Relative Acceleration 16.8. Rate of Change of a Vector with Respect to a Rotating Frame 16.9. Plane Motion of a Particle Relative to a Rotating Frame; Coriolis Acceleration 16.10. Motion About a Fixed Point 16.11. General Motion 16.12. Three-Dimensional Motion of a Particle Relative to a Rotating Frame; Coriolis Acceleration 16.13. Frame of Reference in General Motion 17. Plane Motion of Rigid Bodies: Forces and Accelerations 17.1. Equation of Motions 17.2. Angular Momentum of a Rigid Body in Plane Motion

	17.3. Plane Motion of a Rigid Body. D' Alembert's Principle 17.4. Solution of Problems involving the Motion of a Rigid Bodies 17.5. Systems of Rigid Bodies 17.6. Constrained Plane Motion 18. Plane Motion of Rigid Bodies: Energy and Momentum Methods 18.1. Principle of Work and Energy for a Rigid Body 18.2. Work of Forces Acting on a Rigid Body 18.3. Kinetic Energy of a Rigid Body in Plane Motion 18.4 Systems of Rigid Bodies 18.5 Conservation of Energy 18.6 Principle of Impulse and Momentum 18.7 Conservation of Angular Momentum 18.8 Impulsive Motion 18.9 Eccentric Impact
Laboratory Equipment	None

Course Name	**MECHANICS OF DEFORMABLE BODIES**
Course Description	Axial stress and strain; stresses for torsion and bending; combined stresses; beam deflections; indeterminate beams; and elastic instability.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Statics of Rigid Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the concepts of stress and strain; 2. Calculate stresses due to bending, shears, and torsion under plain and combined loading; 3. Analyze statically determinate and indeterminate structures; and 4. Determine the elastic stability of columns.
Course Outline	1. Load Classification 2. Concept of Stress, Normal and Shear Stress 3. Stresses under Centric Loading 4. Stress Concentration 5. Plane Stress 6. Principal Stresses for Plane Stress 7. Mohr's Circle for Plane Stress 8. Deformations, Normal and Shear Strains 9. Material Properties 10. Working Stresses 11. Deformation in a System of Axially Loaded Members 12. Temperature Effects on Axially Loaded Members 13. Statically Indeterminate Members 14. Thin-Walled Pressure Vessel 15. Torsional Stresses; Elastic Torsion Formula 16. Torsional Deformation; Power Transmission 17. Flexural Stresses by the Elastic Curve 18. Moment Equation Using Singularity Function 19. Beam Deflection by the Double Integration Method 20. Area Moment Theorems 21. Moment Diagram by Parts 22. Beam Deflection by Area Moment Method 23. Statically Indeterminate Beams 24. Buckling of Long Straight Columns

	25. Combined Loadings 26. Analysis of Riveted Connections by the Uniform Shear Method 27. Welded Connections
Laboratory Equipment	None

Course Name	**ENGINEERING ECONOMY**
Course Description	Concepts of the time value of money and equivalence; basic economy study methods; decisions under certainty; decisions recognizing risk; and decisions admitting uncertainty.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Solve problems involving interest and the time value of money; 2. Evaluate project alternatives by applying engineering economic principles and methods and select the most economically efficient one; and 3. Deal with risk and uncertainty in project outcomes by applying the basic economic decision making concepts.
Course Outline	1. Introduction 1.1. Definitions 1.2. Principles of Engineering Economy 1.3. Engineering Economy and the Design Process 1.4. Cost Concepts for Decision Making 1.5. Present Economy Studies 2. Money-Time Relationships and Equivalence 2.1. Interest and the Time Value of Money 2.2. The Concept of Equivalence 2.3. Cash Flows 3. Basic Economy Study Methods 3.1. The Minimum Attractive Rate of Return 3.2. The Present Worth Method 3.3. The Future Worth Method 3.4. The Annual Worth Method 3.5. The Internal Rate of Return Method 3.6. The External Rate of Return Method 3.7. The Payback Period Method 3.8. The Benefit/Cost Ratio Method 4. Decisions Under Certainty 4.1. Evaluation of Mutually Exclusive Alternatives 4.2. Evaluation of Independent Projects 4.3. Depreciation and After-Tax Economic Analysis 4.4. Replacement Studies 4.5. Break win Analysis 5. Decisions Recognizing Risk 5.1. Expected Monetary Value of Alternatives 5.2. Discounted Decision Tree Analysis 6. Decisions Admitting Uncertainty 6.1. Sensitivity Analysis 6.2. Decision Analysis Models
Laboratory Equipment	None

Course Name	**ENGINEERING MANAGEMENT**
Course Description	Decision-making; the functions of management; managing production and service operations; managing the marketing function; and managing the finance function.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the field of engineering management; 2. Know and apply the different functions of management.
Course Outline	1. Introduction to Engineering Management 2. Decision Making 3. Functions of Management 3.1. Planning / Coordinating 3.2. Organizing 3.3. Staffing 3.4. Communicating 3.5. Motivating 3.6. Leading 3.7. Controlling 4. Managing Product and Service Operations 5. Managing the Marketing Function 6. Managing the Finance Function
Laboratory Equipment	None

Course Name	**ENVIRONMENTAL ENGINEERING**
Course Description	Ecological framework of sustainable development; pollution environments: water, air, and solid; waste treatment processes, disposal, and management; government legislation, rules, and regulation related to the environment and waste management; and environmental management system.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisites	General Chemistry
Course Objectives	After completing this course, the student must be able to: 1. Understand the various effects of environmental pollution; 2. Know the existing laws, rules, and regulations of the government on environmental issues; 3. Identify, plan, and select appropriate design treatment schemes for waste disposal; and 4. Understand the importance of waste management and its relevance to the engineering profession.

Course Outline	1. Ecological Concepts 1.1. Introduction to Environmental Engineering 1.2. Ecology of Life 1.3. Biogeochemical Cycles 1.4. Ecosystems 2. Pollution Environments 2.1. Water Environment 2.2. Air Environment 2.3. Solid Environmental 2.4. Toxic and Hazardous Waste Treatment 3. Environmental Management System 3.1. Environmental Impact Assessment 3.2. Environmental Clearance Certificate
Laboratory Equipment	None

Course Name	**SAFETY MANAGEMENT**
Course Description	Evolution of safety management; safety terminology; safety programs adopted by high risk industries; hazards in the construction, manufacturing, gas and power plants, and other engineering industries and how to prevent or mitigate them; techniques in hazard identification and analysis in workplaces; off-the-job safety; disaster prevention and mitigation; and incident investigation.
Number of Units for Lecture and Laboratory	1 unit lecture
Number of Contact Hours per Week	1 hour lecture
Prerequisites	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the importance and the value of safety; 2. Know the health hazards and their prevention; 3. Identify and mitigate or prevent hazards; and 4. Apply the concepts and principles of safety in engineering practice.
Course Outline	1. Overview of Safety 2. Basic Safety Procedures in High Risk Activities and Industries 2.1. Procedure in Hazards Analysis in the Workplace 2.2. Control of Hazardous Energies 2.3. Confined Space Entry 2.4. Basic Electrical Safety 2.5. Fall Protection 2.6. Barricades and Scaffolds 2.7. Fire Safety and the Fire Code 2.8. Industrial Hygiene 2.9. Hazard Communication and Chemical Safety

	3. Value Based Safety and Off-the-Job Safety 3.1. Safety as a Value; Choice vs. Compliance 3.2. Off-the-Job Safety (Residences and Public Places) 3.3. Safety as Related to Health Practices 4.Disaster Prevention and Mitigation 4.1. Rationale for Disaster Prevention and Loss Control 4.2. Planning for Emergencies 4.3. Emergency Response Procedures 5. Incident Investigation and Reporting 5.1. Accident Escalation, Incident Investigation and Reporting 5.2. Causal Analysis; Recognition of Root Cause 5.3. Identification of Corrective or Preventive Actions
Laboratory Equipment	None

D. ALLIED SUBJECTS

Course Name:	**ADVANCED ENGINEERING MATHEMATICS FOR EE**
Course Description	A study of selected topics in mathematics and their applications in advanced courses in engineering and other allied sciences. It covers the study of Complex numbers and complex variables, Laplace and Inverse Laplace Transforms, Power series, Fourier series, Fourier Transforms, z-transforms, power series solution of ordinary differential equations, and partial differential equations.
Number of Units for Lecture and Laboratory	3 lecture units
Number of Contact Hours per week	3 hours/week
Prerequisite	Differential Equations
Course Objectives	After completing this course, the student must be able to: 1. To familiarize the different parameters, laws, theorems and the different methods of solutions in advance mathematics. 2. To develop their abilities on how to apply the different laws, methods and theorems particularly in complex problems.
Course Outline	1. Complex numbers and complex variables 2. Laplace and Inverse Laplace Transforms 3. Power Series 4. Fourier Series 5. Fourier Transforms 6. Power Series solution of differential equations 6.1 Legendre Equation 6.2 Bessel Equations 7. Partial Differential Equations
Laboratory Equipment	

Course Name:	**BASIC THERMODYNAMICS**
Course Description	A course dealing with the thermodynamic properties of pure substances, ideal and real gases and the study and application of the laws of thermodynamics in the analysis of processes and cycles. It includes introduction to vapor and gas cycles.
No. of units for Lec and Lab	Lecture - 3 units

No. of Contact Hrs. per week	Lecture - 3 hours/ week
Prerequisite	Integral Calculus, Physics 2
Course Objectives	Introduce the principles underlying the utilization of energy in the thermal systems; open and closed systems; gas and vapor cycles.
Course Outline	Introduction Basic Principles, Concepts and definition First Law of Thermodynamics Ideal Gases/ Ideal Gas Laws Processes of Ideal Gases Properties of Pure Substance Processes of Pure Substance Introduction to cycle analysis: Second Law of Thermodynamics Introduction to Gas and vapor cycles
Laboratory Equipment	None

Course Name:	**LOGIC CIRCUITS AND SWITCHING THEORY**
Course Description	Review of number systems, coding and Boolean algebra; inputs and outputs; gates and gating networks; combinational circuits; standard form; minimization; sequential circuits; state and machine equivalence; asynchronous sequential circuits; race conditions; algorithmic state machines; design of digital sub-systems.
No. of units for Lec and Lab	4 units-3 units lec, I unit lab
No. of Contact Hrs per week	3 hours lec., 3 hrs lab
Prerequisite	Electronic Circuits Analysis and Design
Course Objectives	Define and identify important logic switching circuit theories and terminologist and use Boolean Algebra in simplifying logic circuits and solving related problems apply minimization techniques in designing combinational circuits and in solving related problems.
Course Outline	Number System Other Number System and Number Conversion System Boolean Algebra and Logic Gates Minimization of Boolean Functions Combinational Circuits Sequential Circuits Algorithmic State Machine (ASM) Asynchronous Sequential Logic Design of digital systems
Laboratory equipment	Logic trainers, Logic Analyzers

Course Name:	**ELECTROMAGNETICS**
Course Description	Electric and magnetic fields, resistive, dielectric and magnetic materials, coupled circuits, magnetic circuits and fields, time-varying electromagnetic fields, and Maxwell's equations.
No. of Units for Lec and Lab	3 units lec

No. of Contact Hrs per week	3 hours lec
Prerequisite	Physics 2, Integral Calculus
Course Objectives	define electromagnetic quantities write the expressions and explain Maxwell's equations apply Maxwell's equations in solving electromagnetic problems identify and observe safety measures relating to Electromagnetic fields.
Course Outline	Introduction to Vector Analysis Steady Electric and Magnetic Fields Dielectric and Magnetic Materials Coupled and Magnetic Circuits Time-Varying Fields and Maxwell's Equation Field and Circuit Relationships Transmission Lines
Laboratory Equipment	None

Course Name:	**MICROPROCESSOR SYSTEMS**
Course Description	The course covers concepts involving microprocessor / micro controller systems architecture/organization including microprocessor/micro controller programming, interfacing techniques, memory systems and bus standards. In the laboratory the students will be involved with experiments using micro controllers and the use of microprocessor/ micro controller development systems and other tools. Experiment topics include: assembly language programming topics, interfacing with input and output devices, data transfer between micro controller-based circuits and the PC via the serial port and parallel port.
No. of Units for Lec and Lab	2 units lec, 1 unit lab
Number of Contact Hrs per week	2 hours lec, 3 hours lab
Prerequisite	Logic Circuits and Switching Theory
Course Objectives	Upon completion of the course, the student must be able to: 1. explain the concepts behind microprocessor systems and their components 2. differentiate between microprocessors and micro controllers, between microprocessors, and between micro controllers based on architecture 3. develop programs to run on microprocessors/ micro controller systems using both assembly language and high-level language via cross-compilation 4. explain how to interface microprocessors/ micro controllers to memory, I/O devices, and other system devices 5. explain the organization/architecture of existing computer systems (Ex. desktops, workstations, etc.) 6. analyze the capabilities of different processors 7. program a specific microcontroller system to accept input, process data and control physical devices
Course Outline	1. Architecture 2. Assembly Language Programming Building Microcomputer 3. I/Q Interface 4. Overview of Z8 Micro controller Family; Z8 Development Environment 5. Source Code Components; Target System Components and Z8

	Connections; Basic Debugger Operations and Creating Programs 6. Creating Programs 7. Basic I/Q and Basic Programming 8. Speaker and Relays Interfacing; and One Time Programming 9. Interrupts and Hardware Timers 10. Seven Segment Display; and Analog Interface 11. Project Design
Laboratory Equipment	Micro controller/microprocessor trainers or equivalent, emulators, personal computers if not provided by trainer, include the following: 1. Assembler, cross-compiler, debugger 2. Seven-segment or LCD displays 3. Switches and keypads 4. Motors with TTL-input drivers 5. Suggested Project: An embedded system using a micro controller demonstrating integration with I/O devices and communication with a PC.

Course Name:	**PRINCIPLES OF COMMUNICATIONS**
Course Description	Bandwidth; filters; linear modulation; angle modulation; phase locked loop; pulse modulation; multiplexing techniques; noise analysis; radio transmitters and receivers, Introduction to Data Communication.
No. of Units for Lec and Lab	4 units-3 units lec, 1 unit laboratory
No. of Contact Hrs per week	3 hours lec, 3 hours lab
Prerequisite	Electronics Circuits, Analysis and Design, Advanced Engineering Mathematics for EE
Course Objectives	Conceptualize and analyze a communication system.
Course Outline	1. Introduction to Communication Systems 2. Noise 3. Amplitude Modulation 4. Single-Sideband Techniques 5. Frequency Modulation 6. Radio Receivers 7. Radiation and Propagation of Waves 8. Pulse Modulation 9. Digital Modulation 10. Broadband Communication System 11. *Introduction to Data Communication*
Laboratory Equipment	Training modules in Analog and *Digital* Communications or equivalent to perform the following experiments: 1. Passive, Active Filters, Tuned Circuits 2. AM Transmitter 3. Frequency Modulation 4. Pulse Amplitude Modulation 5. Diode Detection 6. Time Division Multiplexing 7. Frequency Division Multiplexing Suggested *Project* : superheterodyne receiver *(additional laboratory)* Experiments in Digital and Data Communications

Course Name:	**CONTROL SYSTEM ANALYSIS**
Course Description	This course deals with time and frequency response of feedback control systems. The topics covered include time response of first order and second order systems, modeling, transfer functions, pole-zero map, stability analysis, root locus, bode plots, compensators, PID controllers, and introduction to state-

	space techniques.
No of Units for Lec and Lab	3 units lec,
No. of Contact Hrs per week	3 hours lec,
Prerequisite	Advanced Mathematics for Electrical Engineering
Course Objectives	1. Be familiar with various systems exhibiting control mechanisms and understand their operation 2. develop the value of being analytic and able to apply learned concepts to improve systems. 3. understand and appreciate feedback control. 4. apply system-level thinking 5. demonstrate knowledge of concepts in dealing with feedback and control systems
Course Outline	1. Introduction to control systems. 2. Control system terminology. 3. Review of the Laplace transforms. 4. Introduction to system modeling and the transfer function. 5. Introduction to LTI systems. 6. The concept of linearization. 7. Poles and zeros of transfer functions. The pole-zero map. 8. Introduction to time response and different types of test signals. First-order LTI system transient response analysis. 9. Second-order LTI system transient response analysis 10. Block diagram representation of systems and block diagram algebra. 11. Signal flow graphs. 12. Stability theory. 13. Steady-state errors. 14. Sensitivity and Disturbance rejection. 15. Root Locus. 16. Controllers, Compensators, PID Controller 17. Frequency response analysis: Bode plot, Nyquist diagram, and Nichols chart. 18. Introduction to State-space concepts and applications.
Laboratory Equipment	None

Course Name:	**ELECTRONIC CIRCUITS AND DEVICES**
Course Description	Introduction to quantum mechanics of solid state electronics; diode and transistor characteristics and models (BJT and FET); diode circuit analysis and applications; transistor biasing; small signal analysis; large signal analysis; transistor amplifiers; Boolean logic; transistor switch.
No. of Units for Lec and Lab	3 unit-2 unit lecture, 1 unit lab
No. of Contact Hrs per week	2 hours lec, 3 hours lab
Prerequisite	Physics 2; Integral Calculus
Course Objectives	1. Acquire a strong foundation on semiconductor physics; diode and diode circuit analysis; FET and BJT (small and large signal) circuit analysis.

Course Outline	1. Orientation: Review of Course 2. Assessment of the Different Types of Learners 3. Fundamentals of tubes and other devices 4. Introduction of Semiconductors 5. Diode Equivalent Circuits 6. Wave Shaping Circuits 7. Special Diode Application 8. Power Supply And Voltage Regulation 9. Bipolar Junction Transistor 10. Small- Signal Analysis (BJT) 11. Field Effect Transistor 12. Small-Signal Analysis (FET) 13. Large-Signal Analysis
Laboratory Equipment	Electronics Training Module or set of equipment and components that can perform the following experiments: 1 Solid state Diode familiarization 2 Diode Applications 3 Transistor familiarization 4 Transistor applications 5 JFET familiarization and characteristic curves 6 BJT familiarization and characteristic curves 7 Pre-amplifiers ***Recommended List of Equipment:*** Power Supplies, Signal Generator ,Oscilloscope, Curve Tracer, Digital Multimeter

Course Name:	**ELECTRONIC CIRCUITS ANALYSIS AND DESIGN**
Course Description	High frequency transistor models; analysis of transistor circuits; multi-stage amplifier, feedback, differential amplifiers and operational amplifiers; integrated circuit families (RTL, DTL, TTL, ECL, MOS)
No. of Units for Lec and Lab	3 units-2 unit lecture, 1 unit lab
No. of Contact Hrs per week	2 hours lec, 3 hours lab
Prerequisite	Electronics Circuits and Devices
Course Objectives	Upon completion of the course, the student must be able to: 1. Review the basic electronics learned in Electronics 1. 2. Analyze different circuits and models at high frequency. 3. Analyze and solve problems with regards to transistor circuits. 4. Define an operational amplifier. 5. Analyze combinational and sequential devices for logic circuits. 6. Familiarize with the integrated circuit families.
Course Outline	1. Introduction and Review of Logarithms and Decibels 2. BJT Lower Critical Frequency Response 3. JFET Lower Critical Frequency Response 4. BJT Higher Critical Frequency Response 5. JFET Higher Critical Frequency Response 6. Cascade and Cascode Connection 7. CMOS Circuit, Darlington and Feedback Pair Connection 8. Current Mirrors and Current Source 9. Differentials Amplifier 10. Introduction to Operational Amplifier 11. Practical Operational Amplifier 12.
	13. Operational Amplifier Specification 14. Introduction to Feedback System

	15. Feedback Connections and Practical Feedback Circuits 16. Negative Feedback System 17. Positive Feedback 18. Introduction to Oscillator 19. RC Feedback Oscillator Circuits 20. LC Feedback Oscillator Circuits 21. Other Types of Oscillator 22. Introduction to Filters 23. Designing Filters 24. Types of Filters 25. Transistor Fabrication Designing Integrated Circuit Families
Laboratory Equipment	Electronics Training Module or set of equipment and components that can perform the following experiments: 1 Frequency response of a transistor amplifier 2 Cascaded transistor amplifier 3 The differential amplifier 4 The operational amplifier 5 The transistor as a switch 6 Familiarization with digital circuits 7 Filters Recommended List of Equipment: Power Supplies, Signal Generators, Oscilloscope, Digital Multimeter, Spectrum Analyzer, Logic Analyzer

Course Name:	**INDUSTRIAL ELECTRONICS**
Course Description	Theory and operating characteristics of electronic devices and control circuits for industrial processes; industrial control applications; electronics instrumentation; transducers; data acquisition system, power supply and voltage regulator.
No. of Units for Lec and Lab	4 units-3 unit lecture, 1 unit lab
No. of Contact Hrs per week	3 hours lec, 3 hours lab
Prerequisite	Electronic Circuits Analysis and Design
Course Objectives	1. Be familiar with various electronic power controls and how they are designed and their applications
Course Outline	2. Filtered Power Supply 3. Voltage Multiplier 4. Voltage regulators *4.1Automatic Voltage Regulators* 5. Polyphase Rectifiers 6. SCRs 7. UJT 8. PUT 9. TRIAC, DIAC and other thyristors 10. Optoelectronic Devices and Sensors 11. Automatic Welding System *12.* Transducers *13.* Interfacing techniques *13.1 Introduction to Programmable Logic Circuits* 14. Introduction to Robotics
Laboratory Equipment	Electronics Training Module or set of equipment and components that can perform the following experiments: 1. Filters

	2. Voltage Multiplier 3. Voltage Regulator 4. SCR 5. UJT 1. TRIAC, DIAC and other thyristors 7. Application of power electonics devices e.g IGBT, thyristors *7.1 Motor Speed Controls* *7.2 Automatic Welding Controls* 8. Design Project Recommended List of Equipment: Power Supplies, Signal Generator, Oscilloscope, Curve Tracer, Digital Multimeter.

Course Name:	**MECHANICS OF FLUID**
Course Description	It covers properties of fluid, pressure intensity, static pressure, relative equilibrium of liquids, kinematics of flow and fluid dynamics, flow through orifices, nozzles, venturi meters, weirs and flow meters.
No. of Units for Lec and Lab	2 units lecture
No. of Contact Hrs per week	2 hours lecture
Prerequisite	Mechanics of Deformable Bodies
Course Objectives	1. Develop a good understanding of the principles and practical aspects of Fluid Mechanics
Course Outline	1. Introduction to Fluid Mechanics 2. Fluid Statics 2.1 Principles of Hydrostatic Pressure 2.2 Hydrostatic Pressure on Surfaces 2.3 Archimedes' Principle on Buoyancy 2.4 Dams 2.5 Stability of Floating Bodies 2.6 Static Forces in Pipes and Containers 2.7 Relative Equilibrium of Liquid 3 Fluid Dynamics 3.1 Properties of Fluid Dynamics 3.2 Continuity Equation 3.3 Momentum Equation 3.4 Bernoulli's Energy Equation 3.5 Trajectories of Liquid Jets 3.6 Orifice 3.7 Sluice Gates 3.8 Siphon and Theory of Cavitation 3.9 Characteristics of Pumps and the Turbines 3.10 Flow and Fluid Measurement
Laboratory Equipment	None

Course Name	**FUNDAMENTALS OF MATERIALS SCIENCE AND ENGINEERING**
Course Description	Structure and composition of materials (metals, polymers, ceramics and composites). Processing, properties and behavior in service environments.
No. of Units for Lecture and Laboratory	3 units lecture
No. of Contact Hours per week	3 hours lecture
Prerequisites	General Chemistry, Physics 2
Course Objectives	At the end of the course the student must be able to: 1. Identify the importance of materials to mankind through specific examples of materials which have had significant impact to civilization 2. Identify the different ways of classifying various materials

	3. Identify the different material properties and how these are affected by the composition and structure 4. Determine the ways by which material properties can be engineered or modified to meet certain requirements related to their intended use 5. Select the appropriate material(s) for a given application 6. Evaluate feasibility of designs based on material considerations
Course Outline	1. Introduction (1) 2. Atomic structure and interatomic bonding (2) 3. Atomic arrangement in solids (4) 4. Structural imperfections and diffusion (5) 5. Electronic structures and processes (3) 6. Metals and their properties (4) 7. Polymers and their properties (2) 8. Ceramics and their properties (4) 9. Composite materials (3) 10. Materials selection and design considerations (3) 11. Economic, Environmental and Societal Issues in Materials Science and Engineering
Laboratory Equipment	None

Course Name:	**INFORMATION TECHNOLOGY**
Course Description	A discussion to the field of information Technology that focuses on software development, data communications computer networking, databases, internet and web technologies.
No. of Units for Lec and Lab	3 units-2 unit lecture, 1 unit lab
No. of Contact Hours per week	2 hours lecture, 3 hrs laboratory
Prerequisite	Principles of Communications
Course Objectives	1. To study the fundamentals of Information Technology and to address the IT needs of a company 2. To study the data and databases 3. To study telecommunications
Course Outline	1. Information Technologies in the modern organization 2. Computer Hardware 3. Computer Software 4. Data and Databases 5. Telecommunications and Networks 6. The internet, Intranets, and Extranets 7. Electronic Commerce 8. Information Systems Development 9. Ethics, Impacts, and Security
Laboratory Equipment	Training Modules on Computer Networking and Internet and Web Technology

PROFESSIONAL COURSES

Course Name:	**EE LAWS, CONTRACTS, AND ETHICS**
Course Description	This course deals with the study of existing laws, codes, ethics and standards in the practice of the electrical engineering profession.
No. of Units for Lec and Lab	2 units lecture

No. of Contact Hrs per week	2 hours lecture
Prerequisite	4th year standing
Course Objectives	1. To familiarize the students with existing laws, codes, and standards in the practice of the electrical engineering profession 2. To make the students aware and understand the basic concept of contracts and obligations and ethical standards in the practice of the electrical engineering profession
Course Outline	1. The New Electrical Engineering Law (RA 7920) of 1995 2. Anti-Electricity Pilferage Act (RA 7832) of 1994 3. EPIRA Law (RA 9136) of 2001 4. Code of Ethics for Electrical Engineers 5. Magna Carta for Residential Electricity Consumer 6. Warranties, Liabilities, Patents, Bids, and Insurance 2. Grid Code 8. Distribution Code 9. National Building Code 10. Wholesale Electricity Spot Market Rules 11. Guidelines for Energy Conserving Design of Buildings and Utility Systems 12. Other relevant laws, codes and standards in the energy and power industry
Laboratory Equipment	None

Course Name	**ELECTRICAL TRANSMISSION AND DISTRIBUTION SYSTEMS**
Course Description	This course deals with the study and design of primary and secondary distribution networks, load characteristics, voltage regulation, metering techniques and systems, and protection of distribution systems.
No. of Units for Lec and Lab	4 units-3 units lecture, I unit lab
No. of Contact Hrs per Week	3 hours lecture, 3 hours lab/drafting
Prerequisite	AC Machinery, Electrical Circuits 3
Course Objectives	1. To make the students understand the operation of distribution systems and equipment 2. To equip the students with the necessary tools and techniques to be able to model, analyze, and design electric distribution systems 3. To enable the students to apply Philippine, IEEE/ANSI, and IEC standards in distribution system design
Course Outline	1. Overview of Distribution Systems 2. Load Characteristics 3. Distribution Transformer Applications 4. Overhead and Underground Distribution Lines 5. Voltage Regulators 6. Three-Phase Distribution Power Flow 7. Shunt Capacitor Placement 8. Fault Analysis 9. Distribution Over-current Protection 10. Over-current Protection Coordination 11. Surge Protection 12. Substations 13. Distribution Reliability Analysis

	14. Power Quality 15. Distribution Management Systems
Laboratory Equipment	Transmission Line Trainer & Power Simulation Software

Course Name:	**ELECTRICAL SYSTEM DESIGN**
Course Description	This course deals with the study of electrical system design, installation, and cost estimation for commercial and Industrial establishments, guided by the provisions of the Philippine Electrical Code (PEC) and other relevant laws and standards.
No. of Units for Lec and Lab	2 units lecture, 1 unit lab
No. of Contact Hrs per week	3 hours lecture, 3 hours lab/drafting
Prerequisite	AC Apparatus and Devices
Course Objectives	To make the students understand and apply the basic requirements in the electrical system design, installation, and cost estimation of commercial and industrial establishments based on the provisions of the Philippine Electrical Code and other relevant laws and standards
Course Outline	1. Basic concept of electrical designing 3. PEC Part 1requirements on electrical installations 3. PEC Part 2 Requirements on Electrical Installations 4. Grounding Methods for Electric Supply and Communication Facilities 5. Safety Rules for the Installation and Maintenance of Overhead Electric Supply and Communication Lines 6. Basic Theories of Electrical Estimating
Laboratory Equipment	Electrical Laboratory Workshop Area

Course Name	**INSTRUMENTATION AND CONTROL**
Course Description	Control and Testing; Electromechanical, analog, and digital measuring and testing instruments; R, L and C measurements: calibration; graphic and waveform analyzing instruments; and detectors for the measurements of process variables; analysis of performance characteristics of control systems, electronics, magnetic, hydraulic and mechanical control.
No. of Units for Lec and Lab	2 units lecture, 1 unit lab
No. of Contact Hrs per Week	2 hours lecture, 3 hours lab
Prerequisite	Industrial Electronics
Course Objectives	1. To provide the students with the description and applications of various types of measuring and testing instruments 2. To familiarize the students with new trends in measuring and testing technologies 3. To make students understand and apply the principles of measuring and testing instruments in various fields of electrical engineering
Course Outline	1. Introduction to the basic concepts in instrumentation and Control 2. Instrumentation and control equipment, components, symbols and diagrams 3. Measurement, Testing, and Measurement Errors 4. Electric and Magnetic set-up and measurement systems

	5. Data acquisition, conversion, conditioning, logging, recording and retrieval of Digital data 6. Measurement and control of non-electrical quantities 6.1 Temperature and Heat 6.2 Linear and angular displacement, velocity and acceleration 6.3 Pressure, force, and vibration 6.4 Flow and liquid level 7. Tele-metering 8. Control Configurations and Algorithms
Laboratory Equipment	

Course Name:	**ELECTRICAL CIRCUITS I (LECTURE)**
Course Description	Covers the basic concepts and fundamental laws of electrical circuit theory; analysis and applications of series, parallel and series-parallel resistive circuits; mesh and nodal analysis; network theorems; characteristics of inductors and capacitors; analysis of RL, RC, and RLC circuits with DC excitation
No. of Units for Lec and Lab	3 units lecture
No. of Contact Hrs per week	3 hours lecture
Prerequisite	Physics 2, Integral Calculus
Co-requisite	Circuits 1 (Laboratory), Differential Equations
Course Objectives	1. To serve as an introductory professional course for electrical engineering students. 2. To develop the students' logical thinking in solving linear circuit analysis problems using modern engineering techniques. 3. To stimulate the students' motivation and appreciation of circuit analysis by using examples based on "real-world" applications and examples that feature design considerations.
Course Outline	1. Basic electrical quantities; system of units; circuit components. 2. Ohm's law and Kirchhoff's laws 3. Analysis of series, parallel, series-parallel circuits 4. Applications of resistive circuits - resistance bridge circuits; biasing circuits; voltage divider circuits; analog meters 6. Analysis of resistive circuits with controlled sources 7. Circuit analysis techniques and network theorems 8. Fundamentals of inductors and capacitors 9. Analysis of first order dynamic circuits with DC excitation 10. Analysis of second-order dynamic circuits with DC excitation
Laboratory Equipment	None

Course Name:	**ELECTRICAL CIRCUITS I (LABORATORY)**
Course Description	A laboratory course to accompany Electrical Circuits I (lecture).
No. of Units for Lec and Lab	1 unit laboratory

No. of Contact Hrs per week	3 hours laboratory
Prerequisite	Physics 2, Integral Calculus
Co-requisite	Electrical Circuits 1 (Lecture)
Course Objectives	1. To provide the hands on exercises for selected topics in Electrical Circuits I 2. To provide the students with familiarity and technical skills in handling the different equipment and apparatus to be used 3. To develop communication skills and teamwork in performing the experiments
Course Outline	1. Familiarization with electrical measuring instruments and devices; application of Ohm's Law and Kirchhoff's Laws 2. Resistance bridge circuits 3. Characteristics of series-parallel circuits; delta – wye transformation 4. Design of voltage divider circuits 5. Mesh and nodal analysis 6. Superposition theorem and the principle of linearity 7. Thevenin's theorem and Norton's theorem; Maximum power transfer theorem 8. Complete response of first-order dynamic circuits 9. At least two design experiments on selected topics
Laboratory Equipment	Circuit trainer / modules that can be used to perform the specified experiments; measuring instruments; power supply; circuit components – resistors, inductors, capacitors

Course Name:	**ELECTRICAL CIRCUITS II (LECTURE)**
Course Description	Covers the steady state frequency domain analysis of RLC circuits driven by sinusoidal voltage/current source(s); impedance bridge circuits; application of mesh/nodal analysis and network theorems in AC circuit analysis; concept of power and power factor correction in AC circuits; resonant and tuned circuits; two port network analysis; analysis of dynamic circuits with AC excitation
No. of Units for Lec and Lab	3 units lecture
No. of Contact Hrs per week	3 hours lecture
Prerequisite	Electrical Circuits I (Lecture and Laboratory)
Co-requisite	Electrical Circuits II (Laboratory)
Course Objectives	1. To develop the students' ability to analyze AC circuits both in the time domain and frequency domain 2. To strengthen and further develop the students' logical thinking in solving linear circuit analysis problems using the same techniques learned from

	Electrical Circuits 1 3. To enhance the students' understanding of the concept of power and power factor correction in networks with sinusoidal excitation
Course Outline	1. Generation of AC voltage/current; characteristics of the sinusoidal waveform; sinusoidal response in the time domain 2. Phasor concept; phasor relationships for R, L, and C; impedance and admittance 3. Frequency domain analysis of simple RLC circuits and circuits with controlled sources 4. Network Theorems in AC Circuit analysis 5. Relationship of average, effective and maximum values of periodic functions, time-invariant functions, and composite functions 1. Concept of power and power factor correction in AC circuits 2. Resonant and tuned circuits 3. Two port network analysis 9. Analysis of dynamic circuits with AC excitation
Laboratory Equipment	None

Course Name:	**ELECTRICAL CIRCUITS II (LABORATORY)**
Course Description	A laboratory course to accompany Electrical Circuits II (Lecture).
No. of Units for Lec and Lab	1 unit laboratory
No. of Contact Hrs per week	3 hours laboratory
Prerequisite	Circuits I (Lecture and Laboratory)
Co-requisite	Electrical Circuits II (Lecture)
Course Objectives	1. To provide the hands on exercises for selected topics in Electrical Circuits 2 2. To provide the students with familiarity and technical skills in handling the different equipment and apparatus to be used 3. To develop communication skills and teamwork in performing the experiments
Course Outline	1. Voltage-current relationships in resistive, inductive, and capacitive elements 2. Characteristics and applications of series RLC circuits; concept of impedance 3. Characteristics and applications of parallel RLC circuits; concept of admittance 4. Design and applications of impedance bridge circuits 5. Power in AC circuits; maximum power transfer principle 6. Power factor correction 7. Series-tuned and parallel-tuned circuits 8. Two-port network analysis of RLC circuits 9. At least two design experiments on selected topics
Laboratory Equipment	Circuit trainer / modules that can be used to perform the specified experiments; measuring instruments; power supply; circuit components – resistors, inductors, capacitors

Course Name:	ELECTRICAL CIRCUITS III (LECTURE)
Course Description	Covers the analysis of balanced three-phase systems, with balanced and unbalanced loading; analysis of circuits with magnetically-coupled coils; symmetrical components; per unit calculations
No. of Units for Lec and Lab	2 units lecture
No. of Contact Hrs per week	2 hours lecture
Prerequisite	Electrical Circuits II (Lecture and Laboratory)
Co-requisite	Electrical Circuits III (Laboratory)
Course Objectives	1. To develop the students' logical thinking in analyzing three-phase systems, and circuits with coupled coils 2. To develop the students' analytical skills in determining symmetrical components and doing per unit calculations
Course Outline	1. Three-phase balanced system – voltage relations, current relations, power calculations 2. Three-phase power measurement; power factor correction in three-phase systems 3. Analysis of 3-phase systems with unbalanced loading 4. Analysis of circuits with magnetically-coupled coils 5. Determination of symmetrical components 6. Per unit calculations – changing per unit values on a new base
Laboratory Equipment	None

Course Name:	ELECTRICAL CIRCUITS III (LABORATORY)
Course Description	A course to accompany Electrical Circuits III lecture.
No. of Units for Lec and Lab	1 unit laboratory
No. of Contact Hrs per week	3 hours laboratory
Prerequisite	Electrical Circuits II (Lecture and Laboratory)
Course Objectives	1. To provide the hands on exercises for selected topics in Electrical Circuits 3 2. To provide the students with familiarity and technical skills in handling the different equipment and apparatus to be used 3. To develop communication skills and teamwork in performing the experiments
Course Outline	1. Voltage and current relationships in balanced three-phase systems 2. Power measurement in balanced three-phase, 3-wire and 4-wire systems 3. Analysis of three-phase, 3-wire systems with unbalanced loading 4. Analysis of three-phase, 4-wire systems with unbalanced loading 5. Power factor correction in three-phase systems 6. Analysis of circuits with magnetically coupled-coils

	7. At least four design experiments on selected topics
Laboratory Equipment	Circuit trainer / modules that can be used to perform the specified experiments; measuring instruments; power supply; circuit components – resistors, inductors, capacitors

Course Name:	**AC APPARATUS AND DEVICES (LECTURE)**
Course Description	Covers theory, principle of operation and applications of single-phase transformers, parallel operation of transformers, autotransformers, three-phase transformers, instrument transformers, circuit breakers, power relays and other selected equipment and devices currently used in the field as basic requirements of an electrical system.
No. of Units for Lec and Lab	2 units lecture
No. of Contact Hrs per week	2 hours lecture
Prerequisite	None, co-requisite AC Machinery
Co-requisite	AC Machinery
Course Objectives	1. To provide the students with the applied theories and principles of transformers and other equipment and devices currently used in the field as basic requirements of an electrical system 2. To develop the students' analytical skills and logical thinking in exploring recent technology and its application
Course Outline	Transformer construction, principle of operation, parameters from test data, efficiency, voltage regulation, parallel operation, autotransformers, instrument transformers, three-phase transformers, solenoids, toroids, fuses and circuit breakers, power relays, lighting & surge arresters, and electric meters
Laboratory Equipment	None

Course Name:	**AC APPARATUS AND DEVICES (LABORATORY)**
Course Description	A laboratory course to accompany AC Apparatus and Devices Lecture.
No. of Units for Lec and Lab	1 unit lab
No. of Contact Hrs per week	3 hours lab
Prerequisite	None, co-requisite AC Machinery
Course Objectives	1. To provide the hands on exercises for selected topics in AC Apparatus and Devices 2. To provide the students with familiarity and technical skills in handling the different equipment and apparatus to be used 3. To develop communication skills and teamwork in performing the

	experiments
Course Outline	1. Characteristics tests of a single-phase two-winding transformer: polarity test, open circuit test, short circuit test. 2. Voltage regulation and efficiency of a transformer 3. Conversion of a two-winding transformer into an autotransformer 4. Parallel operation of single-phase transformers 5. The three-phase transformer and the three-phase transformer bank 6. The open delta or V – V connection of single-phase transformers 7. The Scott-connection or T-T connection of two single-phase transformers 8. Parallel operation of three-phase transformers or three-phase banks
Laboratory Equipment	Transformer trainer / Module that can be used to perform the specified experiments, measuring instruments; power supply; circuit components – resistors; inductors; capacitors

Course Name:	**ELECTRICAL EQUIPMENT OPERATION & MAINTENANCE**
Course Description	Covers the principle of operation, functions, characteristics and applications of different electrical equipment and devices; also covers the design, installation and troubleshooting, automation and control of different kinds of industrial motors.
No. of Units for Lec and Lab	3 units lecture
No. of Contact Hrs per week	3 hours lecture
Prerequisite	AC Apparatus and Devices
Course Objectives	1. To provide the students' with the principle of operation of different electrical equipment and devices, their functions, characteristics and applications 2. To develop the students' ability to design, install and troubleshoot different kinds of control systems within the range of industrial motor controls
Course Outline	1. Introduction to electrical equipment and devices: importance and applications. 2. Theory & Concepts on different electrical equipment: CB, Instrument transformers, ATS, etc. 3. Basic motor control and the primary control devices 4. Starting characteristics of DC and AC motors 5. Methods of starting DC & AC Motors 5.1 Direct-on-line starting of DC and AC motors 5.2 Reduced voltage starting using part-winding techniques of 3-phase cage rotor induction motor 5.3 Reduced voltage starting with wye-delta configuration for 3-phase cage rotor induction motor 5.4 Reduced voltage starting using autotransformer of 3-phase cage rotor induction motor 5.5 Current limit starting with primary resistance starter for 3-phase cage rotor induction motor 5.6 Current limit starting with secondary resistance starter for 3-phase wound rotor induction motor

	5.7 Current limit starter for single-phase AC motor 5.8 Current limit starter for DC motor 6. Reversing of AC motors 7. Reversing of DC motors 8. Jogging operation of AC and DC motors 9. Plugging operation of AC and DC motors 10. Power control devices 11. Power control design: techniques and examples 12. Introduction to power electronic devices 13. Principles of thyristor control DC converter for speed and torque control of DC motors 14. Introduction to Pulse Width Modulation (PWM) inverter design 15. Introduction to variable frequency drives (VFD): parts and functions 16. Torque-speed control of VFD on a 3 cage rotor induction motor 17. Programming and setting of parameters of a VFD module
Laboratory Equipment	None

Course Name:	**DC MACHINERY (LECTURE)**
Course Description	Covers the basic principles of electromechanical energy conversion, generalized machine model, and the operating characteristics of DC machines and synchronous machines.
No. of Units for Lec and Lab	2 units lecture
No. of Contact Hrs per week	2 hours lecture
Prerequisite	Electrical Circuits II (Lecture and Laboratory)
Course Objectives	1. To impart the applied theories of DC Machinery that will prepare students for AC Machinery 2. To provide students the skills to explore recent technology and its application. 3. To develop the ability of students to apply gained knowledge for the advancement of mankind.
Course Outline	1. Review of Electromagnetics 1.1. Electric Field 1.2. Magnetic Field 2. Principles of DC Machinery 2.1. Electromechanical Transducers 2.2. Mechanical Energy 2.3. Electromagnetic Forces and Torques 3. Generalized Machine Model 3.1. Features of Rotating Machines 3.2. MMF and Flux Density Patterns 3.3. Non-Salient Pole Machine: Self and Mutual Inductances 3.4. Commutator Machine: Self and Mutual Inductances 3.5. The Generalized Machine 4. General Features of DC Machines 4.1. Generalized Machine Representation 4.2. Types of DC Machines 4.3. Performance Characteristics 5. Synchronous Machines 5.1. General Features of Synchronous Machines 5.2. Types of Synchronous Machines 5.3. Performance Characteristics

Laboratory Equipment	None

Course Name:	**DC MACHINERY (LABORATORY)**
Course Description	A laboratory course to accompany DC Machinery (Lecture).
No. of Units for Lec and Lab	1 unit laboratory
No. of Contact Hours per week	3 hours lab
Prerequisite	Electrical Circuits II (Lecture and Laboratory)
Course Objectives	1. To impart the applied theories and principles of DC Machinery and prepare EE students for broad industry applications of these theories and principles 2. To provide the students with technical skills and actual knowledge of the different equipment to be used 3. To develop communication skills and teamwork in performing the experiments
Course Outline	1. Familiarization with electromechanical energy conversion equipment 2. Characteristics of the DC shunt generator 3. Characteristics of the DC series generator 4. Characteristics of the DC compound generator 5. Parallel operation of DC generators 6. Characteristics of the DC shunt motor 7. Characteristics of the DC series motor 8. Characteristics of the DC compound motor 9. At least one design experiment to illustrate the industrial applications of DC machines
Laboratory Equipment	Electrical Machines Teaching System that can be used to perform the specified experiments; motor-generator set; power supply; measuring instruments; circuit components – resistors; inductors; capacitors

Course Name:	**AC MACHINERY (LECTURE)**
Course Description	Covers theory, principle of operation, engineering aspects and applications of three phase alternators, three-phase induction motors, synchronous motors and single-phase motors
No. of Units for Lec and Lab	3 units lecture
No. of Contact Hrs per week	3 hours lecture
Prerequisite	DC Machinery (Lecture and Laboratory), Electrical Circuits 3
Course Objectives	1. To impart the applied theories and principles of alternating current and electrical machines that includes alternators, induction machines, synchronous machines and single-phase motors 2. To provide students the skills to explore recent technology and its application **1.** To develop the ability of students to apply gained knowledge for the advancement of mankind

Course Outline	1. Alternator construction, parts, nameplate and ratings 2. Generation of voltage, coil pitch & pitch factor 3. Alternator regulation and phasor diagram 4. Alternator efficiency 5. Operation of alternators in parallel 6. Engineering application of alternator 7. Poly-phase motor construction, principle of operation 8. Exact, approximate and IEEE recommended equivalent circuits 9. Characteristics of an induction motor, starting torque, efficiency and starting methods 10. DC resistance, no-load and blocked rotor test 11. Engineering application of induction motor 12. Synchronous motor construction and principles of operation 13.Power factor correction using synchronous motors 14.Single phase motor construction and principle of operation 15. Engineering application of single-phase motor
Laboratory Equipment	None

Course Name:	**AC MACHINERY - (LABORATORY)**
Course Description	Covers experiments to demonstrate the operating characteristics of alternators, induction motors, synchronous motors, and other types of motors; also covers the simulation of the principle of operation and the characteristics of electrical machines based on industrial applications
No. of Units for Lec and Lab	1 unit laboratory
No. of Contact Hrs per week	3 hours laboratory
Prerequisite	DC Machinery (Lecture and Laboratory), Electrical Circuits 3
Course Objectives	1. To supplement the lecture class in Electrical Machinery by providing the hands-on exercises 2. To provide the students with technical skills and actual knowledge of the different equipment to be used 3. To develop communication skills and teamwork in performing the experiments
Course Outline	1. The squirrel-cage induction motor (SCIM) 2. The wound-rotor induction motor 3. The synchronous motor 4. The AC series motor 5. Open circuit saturation curve of an alternator 6. External characteristics of a three-phase alternator 7. Synchronization and parallel operation of three-phase alternators 8. At least two design experiments to illustrate the industrial applications of Ac machines
Laboratory Equipment	Electrical Machines Teaching System that can be used to perform the specified experiments, Motor Generator set, Induction Motor, Single-phase motor, measuring instruments; circuit components; 3-phase power supply

Course Name:	**POWER PLANT ENGINEERING**
Course Description	Includes Load Graphics, types of power plants, power plant operation and protection, interconnections, economics of electric service and arrangement of equipment for modern plants.
No. of Units for Lec and Lab	2 units lecture, 1 unit lab
No. of Contact Hrs per week	2 hours lecture, 3 hours drafting
Prerequisite	Co-requisite- Power System a System Analysis and Design
Course Objectives	1. To make the students recognize, understand, and specify the various existing types of electrical equipment, apparatus and devices used in power plant substations 2. To enhance the students' interest and strengthen their knowledge in power plant design
Course Outline	1. Introduction: Energy Sources 2. Types of Power Plants 3. Load Determination and Load Graphs 3. Power Plant Economics 4. Generating Equipment 5. Power Plant Building 6. Power Plant Layout & Components
Laboratory Equipment	None

Course Name	**POWER SYSTEM ANALYSIS AND DESIGN**
Course Description	Basic structure of power systems, recent trends and innovations in power systems, complex power, per-unit quantities, transmission line parameters, network modeling and calculations, load flow studies, short circuit calculations, use of computer software for simulation
Number of Units for Lec and Lab	3 units Lecture, I unit Lab
No. of Contact Hrs per Week	3 hours Lecture, 3 hours computer laboratory
Prerequisite	Electrical System Design
Course Objectives	1. To illustrate the essential features and structures of power systems 2. To investigate the basic principles which govern the behavior of power systems 3. To awaken the students' interest in the intricacies of power systems' recent trends and innovations 4. To emphasize the important role of computer in power system computations and advancement

Course Outline	1. Growth of Power Systems 1.1 Evolution of Power System Structure 1.2 The New Power System Under EPIRA (RA 9136 of 2001) 1.3 Major Components of Deregulated Power System 1. 4The Interconnected Power Structure 2. Basic Concepts 2.1.Complex Power 2.2 Direction of Power Flow 2.3 Per-Unit Quantities 2.4 Changing the Base of Per Unit Quantities 3. System Modeling 3.1 Series Impedance of Transmission Lines 3.2.Capacitance of transmission lines 3.3 Current and voltage relations on a Transmission lines 3.4 Network Modeling 3.5 Network Calculations 3.6 Load Flow Solutions and Control 4. Short Circuit Calculations 4.1. Symmetrical Three-Phase Faults 4.2. Symmetrical Components 4.3. Unsymmetrical Faults
Laboratory Equipment	Available Computer Software for Simulation from the INTERNET
Suggested Laboratory Activities	Machine Problem 1: Bus Admittance Matrix Machine Problem 2: Kron Reduction (Node Elimination) Machine Problem 3: LU Factorization Machine Problem 4: Gauss-Seidel Machine Problem 5: Newton-Raphson Machine Problem 6: Load Flow Machine Problem 7: Bus Impedance Matrix Machine Problem 8: Short Circuit Analysis 1 Machine Problem 9: Short Circuit Analysis 2

Course Name:	**ELECTRICAL ENGINERING SAFETY**
Course Description	Deals with the industrial accident prevention and safety organization, accident analysis, selection and application of remedy/corrective actions, industrial health and environmental concerns, first-aid and CPR.
No. of Units for Lec and Lab	1 unit lecture
No. of Contact hrs. per week	1 hour lecture
Prerequisite	Safety Management
Course Objectives	To have comprehensive analysis on how and when industrial accidents happen. To have comprehensive knowledge on how to prevent accidents To have the skills in applying first aid and CPR.
Course Outline	1. Identify conditions conducive to accidents 2. Identify the different types of accidents

	3. Analysis of conditions to prevent accidents 4. Study of Industrial environment promoting environmental safety 5. Study of the different medical aid procedures in case of accidents such as first-aid and CPR
Laboratory Equipment	First Aid Kit, safety Shoes, Helmet, portable oxygen tank

Course Name:	**ILLUMINATION ENGINEERING DESIGN**
Course Description	This course deals with the study, design, application, maintenance, cost estimate of electrical system design and use of energy efficient lighting systems in residential, commercial, and industrial establishments.
No. of Units for Lecture and Laboratory	2 units lecture, 1 unit lab/drafting
No. of Contact Hrs per week	2 hours lecture, 3 hours lab
Prerequisite	Co requsite-Electrical System Design
Course Objectives	1. To teach the students the basic components of lighting system 2. To teach the students in design, application, maintenance and use of energy efficient lighting systems in the residential, commercial, and industrial establishments.
Course Outline	1. Basic Illumination 1.1 Light and Lighting Fundamentals 1.2 Low Intensity Discharge Lamps 1.2.1. Linear or tubular and circular fluorescent lamps 1.2.2. Compact fluorescent lamps 1.3 High Intensity Discharge Lamps 1.3.1 Mercury Vapor 1.3.2. Metal Halide 1.3.3 High Pressure Sodium 1.4 Energy Efficient Fluorescent Ballast 1.4.1 Low loss ballast magnetic ballast 1.4.2 Electronic ballast 1.5 Lighting Systems and Luminaire 1.6 Lighting Systems and Design Calculations 1.7 Light Emitting Diode 1.8 Basic Lighting Energy Audit 1.9 Lighting Control Technologies 1.10 Area Lighting System 1.11 Lighting System Maintenance 2. Roadway Lighting Design 2.1 Purpose of the Guidelines 2.2 Purpose of Roadway Lighting 2.3 Scope and Methodology of Roadway Lighting . 2.4 Roadway Lighting Equipment 2.5 Light Sources for Roadway Lighting 2.6 Roadway Luminaires 2.7 Roadway Lighting Electrical and Structural System 2.8 Roadway Lighting Parameters 2.9 Roadway Lighting Design Process and Applications 1.10 Technical Specifications for Roadway Lighting

	1.11 Tunnels and Underpasses 2.12 Maintenance Considerations in Roadway Lighting Design 2.13 Energy Efficient Roadway Lighting Opportunities and Benefits 2.14 Benefits of Effective Energy-Efficient Roadway Lighting Design
Laboratory Equipment	1. **Handheld/Clamp-on power meter.** Measures, computes and display circuit load at a given time (measurement taken at the circuit breaker and other circuit disconnecting means). 2. **Clamp-on data logger power meter.** Automatically log and interface to laptop computer the recorded data for power consumption over a period of time. 3. **True RMS AC Clamp Meter and Hybrid Recorder.** Measure flow of current in a conductor, capable of measuring power consumption, line voltage, insulation resistance in mega-ohm and temperature. It can measure electrical parameters without interrupting power utilization. 4. **Lux meter**. Measure light illumination levels over the specific area (workplane and room surroundings). 5. **Two-way radio.** Use for fast communication and coordination of activity during the conduct of audit especially for large area. 6. **Binocular**. Views nearer and closer readings to some far and elevated location of lighting system and installed meter and indicators in the site. 7. **Steel tape and roller measure**. Use to measure distances and dimensions of rooms.

Course Name:	**NUMERICAL METHODS WITH COMPUTER APPLICATION**
Course Description	This course deals with the study of direct and interactive numerical methods in engineering, determination of error bounds in calculations, computation of series expansions, roots of algebraic and transcendental equations, numerical differentiation and integration, solution to simultaneous linear and non-linear equations, function approximation and interpolation, differential equations, optimization, and their applications.
Number of Units for Lecture and Laboratory	2 units lecture 1 unit lab
Number of Contact Hours per week	2 hours lecture, 3 hours lab
Year and Term to Be Taken	2nd semester, 4th year
Prerequisite	Advanced Engineering Mathematics
Course Objectives	Upon completion of the course, the student must be able to: • Estimate error bounds in numerical calculations • Evaluate series expansions • Solve differential equations • Perform interpolation of functions • Find the roots of equations • Solve simultaneous linear and nonlinear equations • Prepare algorithms, write computer programs, use computer software and implement these to the solution of engineering problems • Prove theorems using logic

Course Outline	• Algorithms and their complexity • The growth of functions • Analysis of errors in numerical calculations • Evaluation of series expansion of functions • Roots of algebraic and transcendental equations • Simultaneous linear equations • Simultaneous nonlinear equations • Function approximation and interpolation • Numerical Differentiation and Integration • Ordinary Differential Equations • Partial Differential Equations • Optimization
Laboratory Equipment	Computer programming and exercises using available software such as Matlab, Mathematica, Mathcad, or equivalent.

PROPOSED EE ELECTIVES
(EE TRACKS)

1. **Power System Operation**
   - 1.1 Power System Planning
   - 1.2 Power System Operation and Control
   - 1.3 Power System Dynamics and Stability
   - 1.4 Power System Market Operation

2. **Power System Protection**
   - 2.1 Protection of Alternators, Transformers, Bus-bars and Lines
   - 2.2 Protective Relaying
   - 2.3 Surge Protection in Power System
   - 2.4 High Voltage Insulation Engineering

3. **Power System Economics**
   - 3.1 Power System Planning
   - 3.2 Power System Reliability
   - 3.3 Economic Operation of Power System
   - 3.4 Power Quality & Demand Side Management (DSM)

4. **Advance Power System Design**
   - 4.1 Distribution Design
   - 4.2 Transmission Design
   - 4.3 CAD in Power System Analysis & Design
   - 4.4 System Protection Design

5. **Advance Electrical Design**
   - 5.1 Advance Illumination Design
   - 5.2 High Rise Building Design
   - 5.3 Sub-station Design
   - 5.4 High-Voltage DC Cable Design or Underground Cable Design

6. **Entrepreneurship**
   - 6.1 Project Management
   - 6.2 Project Testing Design & Documentation
   - 6.3 Total Quality Management
   - 6.4 Sales and Marketing Management

7. **Machine Automation and Process Control**
   - 7.1 Pneumatics & Process Control
   - 7.2 Electropneumatics
   - 7.3 Programmable Logic Controllers in Manufacturing & Power System

7.4 Human Machine Interface

8. Renewable Energy Resources Design

8.1 Nuclear Energy
8.2 Solar Energy
8.3 Wave Energy
8.4 Wind Energy
8.5 Biomass Energy

II. NON-TECHNICAL COURSES

A. SOCIAL SCIENCES (Please refer to CMO 59., s. 1996)
B. HUMANITIES (Please refer to CMO 59., s. 1996)
C. LANGUAGES (Please refer to CMO 59., s. 1996 for English 1 and 2 and Filipino 1& 2)

Course Name	**ENGLISH 3 (TECHNICAL COMMUNICATION)**
Course Description	The nature of technical communication; skills and strategies for reading and writing literature reviews, journal articles, and technical reports; making oral presentations.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisites	English 2
Course Objectives	After completing this course, the student must be able to: 1. Differentiate technical writing from other types of writing; 2. Engage him/herself critically in the reading of a specialized text; 3. Write a summary and review of a journal article; 4. Write a research paper on a technical topic; and 5. Properly acknowledge sources by using a prescribed citation format; 6. Prepare an oral presentation on a technical topic; and 7. Deliver properly an oral technical presentation.
Course Outline	1. The Nature of Technical Communication 2. Technical Writing 2.1. Introduction to Technical Writing 2.2. Library Orientation 2.3. Technical Writing: Formal Schema/Style; Word Choice 2.4. Types of Text Structure in Technical Writing 2.5. Introduction to Research: Choosing a Topic, Outlining 2.6. Skills and Strategies for Reading and Writing Journal Articles, Literature Reviews, and Technical Reports
	2.7. Evaluating Sources and Preparing a Preliminary Bibliography 2.8. Preparing and Interpreting Non-Prose Forms 2.9. Summarizing and Analyzing a Journal Article 2.10. Preparing the Different Parts of the Research Paper or Technical Report 2.11. Writing Bibliographies Using a Prescribed Format 2.12. Independent Study 3. Oral Technical Presentations 3.1. Preparing the Presentation Materials 3.2. Delivering the Technical Presentation
Laboratory Equipment	None