COURSE SPECIFICATIONS
Bachelor of Science in Civil Engineering

1. 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
Suggested References	Dugopolski, Mark. *College Algebra*, 3rd ed. Addison-Wesley, 2002. Leithold, Louis. *College Algebra and Trigonometry*. Massachusetts: Addison-Wesley, 1989. Mijares, Catalina. *College Algebra*. Swokowski, Earl W. and Jeffrey A. Cole. *Algebra and Trigonometry with Analytic Geometry*, 10th ed. Brooks/Cole Publishing Co., 2001.

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
Suggested References	Dugopolski, Mark. *College Algebra*, 3rd ed. Addison-Wesley, 2002. Leithold, Louis. *College Algebra and Trigonometry*. Massachusetts: Addison-Wesley, 1989. Swokowski, Earl W. and Jeffrey A. Cole. *Algebra and Trigonometry with Analytic Geometry*, 10th ed. Brooks/Cole Publishing Co., 2001.

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
Suggested References	Dilley, et al. *Algebra 2 with Trigonometry*. D.C. Heath & Co., 1990. Leithold, Louis. *College Algebra and Trigonometry*. Addison-Wesley, 1992. Sobel, Max A. and Norbert Lerner. *Algebra and Trigonometry*, 4th ed. New Jersey: Prentice Hall, Inc., 1995.

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 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 7.3. Relationships Between Rectangular and Polar Coordinates
Laboratory Equipment	None
Suggested References	Fuller, Gordon and Dalton Tarwater. *Analytic Geometry*, 7th ed. Addison-Wesley, 1993. Protter, Murray H. and Philip E. Protter. *Calculus with Analytic Geometry*, 4th ed. Quirino and Mijares. *Plane and Analytic Geometry*, 2nd ed. Riddle, Douglas F. *Analytic Geometry*, 6th ed. Swokowski, Earl W. and Jeffrey A. Cole. *Algebra and Trigonometry with Analytic Geometry*, 10th ed. Brooks/Cole Publishing Co., 2001.

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
Suggested Reference	Kern, Willis F. and James R. Bland. *Solid Mensuration*, 2nd ed. New York: John Wiley & Sons, Inc.

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	Advanced Algebra Analytic Geometry Solid Mensuration
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
Suggested References	Anton, Howard. *Multivariable Calculus*, 4th ed. New York: John Wiley & Sons, Inc., 1992. Berkey, Dennis D. *Calculus for Management and Social Sciences*, 2nd ed. Saunders College Publishing, 1990 Cozzens, Margaret B. and Richard D. Porter. *Mathematics with Calculus*. D.C. Heath & Co., 1987 Ellis, Robert and Benny Gulick. *Calculus with Analytic Geometry.* Harcourt Brace Jovanovich, 1990. Farlow, Stanley J. *Calculus and Its Application.* McGraw-Hill Publishing, 1990. Goldstein, Larry J., David C. Lay and David I. Schneider. *Calculus and Its Application*, 6th ed. Prentice Hall, Inc., 1993. Harsbarger, Ronald J. and James J. Reynolds. *Calculus with Applications.* D.C. Heath & Co., 1990. Hoffman, Laurence D. *Calculus for Business, Economics and the Social and Life Sciences*, 3rd ed. McGraw-Hill Book Co., 1989. Holder, Leonard L. *A Primer for Calculus*, 4th ed. Wadsworth Publishing Co., 1987. Larson, Roland E. and Bruce H. Edwards. *Finite Mathematics with Calculus*. D.C. Heath & Co., 1987. Leithold, Louis. *The Calculus*, 7th ed. Addison-Wesley, 2001.

	Lial, Margaret L. and Charles D. Miller. *Finite Mathematics and Calculus with Application*, 3rd ed. Scott, Foresman and Company, 1989. Protter, Murray H. *Calculus with Analytic Geometry.* James & Barlett, 1988. Swokowski, Earl W. *Calculus*, 5th ed. PWS-Kent Publishing, 1991. Zill, Dennis G. *Calculus with Analytic Geometry.* PWS-Kent Publishing, 1988. Zitarelli, David E. and Raymond F. Coughlin. *Finite Mathematics with Calculus: An Applied Approach*. Sanders College Publishing, 1989.

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
Suggested References	Anton, Howard. *Multivariable Calculus*, 4th ed. New York: John Wiley & Sons, Inc., 1992. Berkey, Dennis D. *Calculus for Management and Social Sciences*, 2nd ed. Saunders College Publishing, 1990. Cozzens, Margaret B. and Richard D. Porter. *Mathematics with Calculus*. D.C. Heath & Co., 1987. Ellis, Robert and Benny Gulick. *Calculus with Analytic Geometry*. Harcourt Brace Jovanovich, 1990. Farlow, Stanley J. *Calculus and Its Application*. McGraw-Hill Publishing, 1990. Goldstein, Larry J., David C. Lay and David I. Schneider. *Calculus and Its Application*, 6th ed. Prentice Hall, Inc., 1993. Harsbarger, Ronald J. and James J. Reynolds. *Calculus with Applications*. D.C. Heath & Co., 1990. Hoffman, Laurence D. *Calculus for Business, Economics and the Social and Life Sciences*, 3rd ed. McGraw-Hill Book Co., 1989. Leithold, Louis. *The Calculus*, 7th ed. Addison-Wesley, 2001.

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
Suggested References	Asin, Ricardo C. *Elementary Differential Equations*. National Book Store, 1991. Dela Fuente, Feliciano and Uy. *Elementary Differential Equations*. National Book Store, 1999.

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
Suggested References	Sellers, Gene R. and Stephen A. Vardeman. *Elementary Statistics*, 2nd ed. Saunders College Publishing, 1982. Walpole, Ronald E., et al. *Probability and Statistics for Engineers and Scientists*, 7th ed. Prentice Hall, Inc., 2002.

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)
Suggested References	Chang, Raymond. *Chemistry*, 8th ed. (International Ed.). New York: McGraw Hill, 2005. Eubanks, Lucy P., et al. *Chemistry in Context*, 5th ed. Boston: McGraw Hill, 2006. Masterton, William L. and Cecile N. Hurley. *Chemistry: Principles and Reactions*, 5th ed. Canada: Thomson Brooks/Cole, 2004. Brady, James E., and Fred Senese. *Chemistry: Matter and Its Changes*, 4th ed. New Jersey: John Wiley & Sons, Inc., 2004. Brown, Theodore L., et al. *Chemistry: The Central Science*, 9th ed. New Jersey: 2003. Silberberg, Martin S. *Chemistry: The Molecular Nature of Matter and Change*, 3rd ed. (International Ed.). New York: McGraw Hill, 2003.

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
Suggested References	Cutnell, J.D. and K.W. Johnsons. *Physics*, 4th ed. Halliday, David, Robert Resnick and Jearl Walker. *Fundamentals of Physics*, 5th ed. John Wiley & Sons, Inc., 1996. Serway, Raymond A. and John W. Jewett Jr. *Physics for Scientists and Engineer*s, 6th ed. Brooks/Cole Publishing Co., 2003. Young, Hugh D. and Roger A. Freedman. *University Physics*, 10th ed. Addison Wesley.

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
Suggested References	Cutnell, J.D. and K.W. Johnsons. *Physics*, 4th ed. Halliday, David, Robert Resnick and Jearl Walker. *Fundamentals of Physics*, 5th ed. John Wiley & Sons, Inc., 1996. Serway, Raymond A. and John W. Jewett Jr. *Physics for Scientists and Engineer*s, 6th ed. 2004. Young, Hugh D. and Roger A. Freedman. *University Physics*, 10th ed. Addison Wesley.

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
Suggested References	French, Thomas E., Charles J. Vierck and Robert J. Foster. *Engineering Drawing and Graphic Technology*, 14th ed. McGraw-Hill, 1993. Giesecke, Frederick E. *Principles of Engineering Graphics*, 2nd ed. Prentice Hall, Inc., 1993. Giesecke, Frederick E., et al. *Technical Drawing*, 12th ed. 2002. Luzadder, Warren J. *Fundamentals of Engineering Drawing*, 11th ed. Prentice Hall, Inc., 1992. Luzadder, Warren J. and Jon M. Duff. *Introduction to Engineering Drawing*, 2nd ed. 1992.

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
Suggested References	Caputo, Tony C., *Build Your Own Server*, McGraw-Hill, 2003. Kruse, Robert L., Bruce P. Leung and Clovis L. Tondo. *Data Structures and Program Design in C*, 2nd ed. Prentice Hall, Inc., 1996. Press, Barry and Marcia Press. *PC Upgrade and Repair Bible*, Desktop Edition. John Wiley & Sons, Inc., 2004. Sebesta, Robert W. *Concepts of Programming Languages*, 4th ed. Addison-Wesley Publishing Co., 1999.

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
Suggested References	*CAD Software User's Manual*.

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
Suggested References	Bedford, Anthony and Wallace Fowler. *Engineering Mechanics: Statics*, 3rd ed. New Jersey: Prentice Hall, Inc., 2002. Beer, Ferdinand P. and E. Russell Johnston Jr. *Vector Mechanics for Engineers: Statics*, 7th SI ed. Pacheco, Edgardo S. *Statics of Rigid Bodies*, SI ed.

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
Suggested Reference	Beer and Johnston. *Vector Mechanics for Engineers: Dynamics*, 7th SI ed. McGraw-Hill, 2003.

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
Suggested References	Hibbeler, Russell C. *Mechanics of Materials*, 5th ed. Prentice Hall, Inc., 2002. Higdon, Archie, et al. *Mechanics of Deformable Bodies*, 4th ed. John Wiley & Sons, 1989. McGill, David and Wilton M. King. *Engineering Mechanics, An Introduction to Dynamics*, 3rd ed. PWS Publishing Co., 1995.

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
Suggested References	Blank, Leland T. and Anthony J. Tarquin. *Engineering Economy*, 6th ed. McGraw-Hill, Inc., 2005. Grant, Eugene L., et al., *Principles of Engineering Economy*, 8th ed. John Wiley & Sons, Inc., 1990. Newman, Donald G., Jerome P Lavelle and Ted S. Eschenbach. *Essentials of Engineering Economic Analysis*, 2nd ed., Oxford University Press, 2002. Park, Chan S. *Contemporary Engineering Economics*, 3rd ed. Addison Wesley, 2001. Riggs, James L., et al. *Engineering Economics*, 4th ed., McGraw-Hill, 1996. Sullivan, William G., Elin M. Wicks and James T. Luxhoj. *Engineering Economy*, 12th ed. Prentice Hall, Inc., 2002. Thuesen, Gerald J. and W.J. Fabrycky. *Engineering Economy*, 9th ed. Prentice Hall, Inc., 2001.

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
Suggested References	Eisner, Howard. *Essentials of Project and System Engineering Management*, 2nd ed. John Wiley & Sons, Inc., 2002. Gram, Harold A. *An Introduction to Management.* Holt, Rinehart and Winston of Canada, Limited, 1990. Oberlender, Gerold D. *Project Management for Engineering and Construction*, 2nd ed. McGraw-Hill, 2000. Robbins, Stephen P. and Mary Coulter. *Management*, 6th ed. Prentice Hall, Inc., 1999. Wheeler, Thomas F. *Computer and Engineering Management.* McGraw-Hill, 1990.

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
Suggested References	Bellardi, O'Brien. *Hazardous Waste Site Remediation*. John Wiley & Sons, Inc., 1995. Crites, Ron and G. Tchobanoglous. *Small and Decentralized Wastewater Management Systems*. McGraw-Hill, 1998. Davis, Mackenzie L. and Susan J. Masten. *Principles of Environmental Engineering and Science*. McGraw-Hill, 2004. Guzmar, Ruth and Roger Guzmar. *Environmental Education for Sustainable Development*. Wisdom Advocate Publishing, 2000. Heisketh, Howard. *Air Pollution Control - Traditional and Hazardous Pollutants*. Technomic Publishing Co., Inc., 1996. Henze, M., et al. *Wastewater Treatment*. Berlin: Springer Verlag, 1997. Kay, J.G., G.E. Keller and J.F. Miller. *Indoor Air Pollution*. Chelsea, Michigan: Lewis Publishers, 1991. Kiely, Gerard. *Environmental Engineering*. McGraw-Hill, 1997. Metcalf and Eddy, Inc. *Wastewater Engineering - Collection, Treatment and Disposal*. McGraw-Hill, 1991. Mihekic, James. *Fundamentals of Environmental Engineering*. John Wiley & Sons, Inc., 1999. Nemerow, N.L. and F. Agardy. *Strategies of Industrial and Hazardous Waste Management*. International Thomson Publishing Company, 1998. Ortolano, Leonard. *Environmental Regulation and Impact Assessment*. John Wiley & Sons, Inc., 1997. Perry, S., D. Rower and G. Tchobanoglous. *Environmental Engineering*. McGraw-Hill, 1985. Wark, K., C. Warner and W. Davis. *Air Pollution - Its Origin and Control*. Addison-Wesley, 1998.

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
Suggested References	Asfahl, C. Ray. *Industrial Safety and Health Management*, 5th ed. Prentice Hall, Inc., 2003. Department of Labor and Employment. *Occupational Health and Safety Standards.* Hopf, Peter S. *Designer's Guide to OSHA*, 2nd ed. New York: McGraw-Hill, 1982.

D. ALLIED COURSES

Course Name	**BASIC MECHANICAL ENGINEERING**
Course Description	This course is an introduction to fundamental concepts of thermodynamics; heat transmissions in building structures; ventilating and air-conditioning systems; air distribution system design; and indoor air quality. It includes study of design considerations of electrical services, elevator and escalator, fire protection system, illumination, acoustics and automated system for buildings.
Number of Units for Lecture and Laboratory	**3 units lecture**
Number of Contact Hours per week	
Prerequisite	College Algebra, Plane and Spherical Trigonometry, Physics 2
Course Objectives	After completing this course, the student must be able to: 1. Understand the basic concepts of thermodynamics and heat transfer and their application to thermal systems; 2. Know the current design practices and procedures for building electrical services, elevator and escalator, fire protection, intelligent buildings and green building and apply such concepts, practices and procedures to a term project. 3. Know the ethical issues which are relevant to the topics discussed.

Course Outline	1. Basic Concepts of Thermodynamics and Heat Transfer 2. Refrigeration and Air-Conditioning Principles 3. Individual Components Air-Conditioning and Ventilating Systems 4. Cooling Load Calculation and Air Distribution System Design 5. Indoor Air Quality-Comfort and Health 6. Electrical Services for Buildings 7. Elevator and Escalator in Buildings 8. Fire Protection System 9. Illumination and Acoustics 10. Building Automated System Design 11. Green Building Design 12. Visitation to construction sites, problem solving and exhibits
Laboratory Equipment	**None**
Textbooks and References	Benjamin Stein and John S. Reynolds; *Mechanical and Electrical Equipment for Buildings,* 8th Ed., c. 1992 David Bearg, *Indoor Air Quality and HVAC Systems*, c. 1993 ASHRAE Journal Articles ASHRAE Handbook – Fundamentals Charles Fleddermann, *Engineering Ethics*, 2nd Ed., c. 2004

Course Name	**BASIC ELECTRICAL ENGINEERING**
Course Description	This course provides the students a sound background in the theory and concepts of the fundamental and basic laws of electricity and magnetism. Practical applications such as electrical equipment, electrical safety, blueprint reading, house and commercial building wiring, and lighting are introduced
Number of Units for Lecture and Laboratory	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite	College Algebra, Plane and Spherical Trigonometry, Physics 2
Course Objectives	After completing this course, the student must be able to: 1. Have a deeper understanding and appreciation about electric circuits. 2. Understand and apply operating principles of AC-DC equipment. 3. Understand basic electrical blueprint, house wiring and lighting and electrical safety. 4. Appreciate the importance of the course.

Course Outline	1. **DIRECT CURRENT.** Ohm's Law, Series, Parallel Connections, Batteries and Power. 2. **ALTERNATING CURRENT.** Voltage, Current & Phase, Peak, rms, Average Values. 3. **MAGNETISM.** Fundamentals, Magnetic Circuits, Units of Magnetics. **4. ELECTRICAL MATERIALS.** Conductors, Insulators, Semiconductors. 5. **DC MACHINES / EQUIPMENT.** Fundamental Concepts, Motors, Meters. **6. AC MACHINES / EQUIPMENT.** Fundamental Concepts, Motors, Transformers. 7. **ELECTRICAL SAFETY.** Equipment Protection, Personnel Protection. 8. **BLUEPRINT READING.** Electrical Symbols, Electrical Diagrams. 9. **HOUSE/COMMERCIAL BUILDING WIRING AND LIGHTING**
Laboratory Equipment	NONE
Suggested References	1. *National Electrical Code Handbook.* 2. Gussow, Milton; *Schaum's Outline Series: Basic Electricity Theory & Problems.* 1983 3. Fowler, Richard; *Electriity Principles & Applications.* 1989. 4. Mullin, Ray C. and Smith, Robert L.; *Electrical Wiring (Commercial)*

E. PROFESSIONAL COURSES

E.1. Planning

Course Name	**SURVEYING 1 (Elementary and Higher Surveying)**
Course Description	Theory and practice of surveying techniques and instruments including tape, compass, transit, theodolite and level; running a traverse and leveling, preparation of plans of survey, and relocation of boundaries. Topographic surveying methods, Global Positioning System location for latitude, longitude, time and location of shorelines and sounding, measuring velocity and discharge of streams, aerial and satellite surveying. Use of a Global Positioning System in surveying and computer software.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units Fieldwork – 1 unit
Number of Contact Hours per week	Lecture – 3 hours Fieldwork – 3 hours
Prerequisite/Co-requisite	Advanced Algebra, Plane and Spherical Trigonometry, Engineering Drawing
Course Objectives	After completing this course, the student must be able to: 1. Understand the appropriate surveys and investigations required for various civil engineering projects. 2. Know the requirements of various surveys and investigations 3. Know the methodologies of carrying out the more common surveys and investigations such as topographic surveys
Course Outline	1. Surveying concepts 2. Measurements of Vertical and Horizontal Distances 3. Leveling (Differential, Profile, Cross-section) 4. Traverse survey 5. Area computation 6. Subdivision 7. Topographic survey 8. Triangulation 9. Hydrographic survey

	10. Global Positioning System 11. Computer applications
Laboratory Equipment	1. Measuring tapes 2. Stadia rods and range poles 3. Level 4. Transit/Theodolite 5. GPS 6. Surveying software
Suggested References	1. Elements of Plane Surveying, Benton 2. Surveying Fundamentals, McCormac 3. Principles & Application of Surveying, Kavanagh 4. Higher Surveying, La Putt 5. Surveying, Moffit & Bouchard 6. Surveying; Theory and Practice,Anderson, James M.; Mikhail, Edward M.,

Course Name	**SURVEYING 2 (Engineering Surveys)**
Course Description	Design and Layout of Horizontal and Vertical curves, line grade; earthwork volumes, theory of location as applied to highway and railways, mass diagram, overhaul and estimate of cost. Use of computer software for mass diagram. Layout and alignment of civil works structures.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units Fieldwork – 1 unit
Number of Contact Hours per week	Lecture – 3 hours Fieldwork – 3 hours
Prerequisite/Co-requisite	Surveying 1
Course Objectives	After completing this course, the student must be able to: 1. Know the methodologies of carrying out the more common surveys and investigations such as horizontal and vertical curves, line grades, earthworks and theory of locations as applied to highways and railways, mass diagram and overhaul.
Course Outline	1. Horizontal and vertical curves 2. Lines and grades 3. Earthwork computations 4. Layout and alignment of civil works structures 5. Computer applications
Laboratory Equipment	1. Measuring tapes 2. Stadia rods and range poles 3. Level 4. Transit/Theodolite 5. GPS 6. Surveying software
Suggested References	1. Surveying and Levelling, Basak 2. Surveying Fundamentals, McCormac 3. Railway Track Engineering, Mundry 4. Surveying For Construction, Irvine 5. Surveying; Theory and Practice,Anderson, James M.; Mikhail, Edward M.

Course Name:	**CIVIL ENGINEERING PROJECTS**
Course Description	A *project study* presents the highlights, descriptive definition, long—range objectives, feasibility criteria, history, and basic conclusions of the project under study. It gives the analyst and the financier a view of the whole object It also presents a comprehensive description of the business and its

	operations and briefly defines the product lines of the business. Major findings on the market, technical, financial, socio-economic, and management feasibility of the project are included in a project study. A practice oriented design project must integrate the various fields in the field of civil engineering work. Students shall operate in-groups and complete a study for a typical engineering undertaking.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 1 unit Laboratory/field/tutorial – 2 units
Number of Contact Hours per week	Lecture - 1 hour lecture & progress reports Laboratory/Field/Tutorial - 6 hours extensive research and fieldwork.
Prerequisite/Co-requisite	5th Year standing
Course Objectives	After completing this course, the student must be able to: 1. Understand methods of research, such as identification of a feasible project, scopes and delimitations, data interpretation, and research outputs. 2. Develop the technical and management skills required to independently plan, conduct and report on a program of investigation or research. 3. Carry out the design for a specified civil engineering development. The design project will vary from year to year but will include aspects of structural, water, geomechanics and transport design. 4. Select a project from a number of topics offered. The project outcomes are to be summarized in a major report and in a brief oral presentation
Course Outline	1. *Lecture:* Project Summary. 2. *Lecture:* Descriptive Definition of the Project, Project's Long-Range Objective, and Feasibility Criteria. 3. *Lecture:* Highlights of the Project. History. Project Time Table Status. Nature Of The Industry. Mode Of Financing. Investment Costs. 4. *Lecture:* Major Assumption and Summary of Findings and Conclusion. Market Feasibility. Technical Feasibility. Financial Feasibility. Socio-Economic Feasibility. Management Feasibility. Project Proposal. 5. Research and Fieldwork on the Selected Study. Progress Reports. 6. Submission of Work: 100% (written project proposal, final report on practical work, seminar presentation).
Laboratory Equipment	Dependent on the type of project undertaken
Suggested References	1. Cuyugan, Jorge H. 2001. *A Business Planning Manual: A Project Feasibility Study Guide for Filipinos.* Philippines: Bright Concepts. 2. National Writing Project. 2003. *Because Writing Matters: Improving Student Writing in our Schools*. Jossey-Bass. 3. Asian Productivity Organization. 1981. *Project Feasibility Study Preparation.* APO. 4. Published/unpublished thesis, dissertation, project study or feasibility study.

Course Name:	BUILDING DESIGN 1
Course Description	A study on building parts and its construction, i.e. from the foundation to the roofing. Study of the National Building Code and other pertinent codes. A practical subject that will develop in the student the skills required in building design and construction. This includes interpretation of building plans and actual observation and study.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 1 unit Laboratory – 1 unit
Number of Contact Hours per week	Lecture – 1 unit Laboratory – 3 unit
Prerequisite/Co-requisite	Engineering Drawing
Course Objectives	After completing this course, the student must be able to: 1. Have knowledge in drafting building plans. 2. Read and interpret building plans. 3. Apply the theoretical knowledge into the actual construction.
Course Outline	1. Interpretation and reading of building plans 2. Foundation plan and details 3. Floor plans and elevations 4. Floor and roof framing plan and details 5. Structural plans and details 6. Detailed cross and longitudinal sections 7. Formworks and scaffoldings
Laboratory Equipment	Drafting Room
Suggested Textbooks and References	1. Building Construction books 2. Planning and Designers Handbook, Max Fajardo 3. Building Construction Illustrated, Francis D.K. Ching 4. Actual Building Plans in Blueprint 5. Uniform Building Code 6. National Building Code 7. National Structural Code of the Philippines 8. Simplified Building Construction, Max Fajardo

Course Name:	BUILDING DESIGN 2
Course Description	The study of the plumbing code, fire code and electrical code of the Philippines, its interpretation and application in building design and construction.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 1 unit Laboratory – 1 unit
Number of Contact Hours per week	Lecture – 1 unit Laboratory – 3 unit
Prerequisite/Co-requisite	Building Design 1
Course Objectives	After completing this course, the student must be able to: 1. Interpret the various building codes of the Philippines. 2. Prepare drafting plans. 3. Differentiate different electrical and construction materials 4. Understand actual plumbing and electrical layout.
Course Outline	1. Plumbing works 2. Electrical works 3. Mechanical works 4. Carpentry and finishing works 5. Fire Protection
Laboratory Equipment	Drafting Room
Suggested References	1. Simplified Plumbing Design and Estimates by Max Fajardo 2. Simplified Electrical Design and Estimates, Max Fajardo 3. Plumbing Code of the Philippines

	4. Mechanical Code of the Philippines 5. Fire Code of the Philippines 6. Electrical Code of the Philippines 7. Uniform Building Code 8. Building Construction Illustrated, Francis D.K. Ching

E.2. Design

Course Name	**ADVANCED ENGINEERING MATHEMATICS FOR CE**
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, Laplace and Inverse Laplace Transforms, Power series, Fourier series, Matrices and Determinants, Vector Analysis and Numerical Methods.
Number of Units for Lecture and Laboratory	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite	Differential Equations
Course Objectives	After completing this course, the student must be able to: 1. Familiarize themselves with the different parameters, laws, theorems and the different methods of solutions in advance mathematics, 2. Develop their abilities on how to apply the different laws, methods and theorems particularly in complex problems.
Course Outline	1. Complex Numbers 2. Laplace and Inverse Laplace Transforms 3. Power Series 4. Fourier Series 5. Vector Analysis 6. Numerical Methods
Laboratory Equipment	NONE
Textbooks and References	1. Dulay,Virgilio, *Advanced Engineering Mathematics,* 1996 2. Kreyszig, Erwin, *Advanced Engineering Mathematics,* John Wiley and Son Publishing 1972 3. Bromwell,Arthur, *Advanced Mathematics in Physics and Engineering,* Mc Graw Hill Publishing 1953 4. Kolman, Bernard *Linear Algebra*, Mc Millan Publishing Hous1991 5. Scheid, Francis, *Numerical Analysis, Mc Graw Hill Publishing* 1968 *6. MatLab Manuals Rel 12, MSOffice 2000*

Course Name	**GEOTECHNICAL ENGINEERING 1 (Soil Mechanics)**
Course Description	This course deals with the study of the identification and classification of soils and rocks, Site investigation and subsurface exploration, the physical and index properties of soil, compaction, water flow through soils, subsurface stress and deformation phenomena in soils, laboratory testing, and the relevance of these topics as they affect soil strength, compressibility, stability, and drainage. A thorough knowledge of engineering geology and the mechanics of deformable bodies is imperative
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units Laboratory – 1 unit

Number of Contact Hours per week	Lecture – 3 hours Laboratory – 3 hours
Prerequisite/Co-requisite	Mechanics of Deformable Bodies
Course Objectives	After completing this course, the student must be able to: 1. Define soil mechanics and its importance in civil engineering. 2. Show proficiency in determining soil and rockproperties, selecting soil parameters for analysis and design relevant to geotechnical engineering. 3. Describe the fundamentals of geotechnics. 4. Demonstrate concepts and principles of field exploration. 5. Understand various subsurface explorations equipments, soil laboratory tests and equipments
Course Outline	1. Introduction: Soil: Its Importance in Civil Engineering and Man's Most Common and Complex Construction Material. Origin of soils and rocks. Soil identification and classification. *Laboratory Exercise No. 0*--Laboratory Policies and Procedures. *Laboratory Exercise No. 1*--Soil Sampling, Labelling, and Storage. *Laboratory Exercise No. 1a*--Determination of Soil Profiles. *Laboratory Exercise No. 2*--Dry Preparation of a Disturbed Soil Sample. *Laboratory Exercise No. 3*--Wet Preparation of a Disturbed Soil Sample. *Laboratory Exercise No. 4*--Preparation of an Undisturbed Soil Sample. 2. Formation of Soil and Soil Deposits. Site investigation and subsurface exploration. Soil Description and Field Tests. *Laboratory Exercise No. 5*--Simple Visual and Manual Tests: Identification of Soil Sample in the Field. Physical Properties of Soil. 3. Index Properties of Soil. Mass—Volume Relationship. *Laboratory Exercise No. 6*--Unit Weight, Moisture Content, Specific Gravity, Void Ratio, Porosity, and Degree of Saturation Determination. 4. Consistency of Soils: Atterberg Limits. *Laboratory Exercise No.7*--Liquid Limit, Plastic Limit, Shrinkage Limit, and Plasticity Index Determination. 5. Classification Tests for Soils: AASHTO, USDA, Unified Tests. *Laboratory Exercise No. 8*--Grain Size Analysis: Sieve Test, Hydrometer Test. 6. Soil Compaction and Field Tests. *Laboratory Exercise No.9*--Compaction Tests: Standard Proctor Test, Modified AASHTO Test. *Laboratory Exercise No. 10--I*n-Place Density Determination Test: Sand-Cone Method, Water Balloon Method, Calibrated Bucket Method, Immersion Method. 7. Soil Taxonomy. 8. meability of Soils. *Laboratory Exercise No.11*-- Permeability Tests: Constant Head Test, Variable Head Test, Field Test. 9. illarity of Soils. Seepage and Drainage of Soil. 10. *Laboratory Exercise No.12*--Seepage Analysis.
Laboratory Equipment	*Laboratory Exercise No. 0*--Laboratory Policies and Procedures. *Laboratory Exercise No. 1*--Soil Sampling, Labelling, and Storage. 1. Soil Auger. 2. Spade or Shovel. 3. Digging Tools. 4. Moisture tight sample containers. 5. Petrowax or Paraffin. *Laboratory Exercise No. 1a*--Determination of Soil Profiles. 1. **Digging Instruments.** 2. **Small bottles.** 3. **Cardboard or illustration boards.** 4. **Carpet tape.** 5. **Drawing Instruments.** *Laboratory Exercise No. 2*--Dry Preparation of a Disturbed Soil Sample. 1. Triple Beam Balance or Digital Weighing Scale.

	2. Oven with temperature control. 3. Pans. 4. Standard Sieves Nr. 40 and Nr. 10. 5. Rubber Mallet or Rubber-covered Pestle. 6. Mortar and Rubber Pestle. 7. Spoon or Trowel. 8. Sample Splitter. *Laboratory Exercise No. 3*--Wet Preparation of a Disturbed Soil Sample. 1. Triple Beam Balance or Digital Weighing Scale. 2. Oven. 3. Pans with at least 300 mm ϕ and 75 mm deep. 4. Standard Sieves Nr 40. 5. Funnel. 6. Filter Paper. *Laboratory Exercise No. 4*--Preparation of an Undisturbed Soil Sample. 1. Soil Lathe. 2. Wire Saw. 3. Miter Box. 4. Knife. 5. Vernier or micrometer calipers. 6. Magnifying Glass. 7. Cellophane or Wax Paper. 8. Extruder (if the tube sample is used). *Laboratory Exercise No. 5*--Simple Visual and Manual Tests: Identification of Soil Sample in the Field. Physical Properties of Soil. 1. Erlenmeyer Flask. 2. Oven, with temperature control. 3. Mixing Containers. 4. Spoons. 5. Rolling Pan. 6. Glass Plates. *Laboratory Exercise No. 6*--Unit Weight, Moisture Content, Specific Gravity, Void Ratio, Porosity, and Degree of Saturation Determination. *Unit Weight Determination.* 1. Beaker. 2. Vernier Caliper. 3. Balance. 4. Paraffin or Candle Wax. 5. Soil Lathe. 6. Distilled Water. 7. Knife or Wire Saw. 8. Pair of Tongs. 9. Oven with temperature control. 10. Triple beam balance. 11. Small metal drying cans. 12. Pair of tongs. 13. Dessicator. *Moisture Content Determination.* 1. Oven with temperature control. 2. Triple beam balance. 3. Small metal drying cans. 4. Pair of tongs. 5. Dessicator. *Specific Gravity Determination.* 1. Pycnometer or any Volumetric Flask. 2. Oven. 3. Balance. 4. Distilled Water. 5. Thermometer graduated to 0.10° C. 6. Bunsen Burner with iron stand or Single Burner Electric Stove. 7. Water Bath. 8. Sieve Nr. 10.

	9. Drying Cans. 10. Medicine dropper or pipette 11. Pair of Tongs. *Laboratory Exercise No.7*--Liquid Limit, Plastic Limit, Shrinkage Limit, and Plasticity Index Determination. *Liquid Limit Determination.* 1. Liquid Limit Device with Grooving Tool (Casagrnde's Cup). 2. Mixing Bowl. 3. Oven with temperature control. 4. Balance, accurate to 0.10 gram. 5. Sieve Nr. 40. 6. Pans. 7. Drying Cans. 8. Metric Scale. 9. Pair of tongs. 10. Spatula. 11. Distilled Water *Plastic Limit Determination.* 1. Glass Plate. 2. Mixing Bowl. 3. Oven with temperature control. 4. Balance, accurate to 0.10 gram. 5. Sieve Nr. 40. 6. Pans. 7. Drying Cans. 8. Pair of tongs. 9. Spatula. 10. Distilled Water. *Shrinkage Limit Determination.* 1. Shrinkage Mold (45 mm ϕ and 13 mm deep). 2. 50 mm ϕ Glass Cup. 3. Petroleum Jelly. 4. Mercury Supply. 5. Medicine Dropper. 6. 115 mm ϕ Evaporating Dish. 7. Graduated Cylinder. 8. Glass Plate. 9. Prongs. 10. Spatula. 11. Oven with temperature control. 12. Pair of Tongs. 13. Dessicator. 14. Balance, accurate to 0.10 g. 15. Sieve Nr. 40. 16. Straightedge. *Plasticity Index Determination.* 1. Cone Penetrometer. 2. 50 mm ϕ Tin Cup. 3. Prongs. 4. Spatula. 5. Oven with temperature control. 6. Pair of Tongs. 7. Balance, accurate to 0.10 g. 8. Sieve Nr. 40. 9. Straightedge. *Laboratory Exercise No. 8*--Grain Size Analysis: Sieve Test, Hydrometer Test. *Sieve Test.* 1. Set of Standard Sieves. 2. Oven with temperature control. 3. Balance. 4. Pans.

	5. Pair of tongs. 6. Manual or Mechanical Sieve Shaker. 7. Mortar and Pestle. *Hydrometer Test.* 1. Balance, sensitive to at least 0.10 gram. 2. Mechanical Stirring Apparatus and Dispersion Cup. 3. Hydrometer, heavy and calibrated for soil. 4. 1-liter graduated cylinder. 5. Thermometer. 6. Set of Standard Sieves. 7. Water Bath of constant temperature. 8. Oven with temperature control. 9. Beaker, 400 ml capacity. 10. Timer or Stopwatch. 11. Sodium Silicate. 12. Distilled Water. 13. Drying Pans. 14. Dessicator *Laboratory Exercise No.9*--Compaction Tests: Standard Proctor Test, Modified AASHTO Test. *Standard Proctor Test.* 1. Compaction Mold. This consists of a cylindrical metal mold with an internal diameter of 4.00 inches, height about 4.60 inches, and having a volume of 1/30 cu. ft. with a detachable mold collar about 2.50 inches high and 4.00 inches diameter. 2. Metal rammer having a 2.00 inches diameter, weighing 5.50 lbs. and with a suitable means for controlling their drops. 3. Weighing scale, with a minimum capacity of 12 kg. 4. Balance, with a 100 g capacity and sensitive to 0.10 g. 5. Oven with temperature control. 6. Drying cans. 7. Straightedge. 8. Large mixing pan. 9. Mixing bowl. 10. Sieve Nr. 4. 11. Mortar with rubber pestle. 12. Scoop and spoons. 13. Beaker. 14. Distilled Water. 15. Tools or suitable material or mechanical device for extruding the compacted sample from mold. 16. Moisture Sprayer or any suitable device for thoroughly mixing soil sample with water. *Modified AASHTO Test.* 1. Compaction Mold. This consists of a cylindrical metal mold with an internal diameter of 4.00 inches, height about 4.60 inches, and having a volume of 1/30 cu. ft. with a detachable mold collar about 2.50 inches high and 4.00 inches diameter. 2. Metal rammer having a 4.00 inches diameter, weighing 10.00 lbs. and with a suitable means for controlling their drops. 3. Weighing scale, with a minimum capacity of 12 kg. 4. Balance, with a 100 g capacity and sensitive to 0.10 g. 5. Oven with temperature control. 6. Drying cans. 7. Straightedge. 8. Large mixing pan. 9. Mixing bowl. 10. Sieve Nr. 4. 11. Mortar with rubber pestle. 12. Scoop and spoons.

	13. Beaker. 14. Distilled Water. 15. Tools or suitable material or mechanical device for extruding the compacted sample from mold. 16. Moisture Sprayer or any suitable device for thoroughly mixing soil sample with water. *Laboratory Exercise No. 10*--In-Place Density Determination Test: Sand-Cone Method, Water Balloon Method, Calibrated Bucket Method, Immersion Method. *Sand Cone Method.* 1. Density Apparatus. This shall consist of a 4-liter (1-gallon) jar, and a detachable cone consisting of a cylindrical valve with an orifice of 13 mm (½") in diameter. The valve shall have stops to prevent rotating the valve past the completely open or completely closed positions. 2. Guide plate, about 300 mm * 300 mm * 5 mm (12" * 12" * 3/16") with a 150 mm (6") diameter hole at the center. This will serve as the base for tests of soft soil. 3. Sand. It must be clean, dry and free-flowing; preferably having few particles passing Sieve Nr. 40 or retained on Sieve Nr. 10.Use Ottawa Sand, if available. 4. Digging tools. These may consist of an earth auger, a crowbar, a chisel, a knife, and a copping saw. 5. Balances: 10-kg, and 500-gram capacities. 6. Oven with temperature control. 7. Sieve Nr. 40. 8. Sand Funnel. 9. Soil Pan. 10. Drying Cans. 11. Container. 12. Straightedge. 13. Thermometer. 14. Distilled Water. *Water Balloon Method.* 1. Balloon Apparatus. This is a calibrated vessel containing a liquid within a relatively thin flexible, elastic membrane (plastic balloon). 2. Base Plate. A rigid metal plate machined to fit the base of the balloon apparatus. 3. Balances, one of the 10 kg capacity readable to 1.00 g, another of 2.00 kg capacity readable to 0.10g. 4. Oven, with temperature control. 5. Drying Cans 6. Pair of Tongs. 7. Soil Pan. 8. Digging Tools. These may include crowbars, augers, small picks, chisels, spoons, brushes, screwdrivers, and copping saw. 9. Plastic bags, buckets with lid, shovels or spades and a straightedge for leveling and preparing test location. 10. Calibration equipment. Thermometer accurate to 0.50 , glass plate 6mm or thicker, and grease. *Calibrated Bucket Method.* 1. Calibration Bucket. 2. Guide plate, about 300 mm * 300 mm * 5 mm (12" * 12" * 3/16") with a 150 mm (6") diameter hole at the center. This will serve as the base for tests of soft soil. 3. Sand. It must be clean, dry and free-flowing; preferably having few particles passing Sieve Nr. 40 or retained on Sieve Nr. 10.Use Ottawa Sand, if available. 4. Digging tools. These may consist of an earth auger, a crowbar, a chisel, a knife, and a copping saw.

	5. Balances: 10-kg, and 500-gram capacities. 6. Oven with temperature control. 7. Sieve Nr. 40. 8. Sand Funnel. 9. Soil Pan. 10. Drying Cans. 11. Container. 12. Straightedge. 13. Thermometer. 14. Distilled Water. *Immersion Method.* 1. Digging tools. These may consist of an earth auger, a crowbar, a chisel, a knife, and a copping saw. 2. Balance, sensitive to 0.10g. 3. Oven with temperature control. 4. Spatula. 5. Soil Pan. 6. Drying Cans. 7. Paraffin or Petrowax. 8. Distilled Water. *Laboratory Exercise No.11*-- Permeability Tests: Constant Head Test, Variable Head Test, Field Test. *Constant Head Test.* 1. Permeameter Set. The set must be complete with pipe fittings and head with air escape valve and fitting. 2. Standpipe. 3. Vacuum Pump. 4. Balance, sensitive to 0.10g. 5. Sieve Nr. 200. 6. Distilled Water. 7. Thermometer, sensitive to 0.10 C. 8. Stop Watch. 9. Tamping Device. 10. Graduated Cylinder. 11. Oven, with temperature control. 12. Drying Cans. 13. Calipers. 14. Scoop. 15. Funnel. 16. Graduated Flask. 17. Meterstick. 18. Rubber Tubing. 19. Support Frames, and Clamps. *Variable Head Test.* 1. Permeameter Set. The set must be complete with pipe fittings and head with air escape valve and fitting. 2. Standpipe. 3. Vacuum Pump. 4. Balance, sensitive to 0.10g. 5. Sieve Nr. 200. 6. Distilled Water. 7. Thermometer, sensitive to 0.10 C. 8. Stop Watch. 9. Tamping Device. 10. Graduated Cylinder. 11. Oven, with temperature control. 12. Drying Cans. 13. Calipers.

	14. Scoop. 15. Funnel. 16. Graduated Flask. 17. Meterstick. 18. Rubber Tubing. 19. Support Frames, and Clamps. *Field Test.* 1. Bottomless Can, about 1.50-liter capacity. 2. Hammer. 3. Wooden Board. 4. Meterstick. 5. Bucket or Jar, with 2.00-liter capacity. 6. Distilled Water. 7. Stop Watch. 8. Masking or Electrical Tape. *Laboratory Exercise No.12*-- Seepage Analysis. 1. Computer. 2. Software Package on Geotechnical Engineering (Seepage Analysis). 3. Printer or Plotter.
Suggested References	1. Mc Carthy, David F. 2001. *Essentials of Soil Mechanics and Foundations: Basic Geotechnics, 6th Edition*. New Jersey, USA : Prentice Hall. 2. Liu, Cheng. 2000. *Soils and Foundations*. New York, USA : John Wiley & Sons. 3. Liu, Cheng. 2000. *Soil Properties Testing Measurement and Evaluation, 4th Edition.* New Jersey, USA : Prentice Hall. 4. Budhu, Muni. 2000. *Soil Mechanics and Foundations.* New York, USA : John Wiley & Sons. 5. Das, Braja. 1999. *Fundamentals of Geotechnical Engineering.* Brooks/Cole Publishing Co. 6. Bowles, Joseph. 1995. *Foundation Analysis and Design,, 5th Edition.,* USA. 7. Cernica, John N. 1995. *Soil Mechanics.* USA:John Wiley and Sons, Inc. 8. Terzaghi, Karl et. al. 1995. *Soil Mechanics For Engineering Practice.* John Wiley and Sons, Inc. 9. Sowers, George F., Sowers, George B. 1979. *Introductory Soil Mechanics and Foundation.* Macmillan, New York.

Course Name:	**GEOTECHNICAL ENGINEERING 2 (Foundation)**
Course Description	The introductory part of this course deals with the some fundamentals of geotechnical engineering that includes compressibility of soil, shear strength of soils, triaxial tests of soils, settlement, lateral earth pressure, soil bearing capacity, slope stability, and earth retaining structures. The second part of this course deals with the design of reinforced concrete footings such as wall footing, square isolated footing (subject to axial load, and to axial load and bending moment), rectangular footing (isolated and combined), trapezoid footing, footing on piles, and strap footing.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units Laboratory – 1 unit
Number of Contact Hours per week	Lecture – 3 hours Laboratory – 3 hours extensive exercises

Prerequisite/Co-requisite	Geotechnical Engineering 1
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles of soil compressibility as applied to different types of soil profiles. 2. Discuss the procedures on how to solve problems regarding the effective stress concepts that include vertical stress on a point below the ground surface, subsurface stress below water surface and other different current conditions of soil. 3. Analyze the effects of vertical and horizontal stresses of soil on the structure that is to be constructed at a depth below the ground surface. 4. Calculate the magnitude of the lateral earth pressure that can be produced on soil using the Rankine and Coulomb's theories. 5. Use new geotechnical engineering materials. 6. Apply geotechnical engineering software. 7. Apply different methods of analysis and design of the foundation components of structures. 8. Design various types of reinforced concrete footings of the structures to be erected at specific locations
Course Outline	1. Compressibility of Soils: Settlement due to primary consolidation of soil (for normally consolidated of soil and overconsolidated clays), Consolidation settlement due to stresses caused by footing. 2. Shear Strength of Soils: Direct shear test (normally consolidated and overconsolidated clays). 3. Triaxial Tests of Soil: Consolidated-drained test. Consolidated-undrained Triaxial Test (normally consolidated and overconsolidated clays) 4. Lateral Earth Pressure: Lateral Earth pressure using Rankine and Coulomb's theories. 5. Soil Bearing Capacity: Terzaghi's Bearing Capacity. 6. Foundation Structures (Shallow and Deep Foundations)-- Design of Reinforced Concrete Footing: 7. Wall footing. 8. Square isolated footing subjected to axial load, and axial load and bending moment. 9. Rectangular isolated footing. 10. Footing on piles. 11. Rectangular combined footing. 12. Trapezoidal footing. 13. Strap footing. 14. Settlement Analysis. 15. Slope Stability Analysis. 16. Retaining Walls and Slope Protection. 17. Geosynthetics, Geotextiles, Soil Stabilization and Improvement.
	Laboratory Exercise No. 1--Bearing Ratio Capacity of Compacted Soil. 1. Load Machine. This loading machine must have a capacity of at least 44.5 kN, and equipped with a movable head or base that travels at a uniform (not pulsating) rate of 1.25 mm (0.05")/min., for use in forcing the penetration piston into the specimen. The machine shall be equipped with a load-indicating device that can read to 44 KN or less. 2. Mold. Metal and cylinder in shape. It shall be provided with metal extension collar, and a perforated metal base plate. 3. Spacer Disk. 4. Metal Rammer. 5. Expansion-Measuring Apparatus. 6. Sets of Weights. 7. Penetration Piston. 8. Gages – two dial gages. 9. Miscellaneous Apparatus such as mixing bowl, straightedge, scales, soaking tank or pan, oven, drying cans, scoops, filter

Laboratory Equipment	paper and dishes. *Laboratory Exercise No. 2*--Consolidation Test. 1. Casagrande type oedometer, which includes: 1.1 Consolidation ring, internal diameter 75 mm, height 20 mm. 1.2 Fixed ring, consolidation cell. 1.3 Dial gauge reading to 0.01 mm having a travel of at least 10 mm. 1.4 Loading device. 2. Flat glass plate, approximately 100 mm * 100 mm. 3. Oven with temperature control. 4. Top pan weighing balance reading accurate to 0.10 g. 5. Vernier calipers. 6. Packet of 75 mm ϕ Filter Papers. 7. Silicone Grease or Petroleum Jelly. 8. Set of Standard Weights. 9. Stopwatch or Clock readable to 1 second. 10. Palette Knife. *Laboratory Exercise No. 3*--Standard Penetration Test. 1. Drilling Equipment. 2. Split-Spoon sampler 3. Standard Penetration Test Set. 4. Labels, data sheets, sample container and other necessary materials. *Laboratory Exercise No. 4*--Direct Shear Test, Vane Shear Test, Triaxial Shear for Cohesionless Soil, Triaxial Shear for Cohesive Soil. *Direct Shear Test.* 1. Sample Former – a cutter or mold for forming samples to fit the shear box. Samples can be compacted directly in the shear box. 2. Direct shear Machine 3. Proving shear assembly. 4. Extensometer assembly , 2 sets 5. Remolding Cylinder and tamper 6. Stop Watch 7. Other laboratory equipment, as oven with temperature control, drying cans,balances,caliper and pans. *Vane Shear Test.* 1. Vane Shear Set. 2. Steel Torque Rods. *Triaxial Shear Test.* 1. Vacuum shear base and cap. 2. Rubber membrane-for holding sample. 3. Forming jacket, funnel, tampers-for molding sample. 4. Vacuum gage and source-for internal vacuum. 5. Loading machine-to apply axial load. 6. Balance, protractor, scale, calipers. *Laboratory Exercise No.5*--Unconfined Compression Test. 1. Unconfined compression machine. 2. Sample molder and tamper 3. Extensometer Assembly. 4. Protractor and calipe.r 5. Wax Paper. 6. Other laboratory equipment, such as oven with temperature control, drying cans, balances and pans. *Laboratory Exercise No. 6*—Applications of Geotechnical Engineering

	Software. 1. Computer. 2. Software Package on Geotechnical Engineering. 3. Printer or Plotter.
Suggested References	1. Mc Carthy, David F. 2001. *Essentials of Soil Mechanics and Foundations: Basic Geotechnics, 6th Edition.* New Jersey, USA : Prentice Hall. 2. Liu, Cheng. 2000. *Soils and Foundations.* New York, USA : John Wiley & Sons. 3. Liu, Cheng. 2000. *Soil Properties Testing Measurement and Evaluation, 4th Edition.* New Jersey, USA : Prentice Hall. 4. Budhu, Muni. 2000. *Soil Mechanics and Foundations*. New York, USA : John Wiley & Sons. 5. Das, Braja. 1999. *Fundamentals of Geotechnical Engineering*. Brooks/Cole Publishing Co. 6. Bowles, Joseph. 1995. *Foundation Analysis and Design,, 5th Edition.* USA. 7. Cernica, John N. 1995. *Soil Mechanics.* USA:John Wiley and Sons, Inc. 8. Terzaghi, Karl et. al. 1995. *Soil Mechanics For Engineering Practice*. John Wiley and Sons, Inc. 9. Sowers, George F., Sowers, George B. 1979. *Introductory Soil Mechanics and Foundation.* Macmillan, New York.

Course Name	**STRUCTURAL THEORY 1**
Course Description	The course covers the different types of structural systems, loads and its combinations and placement, applicable codes and specifications, and methods of analysis for statically determinate structures.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units Laboratory – 1 unit
Number of Contact Hours per week	Lecture – 3 hours Laboratory – 3 hours
Prerequisite	Mechanics of Deformable Bodies
Course Objectives	After completing this course, the student must be able to: 1. Know the history of history of structural engineering, identify various types of structural systems, appreciate the importance of codes and specifications and decide the appropriate loads to apply into the structures; 2. Idealize real structures to obtain analytical models; identify the state of determinancy and stability of structures; to know the various structural analysis theorems and principles; 3. Apply the equations of static equilibrium to analyze the trusses, beams, frames, cables and arches; 4. Develop intuition on deflected shapes of structures under loading; 5. Analyze moving loads on highway and railway bridges using influence lines; 6. Develop confidence in structural analysis in preparation for design courses; 7. Reflect on the consequences of analysis results to life and safety of people; 8. Develop ethnical responsibility to their clients to produce strong and safe structures.
Course Outline	1. Introduction to structural Engineering; the analysis and design of process; types of structural forms, of loading conditions and building materials. 2. Analysis of statically determinate Structures

	3. Analysis of statically determinate Trusses 4. Internal loadings developed in structural members 5. Cable and arches 6. Influence lines on statically determinate Structures 7. Deflections 8. Approximate analysis of statically indeterminate Structures
Laboratory Equipment	None
Suggested References	**Textbooks** 1. Structural Analysis*, 4th Ed, Prentice Hall 1999., N.J. By: Hibbler, R. C.* 2. National Structural Code of the Philippines, 5th ed. *Association of Structural Engineers of the Philippines, Manila 2001 by Association of Structural Engineers of the Philippines* **References** *1.* Utku, Senol, Norris C.H. and Wilbur, J.B., *Elementary Structural Analysis, 4th ed.*McGraw-Hill Inc. N.Y. 1991 *2. The National Building Code of the Philippines and its Implementing Rules and Regulations,* Philippine Law *3.* Gazette, Manila, 2000 by Foz, V.B. ed *4.* Hagen, K.D., *Introduction to Engineering Analysis*, Prentice Hall, New Jersey, 2001 *5.* Rajan, S.D., *Introduction to Structural Analysis and Design*, John Wiley & Sons, Inc. New York, 2001 *6.* Gahli, A.And Neville A.M., *Structural Analysis, A Unified Classical and Matrix Approach,* 4th ed. E&FN Spon, London 1997 *Theory of Structures,* Vol. 11, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1999 by Gupta, S.P., Pandit, G.S., And Gupta, R. *7.* Lin, T.Y. and Stotesbury, S.D., *Structural Concepts and Systems for Architects and Engineers*, 1981 *8.* Kassimali, A., *Structural Analysis,* 2nd Ed, Brooks/Cole Publishing Company, 1999 *9.* McCormac, J.C. and Nelson J.C., *Structural Analysis, A Classical and Matrix Approach*,_1997 *10.* John Wiley byWest, H., *Fundamentals of Structural Analysis*,_1993,_ *11.* Harrison, H.B., *Structural Analysis and Design*: Some Microcomputer Applications, 2nd Ed, Pergamon Press, 1990 *12.* John Wiley by West, H., *Analysis of Structures: An Integration of Classical and Modern Methods,* 1989,

Course Name	**STRUCTURAL THEORY 2**
Course Description	The course covers the theory of structures analysis as applied to indeterminate structures such as indeterminate beams, planar and space frames and trusses subject to static loads; method of consistent deformation; three-moment equation; slope-deflection method; moment distribution; energy methods, matrix methods; and approximate method of analysis.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units Laboratory – 1 unit
Number of Contact Hours per week	Lecture – 3 hours Laboratory – 3 hours
Prerequisite	Structural Theory 1
Course Objectives	After completing this course, the student must be able to: 1. Apply the fundamental principles of structural analysis for indeterminate structures. 2. Evaluate the structural behavior of indeterminate structures 3. Be analytical and systematic in the approach to problem solving

	4. Prepare for design work
Course Outline	1. Review of deflections of structures 2. Introduction to statically indeterminate structures 3. Approximate analysis of statically indeterminate structures 4. Analysis of statically indeterminate structures by method of consistent deformation; three-moment equation 5. Displacement method of analysis slope-deflection method; moment distribution; 6. Introduction to matrix structural analysis
Laboratory Equipment	NONE
Suggested References	**Textbooks** 1. ***Structural Analysis*, 4th Ed, Prentice Hall 1999., N.J. By: Hibbler, R. C.** 2. ***National Structural Code of the Philippines, 5th ed.*Association of Structural Engineers of the Philippines, Manila 2001 by Association of Structural Engineers of the Philippines** **References** 1. *Elementary Structural Analysis, 4th ed.*McGraw-Hill Inc. N.Y. 1991 by Utku, Senol, Norris C.H. and Wilbur, J.B. 2. *The National Building Code of the Philippines and its Implementing Rules and Regulations,* Philippine Law Gazette, Manila, 2000 by Foz, V.B. ed 3. *Introduction to Engineering Analysis*, Prentice Hall, New Jersey, 2001 by Hagen, K.D. 4. *Introduction to Structural Analysis and Design*, John Wiley & Sons, Inc. New York, 2001 by Rajan, S.D. 5. *Structural Analysis, A Unified Classical and Matrix Approach,* 4th ed. E&FN Spon, London 1997 by Gahli, A. And Neville A.M. 6. *Theory of Structures,* Vol. 11, Tata McGraw-Hill PublishingCo. Ltd., New Delhi, 1999 by Gupta, S.P., Pandit, G.S., and Gupta, R. 7. *Structural Concepts and Systems for Architects and Engineers*, 1981 by Lin, T.Y. and Stotesbury, S.D. 8. *Structural Analysis,* 2nd Ed, Brooks/Cole Publishing Company, 1999 by Kassimali, A. 9. Structural Analysis, A Classical and Matrix Approach,_1997 by McCormac, J.C. and Nelson J.C. 10. Fundamentals of Structural Analysis,_1993,_John Wiley by West, H.

Course Name:	**STRUCTURAL DESIGN 1 (Reinforced Concrete)**
Course Description	This course is concerned with the design, applications and code specifications used in structural reinforced concrete members subjected to flexure *(beams, girders, joists, lintels, girts, etc.),* tension, and compression members *(columns),* combined stressed members *(beam-columns),* beam-column connections using the *Elastic Limit Method*, also known as the Alternate Stress Design (ASD) or Working Stress Design (WSD), and the *Plastic Limit Method* or the Ultimate Strength Design (USD). Applications and specifications as applied to buildings, bridges, and other reinforced concrete structures are also given emphasis. A thorough knowledge and proficiency in Structural Theory is imperative.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units Laboratory/Field/Tutorial - 1 unit
Number of Contact Hours per week	Lecture – 3 hours lecture Laboratory/Field/Tutorial – 3 hours extensive exercises and tutorials

Prerequisite/Co-requisite	Prerequisite: Structural Theory 1 Co-requisite: Structural Theory 2
Course Objectives	After completing this course, the student must be able to: 1. Identify the constituent materials of reinforced concrete and understand their behavior. 2. Develop techniques in structural design in reinforced concrete. 3. Formulate correct design strategies based on theoretical and situational experiences. 4. Formulate correct design strategies based on theoretical and situational experiences. 5. Produce different types of loads to structures using National Structural Code of the Philippines. 6. Appraised the local code of practice, i.e., the National Structural Code of the Philippines. 7. Identify advanced design methods. 8. Develop design skills and proficiency.
Course Outline	1. Introduction: Engineering Structures; Their importance and relation to real-life situations. 2. Physical and Structural Properties of Reinforced Concrete. Reinforced Concrete Materials. Concrete, Steel Reinforcement. 3. Design and Analysis of Flexural Members: Beam Descriptions, Theoretical and Practical Considerations. Rectangular Sections—Singly Reinforced. Rectangular Sections—Double Reinforcement. T-Sections. 4. Design and Analysis of Flexural Members: Shear and Diagonal Tension. Design of Stirrups. 5. Design and Analysis of Flexural Members: Bond, and Anchorage. Development Length, and Splices. 6. Design and Analysis of Flexural Members: Serviceability—Deflection and Crack Control. 7. Structural and Architectural Provisions for Beams. 8. Continuous Reinforced Conrcete Structures—NSCP Specification. 9. Design and Analysis of Flexural Members: Design of Slabs—One Way Reinforcement. 10. Design and Analysis of Flexural Members: Design of Slabs—Two Way Reinforcement: Direct Method. 11. Design and Analysis of Flexural Members: Design of Slabs—Two Way Reinforcement: Equivalent Frame Method. 12. Structural and Architectural Provisions for Slabs. 13. Design and Analysis of Compression Members: Axial Compression. Lateral Ties and Spirals. 14. Compression and Bending—Direct Method. Plastic Centroid. 15. Design and Analysis of Compression Members: Compression and Bending—Interaction Diagrams and Bresler's Equation. 16. Design of Walls 17. Design and Analysis of Composite Structures: Composite Beam-Slab Bridges, Composite Beam-Slab Building Floors. 18. Design and Analysis of Retaining Walls. 19. Connections: Beam-Column Connections.
Laboratory Equipment	Depending on the topic/situation discussed.
Suggested References	1. Mc Cormac, Jack C. *2005. Design of Reinforced Concrete, 7th Edition*John Wiley & Sons, Inc. . New York. 2. Association of Structural Engineers of the Philippines. 2001. *The National Structural Code of the Philippines, 5th Edition.* Manila: Association of Structural Engineers of the Philippines. 3. Nilson, Arthur H. and Winter, George et. al. 2000. *Design of Concrete Structures, 13th Edition*Mc-Graw Hill, Inc. . New York. 4. Mosley, V. H., Bungey, J. H., Hulse, R. 1999. *Reinforced Concrete Design.* Mac Millan. USA. 5. Dobrowski, Joseph A.1998. *Concrete Construction Handbook, 4th*

	Edition. Mc Graw-Hill, New York, USA. 6. Meyer, Christian. 1996. *Design of Concrete Structures.* Prentice Hall. New Jersey.

Course Name:	**STRUCTURAL DESIGN 2 (Steel and Timber)**
Course Description	This course is concerned with the design of structural wood members subjected to flexure, compression and tension members, combined stresses and connections. The presentation of the course is aligned with the provisions of the National Structural Code of the Philippines. This course is also concerned with the design of structural steel members subjected to flexure *(beams, girders, joists, lintels, girts, etc.),* tension, and compression members *(columns),* combined stressed members *(beam-columns),* riveted, welded, and bolted connections using the *Elastic Limit Method*, also known as the Allowable Stress Design (ASD), and the *Plastic Limit Method*. The course also deals with an introduction to *the Load Resistance Factor Design Method* (LRFD) in designing structural steel. Applications and specifications as applied to buildings, bridges, and other steel structures are also given emphasis. A thorough knowledge and proficiency in Structural Theory is imperative.
Number of Units for Lecture, Laboratory , Fieldwork and Tutorial	Lecture – 3 units Laboratory – 1 unit
Number of Contact Hours per week	Lecture – 3 hours. Laboratory – 3 hours extensive exercises.
Prerequisite/Co-requisite	Structural Theory 2.
Course Objectives	After completing this course, the student must be able to: 1. Identify the constituent materials of steel and timber and understand their behavior. 2. Apply the fundamental principles of Timber and Steel Design. 3. Apply techniques in structural design and analysis of structural wood and steel. 4. Formulate correct design strategies based on theoretical and situational experiences. 5. Formulate correct design strategies based on theoretical and situational experiences. 6. Understand and apply the different types of loads to structures using National Structural Code of the Philippines. 7. Appraised the local code of practice, i.e., the National Structural Code of the Philippines. 8. Identify advanced design methods.
Course Outline	1. Properties of Philippine Wood and Lumber. 2. Working Stresses of Structural Timber . 3. Analysis and design of flexural members: Ttheoretical and practical considerations. NSCP Specifications. 4. Analysis and design of compression and tension members: Theoretical and practical considerations. NSCP Specifications. 5. Analysis and design of combined flexure and axial members: Theoretical and practical considerations. NSCP Specifications. 6. Timber Connectors and Fasteners. NSCP Specifications 7. Physical and Structural Properties of Steel. Structural Steel Shapes and Sections. 8. Design and Analysis of Flexural Members: Theoretical and Practical Considerations. Code S*pecification:* Compactness, Slenderness, Lateral Support, Bending Stresses, Shear Stresses, Deflection,

	Beam Bearing Plates, Web Crippling. 9. Design and Analysis of Flexural Members: Beams with Cover Plates. Ideal Sections. Built-Up Sections. Unsymmetrical Bending. Structural and Architectural Provisionsfor Beams 10. Plate Girders. 11. Design and Analysis of Tension Members: 12. *Code Specification:* Gross Area, Net Area, Effective Net Area. Effect of Holes, Staggered Holes. Stiffness Criterion. 13. Design and Analysis of Compression Members: 14. *Code Specification:* Euler's Formula. Short, Intermediate, and Long Columns. Stiffness Criterion. Struts, Columns. 15. Design and Analysis of Combined Stressed Members: 16. *Code Specification:* Tension and Bending, Compression and Bending. Beam-Columns, Eccentrically Loaded Columns. 17. Connections: Riveted, Bolted, Welded Connections. 18. Theory of Plastic Design: Plastic Modulus. 19. Introduction to the Load Resistance Factor Design Method (LRFD).
Laboratory Equipment	Depending on the topic/situation discussed.
Suggested References	1. Association of Structural Engineers of the Philippines. 2001. *The National Structural Code of the Philippines, 5th Edition.* Association of Structural Engineers of the Philippines. 2. Association of Structural Engineers of the Philippines. 2004. *ASEP Steel Handbook 2004, 3nd Edition.* Association of Structural Engineers of the Philippines. 3. Nethercot, David A.2001. Limit States Design of Structural Steelwork, 3rd Edition. Spect Press, London, England. 4. Booth, William D. 1999. *Metal Buckiling Curtailing and Construction.* Mc Graw-Hill, USA. 5. Spiegel, Leonard and Limbrunner George F. 1997. Applied Structural Steel Design, 3rd Edition. Mc Graw-Hill, New York, USA. 6. Salmon, Charles and Johnson John E. 1996. *Steel Structures: Design and Behavior, 4th Edition.* Mc Graw-Hill, New Jersey. 7. 2005. *National Building Code of the Philippines: Implementing Rules and Regulations,* Philippine Gazette, Manila. 8. Parker, Harry and Ambrose, James. 1988. *Simplified Design of Structural Wood,* 4th ed., National Bookstore, Manila, 1988 9. Morrow, Harold W. 1987 *Elements of Steel Design.* Mc Graw-Hill, New York, USA. 10. Parker, Harry. 1974. *Simplified Design of Structural Steel, 4th Edition.* National Book Store, Manila.

Course Name:	**MECHANICS OF FLUIDS**
Course Description	This course deals with properties of fluids; fluid static, hydrokinetics and hydrodynamics; ideal fluid flow for past external and internal boundaries; flow similitude; computer and laboratory fluid experiments.
Number of Units for Lecture, Laboratory , Fieldwork and Tutorial	Lecture – 2 units Lab – 1 unit
Number of Contact Hours per week	Lecture – 2 hrs Laboratory – 3 hrs
Prerequisite/Co-requisite	Dynamics of Rigid Bodies, Mechanics of Deformable Bodies
Course Objectives	After completing this course, the student must be able to: 1. Develop a good understanding of the properties of fluid and the principles of fluid behavior. 2. Understand the principles involving physical ideas, as well as

	mathematical ones, and includes derivations and analysis of resulting equations, which describe fluid behavior. 3. Solve practical problems, which involve numerical calculations from working formulas, often with the conclusion of experimentally determined coefficient. 4. Make solutions and decisions on a particular problem incorporating social and moral impact and put into mind that a mediocre solutions could cause a loss of life and/or property
Course Outline	1. Fundamental Properties of Fluids 2. Hydrostatic Forces on Surfaces 2.1 Total Hydrostatic Pressure on Plane Surfaces 2.2 Forces on Submerged Plane Surfaces Semi-Graphical Approaches 2.3 Forces on Submerges Curved-Surfaces 3. Relative Equilibrium of Liquids 3.1 Hoop Tension in Circular Pipes and Tanks 3.1 Dams 3.2 Principle of Archimedes 3.3 Stability of Submerged Bodies 3.4 Stability of Floating Bodies 4. Kinematics of Fluid Flows 4.1 Flow of ideal, Real Fluids 4.2 Classification of Flow Types 4.3 Pathlines, Streamlines and Flownets 5. Transport Theorems 5.1 Reynold's Transport Theorem 5.2 Mass Transport/Continuity Equation 5.3 Momentum Equations 5.4 Energy Systems 5.5 Flow Through Porous Media (optional) 6. Momentum Equations of Fluid Flow 6.1 Conservation of Momentum 6.2 Applications 6.3 Impact on Blades 7. Bernoulli/Navier-Stokes Equation 7.1 Equation of Motion Theories 7.2 Application 7.1.1 Trajectories 7.1.2 Measuring Devices 7.1.3 Pipe Flows 8. Dimensional Analysis and Hydraulic Similitude 8.1 Geometric/Kinetic/Dynamic Similarity 8.2 PI Buckingham Theorem 9. The Boundary Layer in Incompressible Flow 9.1 Definition of Boundary layer 9.2 Momentum Equation Applied to Boundary Layer 9.2.1 Laminar Boundary Flow and Turbulent Boundary Layer 10. Software Application
Laboratory Equipment	Hydraulic Bench. Software: WaterCAD Flowmaster Pondpack
Suggested References	1. Mays, Larry W. 2004. *Water Resources Engineering, 2005 Edition.* USA. 2. Robert L. Daugherty, Joseph B. Franzini and E. John Finnemore. 2002. *Fluid Mechanics with Engineering Applications, SI Metric Edition.* USA. 3. Ray K. Linsley, Joseph B. Franzini, david L. Freyberg and David L. Tchobanoglous. 1992. *Water Resources Engineering, Fourth Edition.* USA. 4. John A. Roberson, John J. Cassidy and M. Hanif Chaudhry. 1988. *Hydraulic Engineering, Second Edition.* USA. 5. H.W. King, J.O. Wisler and J.G. Woodburn. 1980. *Hydraulics, Fifth Edition.* R. E. Krieger Publishing Company.

Course Name:	**HYDRAULICS**
Course Description	This course deals with the analysis and hydraulic design of by systems such as reservoirs dams, spillways, gates, open channels, pipe networks, pumps and turbines; sediment transport in rivers and reservoir; computer hydraulic modeling.
Number of Units for Lecture, Laboratory , Fieldwork and Tutorial	Lecture – 2 units Laboratory – 1 unit
Number of Contact Hours per week	Lecture – 2 hrs Laboratory – 3 hrs
Prerequisite/Co-requisite	Mechanics of Fluids
Course Objectives	After completing this course, the student must be able to: 1. Develop a good understanding of the principles of water behavior under the influence of forces. 2. Understand the principles involving physical ideas, as well as mathematical ones, and includes derivations and analysis of resulting equations which describe water behavior. 3. Develop skills in solving practical problems, which involve numerical calculations from working formulas used for hydraulic analysis design. 4. Make solutions and decisions on a particular problem incorporating social and moral impact and put into mind that a mediocre solutions could cause a loss of life and/or property.
Course Outline	1. Hoop tension in circular pipes and tanks 2. Dams 3. Review on fundamental of fluid 4. Water flow in pipes 4.1 Minor and Major Headlosses in pipes 4.2 Pipeline with Pumps and Turbines 4.3 Branching pipes 4.3.1 Pipes in series 4.3.2 Pipes Branching Parallel 4.4 Pipe Networks 4.5 Water Hammering and Surges in Pipes 5. Open channel flow 5.1 Open Channel Steady –Uniform Flow Formulas 5.2 Most Economical and Efficient sections 5.3 Specific Energy channels 5.4 Celerity, Critical Velocity, Subcritical & Supercritical Flows 5.5 Depths of Flow Under Steady Conditions 5.6 Equations of gradually varying Flow Conditions 5.7 Water Surface Profiles 5.8 Hydraulic Jump Conditions 6. Hydrodynamics 7. Hydrodynamics Design 7.1 Dams and Spillways 7.2 Flow Through Culverts and Streets Inlets 7.3 Water Profiles Under Bridges 7.4 Water Supply Piping 8. Spillways 9. Gates 10. Pumps 11. Turbines
Laboratory Equipment	Watershed Simulator Pipe Network Software: STORMCAD

Suggested References	1. Mays, Larry W. 2004. *Water Resources Engineering, 2005 Edition.* USA. 2. Robert L. Daugherty, Joseph B. Franzini and E. John Finnemore. 2002. *Fluid Mechanics with Engineering Applications, SI Metric Edition.* USA. 3. Linsley, Ray K. ; Franzini, Joseph B.; Freyberg, David L.; Tchobanoglous, David L. 1992. *Water Resources Engineering, Fourth Edition.* McGraw Hill. 4. John J. Cassidy & M. Hanif Chaudhry. 1988. *Hydraulic Engineering, Second Edition.* USA. 5. H.W. King, J.O. Wisler and J.G. Woodburn. 1980. *Hydraulics, 5th Edition*. R. E. Krieger Publishing Company.

Course Name:	**HYDROLOGY**
Course Description	This course is concerned with the discussion of Hydrologic cycle; occurrence and analysis of components of hydrologic cycle such as precipitation, evapotranspiration, infiltration, stream flow and ground water; river and reservoir sedimentation; flood routing techniques; probability analysis for hydrologic design; computer modeling for hydrologic systems.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Mechanics of Fluids
Course Objectives	After completing this course, the student must be able to: 1. Develop a good understanding of the hydrologic cycle in terms of the processes and storage relationships among its components. 2. Understand the physical meaning of different hydrologic models which capture/stimulate selected hydrologic phenomena. 3. Solve practical problems, which involve numerical calculations from working formulas used for hydrologic analysis and design. 4. Make solutions and decisions on a particular problem incorporating social and moral impact and put into mind that a mediocre solutions could cause a loss of life and/or property
Course Outline	1. Hydrology and the Hydrologic Cycle 1.1 Difference Between Hydrology and Hydraulics. 1.2 The Hydrologic Cycle and the Human Impact. 1.3 Interrelationships of Phases of the Hydrologic Cycle: Evapotranspiration, Precipitation, Infiltration/Percolation, Surface/Subsurface Runoff, Groundwater. 1.4 Philippine Watersheds: Delineation of Drainage Area, Sub-Basing/Physical Properties Determination (Application in the Term Project). 2. Weather Basics (Meterology): Atmospheric Waters 2.1 The Atmosphere: Composition, General Characteristics and Stability. 2.2 Introduction of Cloud Physics: Nucleation, Growth and Distribution. 2.3 Solar radiation and Earth's Energy Balance. 2.4 General Circulation: Thermal Circulation and Earth's Rotation. 2.5 Temperature: Geographic Distribution, Time Variation and Measurement 2.6 Humidity: Geographic Distribution, Time Variation and Measurement 3. Important Phases of Hydrologic Cycle 3.1 Precipitation: Occurrence and Measurement. 3.1.1 Formation, Forms (Philippine Setting), Types and

	Artificially Induced. 3.1.2 Measurement: Gages and Networks, Radar and Satellite Estimates. 3.1.3 Precipitation Data Analysis: Estimation of Missing data, Double-Mass Analysis, Mean Areal Precipitation, Depth-Area-Duration Analysis, Frequency Analysis. 3.2 Evaporation, Transpiration, Interception and Depression Storage 3.2.1 Evaporation from Free Surface: Water Balance Method, Energy Balance Method, Mass-Transfer Method, Penman Equation, Empirical Methods and Direct Measurement. 3.2.2 Transpiration and Evapo-transpiration. 3.2.3 Depression Storage. 3.3 Surface and Subsurface Runoff Phenomenon. 3.3.1 Rainfall-Runoff Processes: Mechanisms, Cycle, Water Stage-Discharge Relationship, Measurement and Interpretation 3.3.2 Flood Prediction. 3.3.2.1 Graph Analysis: Characteristics, Unit Hydrograph Theory, Instantaneous Unit Hydrograph, Synthetic Unit, Hydrographs, Applications. 3.3.2.2 Flow Routing Techniques: Channel Routing (Muskingum Method and Reservoir Routing), Hydraulic Routing (St. Venant Equations and Numerical Solutions), Block-Box Models. 3.4 Infiltration and Percolation: Processes and Measurements 3.5 Groundwater Storage and the Flow of Water 3.5.1 Hydrologic Investigations in Determining Subsurface Resource. 3.5.2 Hydraulics of Low of Groundwater. 3.5.3 Groundwater Exploration and Exploitation in the Philippines. 4. Concepts of Probability and Statistics Hydrology 4.1 Basic Probability Concepts and Probability Models. 4.2 Return Period, Design Storms and Design Turn-Off. 4.3 Regression and Correlation. 4.4 Risks Estimation. 5. Role of Hydrology in Water Resources Planning and Management in the Philippines. 5.1 Agencies Involved in the Collection of Hydrologic Data. 5.2 Problems of Watershed Management and Watershed Protection.
Laboratory Equipment	Hydrology Apparatus Software
Suggested References	1. Mays, Larry W. 2004. *Water Resources Engineering, 2005 Edition.* USA. 2. Mays, Larry W.; Todd, David Keith. 2004. *Groundwater Engineering*. USA 3. Linsley, Ray K. ; Franzini, Joseph B.; Freyberg, David L.; Tchobanoglous, David L. 1992*. Water Resources Engineering, Fourth Edition.* McGraw Hill. 4. Chow, Ven Te; Maidment, David R.; Mays, Larry W. 1988. *Applied Hydrology.* McGraw Hill. 5. Linsley, Ray K.; Kohler Max A.; Palhus, Joseph H. 1978. *Hydrology for Engineers, SI Metric Edition.* New York USA.

Course Name:	**WATER RESOURCES ENGINEERING**
Course Description	This course deals with the principles and analysis of water resources systems such as multi-purpose reservoir, water supply distribution system and stormwater drainage; irrigation system and agricultural drainage system; special topics include river, flood control, drought mitigation and water resource planning management.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Hydraulics
Course Objectives	After completing this course, the student must be able to: 1. Appreciate water resources engineering and its role in infrastructure and socio-economic development of the country. 2. Have a good grasp of the multi dimensional aspects of water resources/watershed problems and non-structural and/or structural interventions that may be done to solve them. 3. Develop tools/skills in solving practical problems, which involve numerical calculations from working formulas used for hydraulic analysis and design of structures. 4. Make solutions and decisions on a particular problem incorporating social and moral impact and put into mind that a mediocre solutions could cause a loss of life and/or property.
Course Outline	1. Definitions and Classifications of Applications: Water Resources and Engineering. Control of Water. Use of Water. Water Quality Analysis and Management. Philippine Water Resources Regions. 2. Watershed Management and Engineering Interventions: Role of Hydrology and Hydraulics in WRE. Engineering Hydrology. Aspects in hydraulics--Important Hydraulic Structures (selected), Water Supply and Distribution System, Groundwater Development, Sewerage Systems, Drainage Structures, River Structures/Coastal Defense, Lahar & Flood Control. Watershed Planning and Management--Definitions/Purpose/Use, Siting of Major Facilities, Role of Geographical Information Systems in Watershed Planning/Management. 3. Field Exercise/Case Studies: Case Study on Water Supply and Distribution, Uses of GIS in WRE, Laguna Lake and Manila Bay Interaction, Tools Development /Softwares/ Approaches-Mini Library, Water Infrastructure needs assessment, Presentation of the Work.
Laboratory Equipment	None
Suggested References	1. Mays, Larry W. 2004. *Water Resources Engineering, 2005 Edition.* USA. 2. Wurbs, Ralph A.; Wesley, James P. 2001. *Water Resources Engineering.* USA. 3. Chin, David A. 1999. *Water Resources Engineering.* Prentice Hall. 4. Wurbs, Ralph A. 1994. *Computer Models for Water Resources Planning and Management.* USA. 5. Linsley, Ray K. ; Franzini, Joseph B.; Freyberg, David L.; Tchobanoglous, David L. 1992. *Water Resources Engineering, Fourth Edition.* McGraw Hill.

Course Name:	HIGHWAY ENGINEERING
Course Description	This course deals with the development of highways in the Philippines, highway design, and the materials that are used in road construction and maintenance. The course includes highway administration; traffic, driver, pedestrian and vehicle characteristics; geometric design, roadside design, highway and related structures; intersection, interchanges, terminals; drainage structures; traffic engineering; asphalt and concrete pavements, survey, plans, estimates, contracts and supervision, earthworks, bases and sub-bases, highway maintenance and rehabilitation. The Standard Specification for Public Works and Highways will also be discussed and be given emphasis in the discussion.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Surveying 2
Course Objectives	After completing this course, the student must be able to: 1. Discuss the highway development in the Philippines from the early part of 1900 to the present era. 2. Explain the importance of community involvement in the planning stage of a proposed road construction project. 3. Be familiar with the items involved in highway design using the Standard Specification for Public Works and Highways. 4. Identify materials used in road construction and maintenance. 5. Use the methods of analysis and design relevant to highway engineering. 6. Prepare documents, plans and details. 7. Understand the factors that affect the performance of highways and related structures. 8. Use computer-aided design methods.
Course Outline	1. The Highway and its Development: Highway in the Philippines,, Planning difficulties. Highway programming. Community involvement. Highway economy. Location of the proposed highway. Highway plans and specifications. 2. Designing the Highway: Consistency. Design speed. Cross-section of typical highway. Road shoulder. Cut or fill slope. Cross slope. Highway median. The grade line. Right of way. Road alignment. Widening of curves. Islands. Types of interchange. Highway intersection. Freeway entrance and exit. 3. Soil: Soil and its origin. Soil types. Characteristics of soil. Soil classification. 4. Road materials: Aggregates. Aggregates for bituminous pavement. Aggregates for Portland Cement Concrete. Mineral fillers. Bituminous materials and binders. Bituminous concrete pavement. Asphalt concrete pavement. Bituminous pavement failure. Macadam asphalt. Surface treatment. 5. Road Bed Construction: Treated and Untreated base courses. DPWH standard specifications on: Aggregate sub-base course, Clearing and grubbing, Excavation, Freehaul-overhaul, Construction of fills and embankment, Subgrade preparation, Compaction and stabilization. 6. Concrete Pavement: Concrete pavement characteristics and behavior. Transverse expansion, longitudinal and construction joints. Reinforcement of joints. Sub-grade and sub-base for concrete pavement. Concrete proportions and mixtures. Curing of concrete pavement. DPWH specifications on concrete pavement. Preparation of grade. Handling, measuring and batching of materials. Placing of concrete. Removal of forms. 7. Drainage and Slope Protection: Drainage. Hydrology. Drainage economic considerations. Draining the highway. Manholes, inlets and catch basins. Channels and culverts. Stabilization the

	unsupported slope. Improving the stability of slope. Retaining wall. Highway bridges. 8. Design of Pavement: Rigid pavement. Flexible pavement. Thickness of pavement using McLeod's method, U.S. Corps of Engineers, California Resistance Value Method, Expansion pressure method, Stress at the corner of a slab using Goldbecks formula, Width of widening of a curve section of road, Thickness of base course using triaxial test method. 9. Highway Maintenance and rehabilitation. 10. Recycling equipments and methods.
Laboratory Equipment	None
Suggested References	1. Mannering Fred, Washburn Scott, Kilaresky Walter. 2004. *Principles of Highway Engineering & Traffic Analysis*. Muze Inc. 2. Wright, Paul H. 2003. *Highway Engineering*. Wiley & Sons. 3. Garber, Nicholas; & Hoel, Lester. 2001. *Highway and Traffic Engineering.* Brookes/Cole Publishing. 4. Fajardo, Max Jr. B., *Elements of Roads and Highways, Second Edition,* 5138 Merchandising Publisher, Manila, 1998. 5. Department of Public Works and Highways. 1995. *Standard Specification for Public Works and Highways (Volume II – Standard Specification for Highways, Bridges and Airports),* DPWH, Office of the Secretary, Bonifacio Drive, Port Area, Manila.

Course Name:	**TRANSPORTATION ENGINEERING**
Course Description	Design and construction aspects of Highway Surfaces and Railways' Guideways; Capacity and Level of Service of Air, Rail, and highways. Environmental impacts and their mitigation of transportation system; Traffic-Analysis Techniques; Traffic Flow and Control.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Highway Engineering
Course Objectives	After completing this course, the student must be able to: 1. Use the methods of analysis and design relevant to transportation structures and systems 2. Gather traffic data. 3. Generate traffic models. 4. Analyzed traffic data. 5. Formulate mathematical and computer models 6. Prepare documents, plans and details 7. Apply transportation-engineering software.
Course Outline	1. Components in Transportation systems 2. Urban transportation problems 3. Land use – transport interaction 4. Design of Surfaces and Guideways 5. Mitigation of Environmental Impacts 6. Traffic-Analysis Techniques 7. Traffic Flow 8. Pedestrian, Vehicle Flow and motion studies 9. Capacity and Level of Service 10. Traffic Control
Laboratory Equipment	Transportation engineering software

Suggested References	1. Transportation Engineering & Planning, Papacostas 2. Urban Mass Transportation Planning, Black 3. Transportation Engineering Planning and Design, Wright & Ashford 4. Introduction to Transportation Engineering, James H. Banks

E.3. Construction

Course Name:	**CONSTRUCTION MATERIALS AND TESTING**
Course Description	The course deals with the physical properties of common construction materials primarily metals, plastics, wood, concrete, coarse and fine aggregates, asphalt and synthetic materials; examination of material properties with respect to design and use of end product, design and control of aggregates, concrete and asphalt mixtures, principle of testing; characteristics of test; properties of materials and materials testing equipment.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 2 units Laboratory – 1 unit
Number of Contact Hours per week	Lecture – 2 hours Laboratory – 3 hours
Prerequisite/Co-requisite	Mechanics of Deformable Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the range of various materials for civil engineering projects; 2. Understand relevant properties of common construction materials; 3. Understand applicable local, international and foreign standards on materials and materials testing; 4. Perform measuring, testing and evaluating the results; 5. Ability to test, measure, evaluate the best use of building and construction materials
Course Outline	1. Introduction to Construction Materials & Testing; 2. Familiarization with apparatus & equipment used in testing of materials; 3. General Properties of Materials; 4. Specific Weight, Water Absorption, Abrasion, Density and Uniformity of Aggregates; 5. Preparation and Curing of Concrete Test Specimens; 6. Determination of Setting Time of Hydraulic Cement; 7. Familiarization with the Parts and Functions of the Universal Testing Machine; 8. Testing of Wood: Samples for Bending, Compression, Shear, Tension, and Water Content; 9. Determine the Compressive Strength of Concrete Hollow Blocks; 10. Determining the Time of Setting of Portland Cement 11. Testing the Tensile Strength of Steel Bars 12. Field Tests of Construction Materials
Laboratory Equipment	Marshall Stability Test Centrifuge Extraction Test (recommended) Universal Testing Machine (recommended) Curing Tank Oven Molds for mortar and Concrete Specimens Vicat Apparatus Weighing Scales

Suggested References	1. Basic Construction Materials 2002, Theodore W. Marotta 2. Civil Engineering Materials 1992 Davis, Troxell & Hawck 3. Construction Materials, Smith 4. Materials of Construction 4Ed 1990 Chandigarah 5. Testing of Engineering Materials 1982 Gildey, Murphy & Bragman 6. Materials Testing Blackowski & Ripling 7. Strength & Structure of Engineering Materials

Course Name:	**CONSTRUCTION METHODS AND PROJECT MANAGEMENT**
Course Description	The course deals with the principles of construction methods and equipment, management and their applications. It covers project planning, scheduling, monitoring and control. It also includes concepts on organization, safety, information systems and computer applications. Students are given opportunities to visit actual project sites and observe the application of these theories in construction projects.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units Fieldwork – 1 unit
Number of Contact Hours per week	Lecture – 3 hours Fieldwork – 3 hours
Prerequisite/Co-requisite	5th Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the construction project cycle from inception, planning, execution, testing and certification. 2. Understand construction project requirements such as permits and licenses, clearance, and compliance to all applicable laws and ordinances, etc; 3. Read and interpret construction plans, working drawings, and revise contract documents, estimates and technical specifications; 4. Understand the components of the Terms of Reference (TOR) for professional services and bidding/tendering processes, award and acceptance; 5. Prepare and update construction schedule and work programs; 6. Understand construction methods, equipment, materials and manpower control; 7. Understand temporary facilities requirements of a construction project; 8. Understand the existing local labor laws and regulations
Course Outline	1. Contracts and Specifications; 2. Construction Project Organization; 3. Planning and Scheduling (PERT/CPM); 4. Construction Estimates and Values Engineering 5. Construction Methods and Operations; 6. Construction Equipment Operations and Maintenance 7. Construction Manpower Safety; 8. Computer Applications in Construction Management; 9. Construction Reports 10. Construction Fieldwork 11. Construction Disputes 12. Fieldwork: Observation of construction projects
Laboratory Equipment	None
Suggested References	1. Construction Planning Equipment & Methods, latest edition 2. Project Management for Engineering and Construction, latest edition 3. Construction Management Handbook, CMDF 4. Constructors Performance Evaluation System (CPES) Implementing Guidelines, CIAP

Course Name:	**CIVIL ENGINEERING LAWS, CONTRACTS, AND SPECIFICATIONS**

Course Description	This course deals on the principles and fundamentals of the laws on obligations, contracts, and professional ethics that are applicable to the civil engineering profession. It is designed to prepare civil engineering students for professional practice. Topics on the perspective of the student as future practitioners, contractors, and employees in the field are also given emphasis. They include the study of code of ethics, legal procedure in the practice of civil engineering in the Philippines, ethical relations of an engineer with fellow professionals, clients, and general public, elements of contracts, obligations, Civil Engineering Law, (RA 544) National Building Code, labor laws, E-Procurement Law, and the Manual of Professional Practice for Civil Engineers.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	5th Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Identify the Civil Engineering Code of Ethics and Obligations. 2. Distinguish and know the value formation towards the practice of civil engineering. 3. Explain the right perspective of the nature, principles, and applicability of the laws of obligation and contracts. 4. Recognize the proposition of ethical values. 5. Understand the Civil Engineering Law; 6. Understand other laws relevant to the practice of Civil Engineering such as P.D. 1096 or the National Building Code, R.A. 9184 or the Government Procurement Reform Act. 7. Know relevant professional documents such as FIDIC, Manuals of Practice, DPWH “Blue Book”. 8. Know the standard contract documents such as the pro-forma construction and consultancy contracts; Instructions to Bidders, Technical Specifications, Bid Documents; Philippine Bidding Documents for Consulting Services and Works. 9. Develop engineering skills and proficiency.
Course Outline	1. *Introduction to General Ethics and Ethical Values.* 2. *Civil Engineering Code of Ethics:* Fundamental Principles. Fundamental Canons. Guidelines to Practice under the Fundamental Canons of Ethics. 3. *The Practice of Civil Engineering:* Professional Responsibility. Client-Civil Engineer Relationships. Civil Engineering Services. Specialization of a Civil Engineer. Selection of a Civil Engineer. Prime Professional Practice. Employment. Design Competition. Contingency Basis of Employment. Professional Practice of Foreign Civil Engineers. 4. *Classification of Engineering Services:* Consultations, Research Investigations and Reports. Design Services for Construction Projects. Construction Services. Special Services for Construction Projects. Engineering Support Services. Academic Services. Services as Employee. 5. *The Selection of the Civil Engineer:* Basis for Selection. Client’s Selection Committee. Qualifications-Based Selection (QBS) Procedure. Selection Procedure for “Level of Effort Contracts. 6. *Charging for Civil Engineering Services:* Salary Cost * Multiplier + Direct Non-Salary Expense. Hourly Billing Rate. Per Diem. 7. *Charging for Civil Engineering Services:* Cost Plus Fixed Fee. Fixed Price. Percentage of Construction Cost. Schedule of Minimum Fees. 8. *Total Project Cost:* Professional Engineering Costs. Construction Costs. 9. *Total Project Cost:* Legal, Land, Administration, Stuffing, and Financial Costs. Contingency Allowance. 10. *RA 544:* An Act to Regulate the Practice of Civil Engineering in the

	Philippines. 11. R.A. 9184: The Government Procurement Reform Act. Implementing Rules and Regulations on the Procurement of Consulting Services for Government Projects. 12. PD 1594 and its Implementing Rules and Regulations as Amended. 13. CIAP Document 102: Uniform General Conditions of Contract for Private Construction. 14. Extracts from the New Civil Code: Obligations and Contracts. 15. The Civil Engineering Professional Licensure Examination. 16. PD 1096: The National Building Code and its Implementing Rukles and regulations. 17. Seminar: Trends and Issues Concerning Civil Engineering Practice.
Laboratory Equipment	None
Suggested References	1. Philippine Institute of Civil Engineers, Inc. 2003. *Manual of Professional Practice for Civil Engineers, 2nd Edition. Manila:* Philippine Institute of Civil Engineers, Inc. 2. Hinze, Jimmie. 2001. *Construction Contracts, 2nd Edition.* Boston, USA : Mc Graw-Hill. 3. Central Book Supply. 2000. *Engineering Laws in the Philippines and Related Laws.* Manila: Central Book Supply. 4. Sajorda, Q.A., 1996 *Construction MASTER SPECIFICATIONS,* Elastomark Corporation, Philippines 5. Mead, Mead, and Akerman. 1992. *Contracts, Specifications and Engineering Relation.* USA*:* McGraw-Hill Book Company. 6. Nolledo, Jose. 1989. *The Civil Code of the Philippines.* Manila: National Book Store. 7. Philippine Bidding Documents for Government Contracts.

F. TECHNICAL ELECTIVES

F.1 Structural

Course Name:	**EARTHQUAKE ENGINEERING**
Course Description	This course deals with the fundamentals and basic concepts of seismic design as well as the minimum standards for the analysis, design, and construction of earthquake resistive structures. The course covers the introduction to seismology and seismic analysis of buildings and structures, effects of earthquake on bearing capacity, procedure for the design of earthquake resistant structures, calculation of seismic forces, and dynamic analysis of structures. It also deals with the determination of loads of structures due to motions, methods of analysis for lateral forces, approximate dynamic analysis, time history analysis, concepts of mass, damping, stiffness of structures, design for inelastic behavior and retrofitting of existing building. Critical building configurations and appropriate methods of analysis are also given emphasis. Applications and specifications as applied to vertical and horizontal structures are also given importance. A thorough knowledge and proficiency in Structural Theory is imperative.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Structural Theory 2.
Course Objectives	After completing this course, the student must be able to: 1. Identify earthquake engineering. 2. Understand the general theory of vibration of single and multi degree-of-freedom systems and its applications to civil engineering

	structures. 3. Differentiate and design structural elements to resist seismic ground motions. 4. Identify advanced seismic design methods. 5. Acquire a thorough knowledge of the Code and Specifications used in earthquake design; 6. Design civil engineering structures subject to earthquake and other lateral forces such as wind; 7. Develop design skills and proficiency.
Course Outline	1. *Introduction to Earthquake Resistant Design:* Earthquakes and Urbanization. History of Major International & Philippine Earthquakes. The Ring of Fire. 2. *Elements of Seismology:* Earthquake Faults; Theory of plate Tectonics. 3. *Earthquake Records and Measuring Instruments:* Seismographs; Accelerographs; Seismoscopes; Earthquake Networks. Design of an Improvised Seismograph. 4. *Propagation of Seismic Disturbances:* Earthquake Waves. 5. *Earthquake Descriptors:* Earthquake Magnitude; Seismic Moment; Seismic Energy; Th eCentroid Moment Tensor Propject; Magnitude and Faulting; Foreshocks, Aftershocks, and Swarms; Seismic Intensity (Rossi-Forrel Scale, Modified Mercalli Scale, USSR GEOFAN Scale, MSK-64 Scale). 6. *Major Earthquake Zones in the Philippines:* PHIVOLCS Information 2000; PHIVOLCS Earthquake Portfolio 2004. 7. *Earthquake Load Analysis:* Introduction to NSCP 2001 Specification —Design Basis. 8. *Earthquake Load Analysis:* Criteria Selection. System Limitations, Site Categorization Procedure. 9. *Minimum Design Lateral Forces and Related Effects:* Earthquake Loads and Modelling Requirements, PΔ Effects. 10. *Lateral Force Procedures for Building Structures:* Selection of Lateral Force Procedure, Seismic Design and Analysis, The Static Lateral Force Procedure. Vertical Distribution of Forces. 11. *Lateral Force Procedures for Building Structures:* The Simplified Static Lateral Force Procedure, PΔ Effects, Storey Drift Limitations. Vertical Component of Force. 12. *Lateral Force Procedures for Non Structural Elements:* Design of Lateral Force, Specification of Lateral Forces, Relative Motion Equipment Attachment, Alternative Designs. 13. *Lateral Force Procedures for Non Building Structures:* Definition and Criteria, Weight, Period, Drift, Interaction Effects, Non Building Structures, Rigid Structures, Tanks with Supporting Bottom, Other Non Building Structures. 14. *Analysis of Frames Subjected to Lateral Loads:* Forces, Distribution of Lateral Forces—Portal Method, Distribution of Lateral Forces—Q Factor Method. 15. *Introduction to the Response Spectrum Analysis and Design:* Time Histories, Earthquake Response Spectrum, Earthquake Design Spectrum.
Laboratory Equipment	None

Suggested References	1. PHIVOLCS. 2004. *Earthquake Portfolio.* Manila, Philippines. 2. Association of Structural Engineers of the Philippines. 2003. *Earthquake Design Manual Volume 1—Code Provisions for Lateral Forces.* Manila: Association of Structural Engineers of the Philippines. 3. Association of Structural Engineers of the Philippines. 2003. *Earthquake Design Manual Volume 2 —Earthquake Resistant Design of Structures:* Manila: Association of Structural Engineers of the Philippines. 4. Association of Structural Engineers of the Philippines. 2001. *The National Structural Code of the Philippines, 5th Edition.* Manila: Association of Structural Engineers of the Philippines. 5. Rotterdam, Balkens. 2001. *Dynamic Analysis and Earthquake Resistant Design.* New York, USA: Mc Graw-Hill. 6. Hart, G., Kai Fai Wong, K. 2000. Structural Dynamics for Structural Engineers. Wiley & Sons, New York.

Course Name:	**PRESTRESSED CONCRETE DESIGN**
Course Description	This course is concerned with the elastic and ultimate strength analysis and design of prestressed concrete structures. The course covers the calculations of stresses due to bending, shear, torsion and anchorages, losses of prestresses and deflections. Behavior of statically indeterminate prestressed concrete beams is also studied.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Structural Design 1 (Reinforced Concrete)
Course Objectives	After completing this course, the student must be able to: 1. Understand the behavior of prestressed concrete beams under elastic and ultimate loading conditions. 2. Calculate stresses due to bending, shear, and torsion. 3. Calculate anchorage stresses and deflections of prestressed concrete beams. 4. Analyze the behavior of statically indeterminate prestressed concrete beams.
Course Outline	1. Difference between prestressed and reinforced concrete 2. Stresses in bending, shear and torsion 3. Elastic design of prestressed concrete beams. 4. Losses of prestress 5. Deflections due to prestress 6. Anchorage stresses 7. Statically indeterminate prestressed concrete beams. 8. Ultimate strength analysis.
Laboratory Equipment	None
Suggested References	1. Association of Strutural Engineers of the Philippines. 2001. *National Structural Code of the Philippines Vol. 1 & 2.* Philipppines. 2. McCormack, Jack. 1998. *Design of Prestressed Concrete.* Addison-Wesly. 3. Hurst, M. K. 1998. *Prestressed Concrete Design.* Spon Press. 4. Gilbert, R. I., Mickelborough, Neil. 1990. *Design of Prestressed Concrete.* Routledge. 5. Nilson, Arthur H. 1987. *Design of Prestressed Concrete.* Wiley & Sons. 6. Naaman, Antoine. 1982. Prestressed Concrete Analysis *and Design.* McGraw-Hill.

Course Name:	BRIDGE ENGINEERING
Course Description	This course deals with the structural analysis and design of modern bridge structures. The course covers the study of influence lines and their application to moving loads, applications of AASHTO and NSCP Volume 2 Specifications to bridge design especially steel, reinforced concrete and prestressed concrete bridges, aerodynamic performance of bridges under wind loads, earthquake response of bridges, maintenance and rehabilitation.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Prerequisite: Structural Design 1 & 2 Co-requisite: Prestressed Concrete Design
Course Objectives	After completing this course, the student must be able to: 1. Gain thorough knowledge of the principles of designing various types of bridges in accordance with the recent design referral code such as the NSCP and the AASHTO code requirements.
Course Outline	1. Review of statistically indeterminate beams. 2. Influence lines. 3. Types of bridges. 4. Bridge loadings. 5. Slab bridge design. 6. T-girder bridge design. 7. Prestressed concrete deck girder design. 8. Composite steel deck girder design. 9. Substructure design. 10. Maintenance and rehabilitation of bridges.
Laboratory Equipment	None
Suggested References	1. Tonias, Demetrios E.; Chen, Stuart; Grabbrabt, Richrd. 2004. *Bridge Engineering: Design, Rehabilitation and Maintenance of Modern Highway Bridges.* McGraw-Hill 2. Association opf Strutural Engineers of the Philippines. 2001. *National Structural Code of the Philippines Vol. 2.* Philipppines. 3. AASHTO.1998. *LRFD Bridge Design Specifications Set (SI Units).* AASHTO. 4. Xanthakos, Petros. 1993. *Theory and Design of Bridges.* Wiley-Interscience.

F.2. Water Resources Engineering

Course Name:	IRRIGATION, FLOOD CONTROL, AND DRAINAGE ENGINEERING
Course Description	This course deals with the planning and design of structures for irrigation, flood control and drainage, reservoir storage, flood routing, urban run off, drainage, water flow and similar control structures.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Structural Theory 1 & 2, Hydrology, Water Resources Engineering.
Course Objectives	After completing this course, the student must be able to: 1. Prepare plan and design the control structures for irrigation, flood control and drainage. 2. Use frequency histograms and graphs of floods as well as rainfall. 3. Analyze the forces on control structures for irrigation, flood control and drainage.

Course Outline	1. Irrigation: Water Requirement, Soil Water Relation, Water Quality, Methods and Structures. 2. Flood Control: Design Flood, and Flood Control Structures. 3. Drainage: Estimate of Flow, Storm Drainage, Land and Highway Drainage, Culverts and Bridges; and Drainage Structures. 4. Water Containment Structures.
Laboratory Equipment	None
Suggested References	1. American Society of Civil Engineers. 2005. *Journal of Irrigation and Drainage Engineering.* 2. Chin, David A. 1999. *Water Resources Engineering.* Prentice Hall. 3. Department of Public Works and Highways. 1995. *Standard Specification for Public Works and Highways (Volume I – Standard Specification for Irrigation, Flood Control and Drainage).* DPWH Office of the Secretary, Bonifacio Drive, Port Area, Manila. 4. Cuenca, R.H. 1989. *Irrigation Systems Design - An Engineering Approach.* Prentice Hall, New Jersey, USA. 5. National Irrigation Administration (NIA). 1995. *NIA Design Manual.* National Irrigation Administration, Philippines. 6. CIAP. ____. CPES Implementing Guidelines for Irrigation and Flood Control.

Course Name:	**SANITARY ENGINEERING**
Course Description	This course deals with the principles and applications of sanitary engineering and other related sanitary sciences to the control of man's environment, sources of infection; modes of transmission, diseases vectors, rural sanitation, control of animal and insects vectors of diseases, industrial hygiene, air pollution, radiological health and stream sanitation.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Environmental and Safety Engineering
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles and the applications of engineering methods to control man's environment. 2. Understand and identify transmission of infections, diseases, rural sanitations and other environmental problems.
Course Outline	1. Introduction 2. Diseases and Immunity 3. Statistics in Public Health 4. Rural Water Supply 5. Rural Excreta Disposal 6. Refuse Disposal 7. Rodent Control 8. Mosquito Control 9. Fly Control 10. Milk and Food Sanitation 11. Stream Sanitation 12. Housing and Swimming pool sanitation 13. Industrial Hygiene 14. Air Pollution 15. Radiological Health 16. Odor Control 17. Noise Pollution
Laboratory Equipment	None
Suggested References	1. Tchobanoglous, G.; Burton, F.; Stensel H. 2002. *Wastewater*

	Engineering, 4th Edition. Royal Society of Chemistry. UK. 2. Wise, A. F. E. 2002. *Water, Sanitary, and Waste Services for Buildings.* Butterworth-Heinemann. 3. Miner, Ronald, et. al. 2001. *Managing ivestock to Preserve Envoronmental Quality.* Iowa Stae University Press. 4. Tebbutt, T. H. Y. 1997. *Principles of Water Quality Control.* Butterworth-Heinemann. 5. Wolley L. 1988. *Drainage Details.* Spon Press.

Course Name:	**WATER AND WASTEWATER ENGINEERING**
Course Description	This course covers water pollutants, water quality and quantity, principles of water treatment, water process analyses and treatment, wastewater characterization, principles of wastewater treatment and wastewater treatment process analysis and selection.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Prerequisite: Chemistry, Environmental Engineering. Co-requisite: Hydrology, Water Resources Engineering, Irrigation, Flood Control and Drainage Engineering.
Course Objectives	After completing this course, the student must be able to: 1. Understanding the quality and quantity of the different water supply sources. 2. Understand water and wastewater processes of treatment. 3. Identify the appropriate water and wastewater treatment technology.
Course Outline	1. Introduction/Review of Hydrology aspects of water supply. Water quality and quantity. Drinking water standards. 2. Water treatment processes. Aeration, Coagulation, Flocculation, Chemical treatment, sedimentation, slow sand filter, rapid sand filter, softening, activated carbon, disinfection, saline water conversion. 3. Wastewater characterization. Constituents, sampling procedures and physical characterization. Chemical Characteristics. Biological characterization. 4. Process Analysis and selection. 5. Physical unit operation. 6. Chemical unit operation. 7. Biological treatment. 8. Aerobic and Anaerobic treatment.
Laboratory Equipment	None
Suggested References	1. Binnie, C. et. al. 2003. *Basic Water Treatment*. USA. 2. Tchobanoglous, G.; Burton, F.; Stensel H. 2002. *Wastewater Engineering, 4th Edition.* Royal Society of Chemistry. UK. 3. Nathanson, Jerry. 2002. *Basic Environmental Technology: Water Supply, Waste Management and Pollution Control., 4th Edition.* Prentice Hall. USA. 4. Drinan, Joanne. 2001. *Water and Wastewater treatment: A Guide for Nonengineering Professional*. Technomic Publishing Co. UK. 5. Twort, A. C. 2000. *Water Supply.* Butterworth-Heinemann. UK. 6. Fair, Gordon. 1971. *Elements of Water Supply and Wastewater Disposal.* John Wiley & Sons. New York, USA. 7. Maskew, Fair, et. al. 1966. *Water and Wastewater Engineering.* John Wiley & Sons. New York, USA. 8. DAO 35. Philippine Drinking Standard.

F.3 Construction Engineering and Management

Course Name:	**ENTREPRENEURSHIP FOR ENGINEERS**
Course Description	This course is designed to introduce the upper level undergraduate students to the concepts and practices of entrepreneurial thinking. Using a combination of lectures, case studies, student led discussions, team business plans, and investor presentation formats, the course teaches life skills in entrepreneurial thought and action that students can utilize in careers ranging from starting companies to instigating cutting edge R&D projects in large company intrapreneurial endeavors. Major course themes include: Introduction to Entrepreneurship, Idea Generation and Feasibility Analysis, and Business Planning.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Engineering Management, Engineering Economy.
Course Objectives	After completing this course, the student must be able to: 1. Explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries. 2. Examine the entrepreneurial process from the generation of creative ideas to exploring feasibility to creation of an enterprise for implementation of the ideas. 3. Experience the dynamics of participating on a business team and the power inherent in a team relative to individual effort. 4. Create and present a business plan for a technology idea. 5. Provide the background, tools, and life skills to participate in the entrepreneurial process within a large company, in a new venture, or as an investor.
Course Outline	1. Introduction to Entrepreneurship. 2. Idea and Opportunity Generation: Attributes an Myths of Entrepreneurs. Sources of Opportunity. Creativity. The Origin and Evolution of New Business. The mindset of the Entrepreneur Leader. Entrepreneurial Opportunity and Feasibility Analysis. 3. Business Planning and the Value Proposition: Company Research. Entrepreneurial Market Research. Business Plans. Value Proposition Presentation. Company Formation. Financials, Balance Sheets, Cash Flow Analysis, Income Statement, Pro-formats. 4. Building a Winning management Team. 5. Intellectual Property. 6. Company Valuation and Deal Making: Obtaining Capital. 7. Team Final Presentation.
Laboratory Equipment	None
Suggested References	1. Kawasaki, Guy. 2005. *The Art of the Start: The time-tested, battle-hardened guide for anyone starting anything.* USA. 2. Timmons, Jeffry. 2005. *New Venture Creation 6th Edition.* USA. 3. Komisar, Randy. 2005. *The Monk and the Riddle.* USA. 4. Michaelson, Steven. 2005. *Sun Tzu for Success: How to Use the Art of War to Master Challenges and Accomplish the Important Goals in Your Life.* USA.

Course Name	CONSRUCTION COST ENGINEERING
Course Description	The course covers conceptual estimate of projects, parametric estimating, work breakdown structure, estimated/schedule interface planning, earned value, detailed estimating, special estimates and use of estimating manuals.
Number of Units for Lecture and Laboratory	Lecture - 3 units Laboratory - 0
Prerequisite	Fifth year standing
Course Objectives	After completing this course, the student must be able to: 1. Analyze the cost implication of project scope 2. Optimize the balance between cost and time implication of design decisions. 3. Avoid costly and time-consuming errors due to poorly prepared estimates. 4. Accrue time and cost savings by implementing a cost engineering program.
Course Outline	1. The Conceptual Estimate. 2. Parametric Estimating 3. Work Breakdown Structure 4. Estimate/Schedule Interface Planning 5. Earned Value 6. Detailed Estimating 7. Special Estimates 8. Estimating Manuals
Laboratory Equipment	NONE
Suggested Textbook **References**	1. Ostwald, Engineering Cost Estimating, Prentice Hall, 1992. 2. Dagostino, Estimating in Building Construction, Prentice Hall, 1993.

Course Name	DATABASE MANAGEMENT IN CONSTRUCTION
Course Description	The course covers Civil Engineering Information Systems, information Engineering and Architectures, Information Strategy, Enterprise-wide Information Strategy planning, Case tools, Relational Database, Modeling and Normalization, Zachman's Framework, Object Oriented Modeling and Design, Data Warehousing and Data Mining.
Number of Units for Lecture and Laboratory	Lecture - 2 units Laboratory – 1 unit
Prerequisite	Fifth year standing
Course Objectives	After completing this course, the student must be able to: 1. Deal with strategic issues regarding information engineering, database modeling, and use of database management systems. 2. Develop, evaluate and make decisions regarding short and long term information strategies
Course Outline	1. Civil Engineering Information Systems. 2. Information engineering and Architectures. 3. Information Strategy Plan. 4. Enterprise – Wide Information Strategy Planning: Top-Down Approaches, Analysis of Goals and Problems, Critical Success Factor Analysis, Technology Impact Analysis, Strategic Systems Vision.

	5. Case Tools: Matrices, Hierarchies, Process Modeling Relationship Framework. 6. Relational Database Modeling and Normalization. 7. Zachman's Framework. 8. Object Oriented Modeling and Design. 9. Database Management Systems: Access and Oracle. 10. Automating Information Discovery: Data Warehousing and Data Mining
Laboratory Equipment	Computers and Special Software's
Suggested References	1. Paulson, Computer Application in Construction, MC Grew Hill, 1995. 2. Rumbaugh, et al. Object-Orientation Modeling and Design, Prentice-Hall, 1991. 3. Date, An Introduction to Database Systems, Addison-Wasley, 1990. 4. Martin, Information Engineering, Books II and III, Prentice-Hall, 1990..

F.4. Transportation Engineering

Course Name:	**TRANSPORTATION PLANNING**
Course Description	Urban transportation planning process, design of urban transportation models including trip generation; urban transit planning and Operations; Transportation Demand Analysis; Transportation Project Evaluation
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture – 3 units
Number of Contact Hours per week	Lecture – 3 hours
Prerequisite/Co-requisite	Transportation Engineering / Fifth year standing
Course Objectives	After completing this course, the student must be able to: 1. Prepare trip generation models and traffic distribution models 2. Formulate mathematical and computer models 3. Prepare route planning, route location, and stop location design. 4. Do economic evaluation techniques in a transportation project. 5. Prepare environmental impact assessment in a transportation project. 6. Apply transportation-engineering software.
Course Outline	1. Transit Operations (Route Planning, Route Location, Route Schedules, Stop locations) 2. Transportation Demand Analysis (Travel behavior, Travel demand modeling, Trip generation models, Trip Distribution models, Trip assignment models) 3. Transportation Planning (Planning process, Planning regulations, Transportation and Air quality planning, Planning studies, Planning study organization 4. Transportation Project Evaluation (Economic evaluation techniques, Environmental Impact assessment)
Laboratory Equipment	Transportation engineering software
Suggested References	1. Transportation Engineering & Planning, Papacostas 2. Urban Mass Transportation Planning, Black 3. Transportation Engineering Planning and Design, Wright & Ashford 4. Introduction to Transportation Engineering, James H. Banks

Course Name	**TRANSPORTATION SYSTEMS DESIGN**
Course Description	This course is directed to the overall design of transportation systems.

	Emphasis will be upon the principles of systems analysis as they relate to the planning, design, operation and evaluation of transportation systems. The central feature of the course is a project and/or a seminar delivery to be coordinated with class activities.
Number of Units for Lecture and Laboratory	Lecture - 3 hrs.
Prerequisite	Fifth year standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles of systems analysis as they relate to the planning, design, operation and evaluation of transportation systems. 2. Develop plans, policies, projects, actions and strategies that address the issue of transportation of growing urban areas.
Course Outline	1. Introduction, Current Issues in Transportation. 2. Project Planning. 3. Systems Design Process. 4. Transportation Supply. 5. Evaluation of Costs, Sunk Cost, Opportunity Cost, Non-quantifiable Costs, Uncertainty. 6. Measuring Effectiveness, Values, Social Impact, Economic Impact, and Environmental Impact. 7. Cost-effectiveness Evaluation, Standardized Approach, Objectives, Goals, Criteria, Economic Framework.
Laboratory Equipment	NONE
Recommended Textbook	• Vuchic, V. Transportation for Livable Cities.

Course Name	**HIGHWAY DESIGN AND TRAFFIC SAFETY**
Course Description	This course is intended to provide the fundamentals of highway design and operation, human factors and vehicular characteristics and how they interact with the roadway, and highway safety analysis and different statistical techniques employed in the analysis.
Number of Units for Lecture and Laboratory	Lecture - 3 units Laboratory - 0
Prerequisite	Fifth year standing
Course Objectives	After completing this course, the student must be able to: 1. Design different highway facilities and apply relevant highway design standards. 2. Analyze crash and traffic data employing the appropriate statistical techniques. 3. Conduct traffic safety studies, identifying high-accident locations and propose engineering solutions.
Course Outline	1. Highway Functions, Roadway Design, Driver Vehicle Characteristics. 2. Design Speeds, Horizontal Alignment, and Super elevation. 3. Vertical Alignment, Sight Distance, Special Curves. 4. Cross Sections Design, Earthwork, Drainage. 5. At-Grade Intersection, Low Volume Intersections, Left-Turn Treatments. 6. Freeway Interchanges, Design Project I. 7. Signing and Marking Traffic Calming, Evaluation. 8. Highway Safety, Safety Analysis. 9. Statistical Models for Safety Analysis. 10. Safety Enhancements Projects, Crash Counter Measures. 11. Risk Management, Assessment of High Collision Sites. 12. Safety at Construction Zone, Design Project 2.

	13. Design Guides for elderly Drivers, Liability in Design and Operations. 14. Bicycle/Pedestrian Safety and Signal Timing, Accident Investigation. 15. Accident Reconstruction, Expert Witness Analysis, Design Project 3.
Laboratory Equipment	NONE
Suggested References	1. Lamn, Psarianos and Mailand Highway Design and Traffic Safety Engineering Handbook, Mc Graw Hill Handbooks, 1999 (ISBN 0-07-038295-6) 2. ASSHTO Green Book, A Policy on Geometric design of Highways and Streets, 2001 MUTCD, Manual on Uniform Traffic Control Devices..

F.5. Geotechnical And Geo-Environmental Engineering

Course Name:	GEOSYNTHETICS IN GEOTECHNICAL ENGINEERING
Course Description	This course involves the design techniques and applications for geotextiles, geosynthetics, geogrids, geonets, geomembranes and geocomposites as they are used in environmental, geotechnical, and other construction engineering projects. The course first studies natural slopes and embankments for their stability and seepage problems. The proceeding sessions deal with applications of geosynthetic construction materials to designs of those earth structures. In the recent years, geosynthetics became very practical and economical materials to be used in earth reinforcement, filtration, pond liner, landfill liner, and many other subsurface constructions and earth structures. The class reviews different types of available geosynthetic materials, those applications, and design techniques.
Number of Units for Lecture, Laboratory , Fieldwork and Tutorial	Lecture -3 units
Number of Contact Hours per week	Lecture - 3 hrs.
Prerequisite/Co-requisite	Geotechnical Engineering 1 & 2.
Course Objectives	After completing this course, the student must be able to: 1. Identify geosynthetics and their applications in civil and environmental engineering.
Course Outline	Seepage through dams. Earth filtering design. Slope stability analysis. Overview of geosynthetics. Description of geosynthetics, Functions of geosynthetics, Polymers, Geosynthetics tests. Geotextiles. Separation. Unpaved roadway reinforcement. Filtration. Reinforced walls. Drainage. Geogrids. Reinforced walls. Geonets. Drainage. Geomembrances. Liquid containment (pond) liners. Solid material (landfill) liners. Cap and enclosures. Geosynthetic clay liners. Geo-others.
Laboratory Equipment	None
Recommended Textbook	Koerner, Robert M.1997. Designing with Geosynthetics, 4th Edition. Prentice Hall.

Suggested References	Horvath, J.S.1995. Geoform Geosynthetics. Horvath Engineering. Holtz, R.D., Christopher, B.R., and Berg, R.R. 1995. Geosynthetic Design & Construction Guidlines, Participant Notebook, NHI Course No. 13213, prepared for National Highway Institute, FHA. IFAI,. 1990. A Design Primer: Geotextile and Related Materials. Wu, J.T.H. 1994. Design and Construction of Simple, Easy and Low Cost Retaining Walls. Colorado Transportation Institute.

Course Name:	**GEOTECHNICAL EARTHQUAKE ENGINEERING**
Course Description	This course concerns plate tectonics and elastic rebound theory of earthquakes and faults; characterization of ground motions; seismicity; deterministic and probabilistic seismic hazard analyses; effects of local soil conditions on ground response; development of design ground motions; liquefaction; dynamic lateral earth pressures; seismic slope stability.
Number of Units for Lecture, Laboratory , Fieldwork and Tutorial	Lecture -3 units
Number of Contact Hours per week	Lecture - 3 hrs.
Prerequisite/Co-requisite	Geotechnical Engineering 1 & 2.
Course Objectives	After completing this course, the student must be able to: 1. Identify ground motion and their applications in geotechnical and environmental engineering.
Course Outline	a. Seismology and Earthquakes. Introduction to Vibratory Motion. Characterization and Prediction of Ground Motions. Review of Dynamics of Discrete Systems (SDOF & MDOF). Strong Ground Motion Characterization. Seismicity and Seismic Hazard Analysis. b. Dynamic Soil Properties c. Development of Design Ground Motions. Local Site Effects on Ground Motions. Ground Response Analysis d. Foundation – Vibrations. Analog Solution, Circular Foundation: Vertical, Sliding, Rocking and Torsional Vibrations Foundation - Bearing Capacity Considering Earthquake Loading. Terzaghi's Equation, Meyerhoff's Equation, Bearing Capacity with Eccentricity. One-dimensional Wave Propagation. 3. Longitudinal and Torsional Waves in a Bar (Infinite and Short Bars). Resonant Column Device. Description of Device, Determination of G_{max} and 2D Empirical Relationships for G_{max}. G_{max} for Cohesionless and Cohesive Soils. Longitunal Wave in a Bar 4. 2D Wave Propagation. Dynamic Equation of Motion. Plane Waves: Navier's Equation, Compressional Wave, Shear Wave, Relationship between vp and vs. Surface Waves: Rayleigh Wave, Love Wave, Cyclic Behavior of Soils, Laboratory and In-Situ Tests. Laboratory Tests: Bender Tests, Small Strain Measurements, Improved Cyclic Triaxial Tests, Up-hole Test, Down-hole Test, Cross-hole Tests, etc. 5. Cyclic Behavior: Strain Level Effects, G/Go~gamma, D~gamma Relationships for Sand and Clay, Soil Models for Cyclic Loading. Linear Viscoelastic Models, Complex Modulus Model, Masing Rule. Seismic Response Analysis. Shake Program 6. Slopes. Seismic Stability Analysis - Planar Mechanism: Extended Culmann-Francais Analysis - Circular Mechanism: Extended Taylor Charts. Permanent Displacement Analysis - Seismic Factor of

	Safety on Planar Mechanism - Critical Yield Acceleration - Permanent Displacement and Rotation 7. Liquefaction. Mechanism of Liquefaction - Cyclic Simple Shear and Cyclic Triaxial Tests - Liquefaction and Cyclic Mobility, Phase Transformation - Excess Pore Water Pressure and Stress Path Method - Liquefaction Potential based on Simplified Method and In-situ Tests. Remediation Methods Response and Liquefaction of Ocean Bed Subject to Wave Loading - Cyclic Stresses due to Wave Loading - Liquefaction Strength considering Principal Stress Rotation - Liquefaction Analysis 8. Seismic Stability of Slopes and Embankments. Seismic Design of Slopes and Retaining Structures. Multi-layer Wave Propagation, Earth Retaining Structures. Dynamic Earth Pressure Theory (Mononobe-Okabe Analysis). Displacement-Limit Design of Retaining Walls 9. Soil Models for Cyclic Loading. Bilinear Model, Hardin -Drnevich (Hyperbolic Model), Ramberg-Osgood Model, Calibration of Cyclic Models 10. Dynamic Lateral Earth Pressures 11. Composite Breakwater/Caisson under Water Wave Impact. Storm/Tsunami 12.1 Failures due to Wave Impact 12.2 Goda Wave Pressure Formula 12.3 Sliding Stability 12.4 Permanent Sliding *13.* Mitigation of Seismic Hazards
Laboratory Equipment	None
Recommended Textbook	Kramer, Steven L. 1996. *Geotechnical Earthquake Engineering. First Edition.* Prentice Hall.
Suggested References	1. Ishihara, K. 1996. *Soil Behavior for Earthquake Geotechnics*, Oxford University Press. 2. Das, B.M. 1993. *Principles of Soil Dynamics* .PWS Publishing Company. 3. Richart, Jr., F.E., Hall, Jr., J.R., and Woods, R.D. 1970. *Vibrations of Soils and Foundations.* Prentice-Hall, Inc.

Course Name:	**GEOTECHNICAL ASPECTS OF LANDFILL DESIGN**
Course Description	This course presents geotechnical aspects related to the design of solid waste landfills. The course teaches settlement analyses, slope stability, liner compaction, and leachate collection systems as they relate designing a landfill. Computer software is used to assist design scenarios.
Number of Units for Lecture, Laboratory , Fieldwork and Tutorial	Lecture - 2 units Computer Laboratory- 1 unit
Number of Contact Hours per week	Lecture - 2 hours Laboratory- 3 hours
Prerequisite/Co-requisite	Geotechnical Engineering 1 & 2
Course Objectives	After completing this course, the student must be able to: 1. Identify key sources, typical quantities generated, composition, and properties of solid and hazardous wastes. 2. Identify waste disposal or transformation techniques (landfills and incinerators). 3. Recognize the relevant regulations that apply for facilities used for

	disposal, and destruction of waste. 4. Conduct invasive and non-invasive site investigation and understand permitting process for constructing landfills. 5. Identify and design Solid and Hazardous Waste Landfills (RCRA Subtitle D and C) including closure, post-closure, and rehabilitation issues; 6. Estimate typical waste disposal cost. 7. Identify recycling and reuse options (composting, source separation, and re-use of shredded tires, recycled glass, fly ash, etc.).
Course Outline	• Sources, quantities generated, and physochemical properties of municipal solid waste and hazardous waste. • Solid Waste Management Pyramid – Key Technologies for SWM (collection, handling, transformation, landfills, incinerators, composting). • Relevant environmental regulations for waste disposal, site investigations. • Site investigations, Site Selection (NIMBY), Regulatory permitting process. • Incineration and composting. • Types of Landfills, basic geotechnical considerations, earthen liners for waste disposal. • Clay mineralogy, factors controlling hydraulic conductivity, methods to measure the coefficient of permeability, k in the laboratory and field, compatibility of liner materials to chemicals in leachate. • Contaminant and liquid transport in soil liners for RCRA liners (advection and diffusion). • Geosynthetics for waste disposal – overview, Geomembranes-leakage, transport, and structural stability, Gesosynthetic Clay Liners (GCLs). • Design of Leachate Collection System for Landfills – Use of gravel and GDLs. • Operational aspects of MSW landfills (daily cover, leachate disposal, GW monitoring). • Landfill Gas Collection System and Leachate Recirculation System Design. • Landfill Final Cap Design and Water Balance (demonstration of HELP Model).
Laboratory Equipment	Computer Software in Landfill Design (PCSTABL, UNISETTLE, CEBAR)
Recommended Textbook	La Grega, M. D., Buckingham, P. L., and Evans, J. C. 2001. *Hazardous Waste Management, 2nd Edition.* McGraw-Hill.
Suggested References	1. Quian, et. Al. 2002. *Geotechnical Aspects of Landfill Design.* Prentice Hall. 2. Tchobanoglous,Theisen,Vigil. 2002. *Integrated Solid Waste Management.* McGraw-Hill. 3. Sharma, H. D. 2001. *Waste Containment Systems, Waste Stabilization, & Landfills. Design & Evaluation*. John Wiley & Sons.

F.6. Others/Special Topics

Course Name:	**CIVIL ENGINEERING CORRELATION COURSE**
Course Description	This course will cover the review of all the basic courses covered in the Civil Engineering Licensure examination.
Number of Units for Lecture, Laboratory, Fieldwork and Tutorial	Lecture - 3 units Tutorial - 3 units
Number of Contact Hours per week	Lecture - 3 hours Tutorial - 3 hours
Prerequisite/Co-requisite	Candidate for graduation.
Course Objectives	After completing this course, the student must be able to: 1. Gain thorough understanding of all the basic courses covered in the licensure examination thereby improving their chances of qualifying as licensed civil engineers.
Course Outline	1. Review of all mathematics and surveying courses. 2. Review of mechanics and materials. 3. Review of geotechnical engineering. 4. Review of Structural Theory and Structural Design courses. 5. Review of mechanics of fluids, hydraulics and hydrology. 6. Review of related construction and design courses. 7. *NOTE: Refer to the syllabus prescribed by the Board of Civil Engineering, Philippine Regulation Commission.*
Laboratory Equipment	None.
Suggested References	1. Textbooks and references prescribed by the BS Civil Engineering Course.

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)

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
Suggested References	American Psychological Association. *Publication Manual of the American Psychological Association*, 4th ed. Washington, DC: American Psychological Association, 1994. Carreon, E. and C. Balarbar. *Series in English for Specific Purposes: Engineering*. Manila: DLSU Press, 1995. McWhorter, K. *Guide to College Reading*. New York: Longman, 2003. Penrose, J.M., R.W. Rasberry and R.J. Myers. *Advanced Business Communication*. Cincinnati: South-Western College Publishing, 1997. Weissberg, R. and S. Buker. *Writing Up Research: Experimental Research Report Writing for Students of English*. New Jersey: Prentice Hall, Inc., 1990.