Republic of the Philippines
OFFICE OF THE PRESIDENT
COMMISSION ON HIGHER EDUCATION

CHED MEMORANDUM ORDER(CMO)
No. 10
Series of 2008

SUBJECT : POLICIES AND STANDARDS (PS) FOR BACHELOR OF SCIENCE IN MINING ENGINEERING (BSEM) PROGRAM

In accordance with the pertinent provisions of Republic Act (RA) No. 7722, otherwise known as the "Higher Education Act of 1994, " and by virtue of Resolution No. 742 - 2007 of the Commission en banc dated 15th day of October 2007 and for the purpose of rationalizing the mining engineering education in the country, the set of policies is hereby adopted and promulgated by the Commission.

ARTICLE I - INTRODUCTION

Section 1. Background and Rationale

Mining Engineering is a profession that deals with the application of mathematics, natural and applied sciences, humanities and social sciences in mineral deposit assessment; mine feasibility study; mine design, development and construction; management of mining operations, environmental protection, and associated activities and processes; and, mine progressive rehabilitation, closure, and decommissioning to harness mineral resources safely and economically for the social benefit of the country.

The herein Policies and Standards have been reviewed in accordance with recently approved CMO, industry needs, latest trends and technology in the field of mining engineering. This PS emerged as a result of the consolidated efforts of the academe, industry and other related agencies.

ARTICLE II - AUTHORITY TO OPERATE

Section 2. All private higher education institutions (PHEIs) intending to offer **Bachelor of Science in Mining Engineering** must first secure proper authority from the Commission in accordance with existing rules and regulations. State Universities and Colleges (SUCs), and Local Colleges and Universities (LCUs) should likewise strictly adhere to the provisions in these policies and standards.

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ARTICLE III - PROGRAM SPECIFICATION

Section 3. Degree Name

The degree program herein is called **BACHELOR OF SCIENCE IN MINING ENGINEERING (BSEM)**

Section 4. Program Description

4.1 Nature of Programs

This program prepares and enables students in the fields of mining engineering to attain the basic competencies such as conceptualization and design of mining methods, generation of technical specification and standards, undertake research and development, design improvement and mine optimization, and apply mining principles to operations. The Mining Engineering curriculum is designed specially to meet this minimum educational standard by emphasizing fundamental knowledge, transferable skills, and life-long learning.

4.2 Program Outcomes

The Bachelor of Science in Mining Engineering (BSEM) program must produce graduates that possess the following capabilities:

a. An ability to apply principles of mathematics, engineering, and other sciences to the practice of mining engineering;
b. An ability to design and conduct experiments, as well as to analyze and interpret data;
c. An ability to design a system, build, improve, and install systems or processes that can meet desired standards and needs within realistic constraints;
d. An ability to work effectively and efficiently in multi-disciplinary and multi-cultural teams;
e. An ability to identify, analyze, formulate, and solve basic mining engineering problems;
f. A knowledge and appreciation of the professional, ethical, social & environmental responsibilities;
g. An ability to communicate effectively in verbal and non-verbal interactions;
h. A broad knowledge necessary to understand impact/s of engineering solutions in a global/ societal context;
i. An ability to engage in life-long learning and to keep current on developments in a specific field of specialization;
j. A knowledge of contemporary issues; and,
k. An ability to use the appropriate techniques, skills and modern engineering tools necessary for the practice of mining engineering to be locally and globally competitive.

4.3 Specific Professions/ Careers/ Occupations or trades that the graduates may go into

4.3.1 Mine and Mineral Resource Development Operation and Management
4.3.2 Government Service/s in Mining
4.3.3 Mine Services
4.3.4 Academe
4.3.5 Mine Environmental & Enhancement Services
4.3.6 Mine Research and Development

Section 5. Allied Programs

The BSEM allied programs are Geology, Mineral Engineering, Geodetic Engineering, and Electrical Engineering.

ARTICLE IV - COMPETENCY STANDARDS

Section 6. This section defines the entry level competency standards, knowledge, attitudes, values and skills applicable to the BS Mining Engineering graduate, which are contained in **ANNEX I** of this Memorandum.

ARTICLE V - CURRICULUM

Section 7. Curriculum Description

7.1 The BS Mining Engineering program has a total of **189** credit units. The program is comprised of general education courses, basic engineering courses, allied and elective courses, and professional courses,
7.2 The general education courses are in accordance with the CHED Memorandum Order No. 59, s. 1996 "The New General Education Curriculum (GEC)"
7.3 The Technical Course includes Mathematics with a total of **26** units; Physical Sciences with a total of **12** units; Basic Engineering Sciences with a total of **21** units; the PE/NSTP with a total of **14** units; and, Electives of **9** units.
7.4 There are **12** professional courses with a total of **36** credit units.
7.5 There are **11** allied courses with a total of **32** units
7.6 In addition to the professional courses, students are required to undergo mine and plant apprentenship program (or On-the-Job-Training, OJT) with a minimum duration of **384** hours. Monitoring of OJT in conformity with course objectives will be the responsibility of the respective mining departments of Universities or Colleges.

Classification/ Field / Course	Minimum No. of Hours per week		Minimum Credit Units
	Lecture	Laboratory	
D. Mandated Course			
Life and Works of Rizal	3	0	3
Sub-Total:	**3**	**0**	**3**
E. Physical Education			
P.E. 1			2
P.E. 2			2
P.E. 3			2
P.E. 4			2
Sub-Total:			**8**
F. National Service Training Program			
NSTP 1			3
NSTP 2			3
Sub-Total:			**6**
GRAND TOTAL			**189**

* Students are required to undergo three hundred eighty four (384) hours of On-the-Job Training (OJT). It is recommended that the time allotments of the OJT are as follows: Two hundred sixty eight (268) hours for mine operation; fifty eight (58) hours for mineral exploration: and, fifty eight (58) hours for mineral processing.

Suggested Electives:

Mining:

1. Coal Mining
2. Drilling and Blasting,
3. Tunneling
4. Mine Feasibility Studies
5. Mine Surveying
6. Mine Project Development
7. Contract Mining
8. Best Practices in Mining
9. Computer Application in Mining Engineering

Energy Resource Extraction :

1. Introduction to Petroleum Engineering
2. Introduction to Geothermal Engineering
3. Energy related courses
4. Geotechnical Engineering

These electives are composed of two(2) subjects under Mining electives (equivalent to 6 units) and one (1) subject under the energy resource extraction electives (equivalent to 3 units). One of the mining electives must be three (3) units of computer application in Mining Engineering.

SUMMARY			
Classification/ Field	Total No. of Hours per week		Total No. of Units
	Lecture	Laboratory	
I. TECHNICAL COURSES			
A. Mathematics	26	0	26
B. Natural Sciences	9	9	12
C. Basic Engineering Sciences	17	12	21
D. Allied Courses	27	15	32
E. Professional Course	35	387	36
F. Elective	9	0	9
Sub- Total	**123**	**423**	**136**
II. NON- TECHNICAL			
A. Social Sciences	12	0	12
B. Humanities	9	0	9
C. Languages	15	0	15
D. Life and Works of Rizal	3	0	3
Sub-Total	**39**	**0**	**39**
Total	**162**	**423**	**175**
Physical Education			8
NSTP			6
Grand Total			**189**

Section 9. Relationship of the Courses to the Program Outcomes

The relationship of the identified courses in Section 8 to the identified program outcomes in Section 4-4.2 are contained in ANNEX II of this Memorandum

Section 10. Sample/ Model Program of Study

The institution may enrich the sample/model program of study depending on the needs of the industry, provided that all prescribed courses required in the curriculum outlines are offered and pre-requisite are complied with.

SECOND YEAR

2nd Year – First Semester

Courses	No. of Hours		Units	Pre-requisites
	Lec.	Lab		
Differential Calculus	4	0	4	Advanced Algebra, Analytic Geometry, Solid Mensuration
Physics 2	3	3	4	Physics 1
General Surveying	2	3	3	College Algebra, Plane and Spherical Trigonometry
Humanities 3	3	0	3	Humanities 2
English 3 (Technical Communication)	3	0	3	English 2
Social Science 1	3	0	3	None
PE 3			2	PE 2
NSTP 1			3	None
TOTAL	**18**	**6**	**25**	

2nd Year – Second Semester

Courses	No. of Hours		Units	Pre-requisites
	Lec.	Lab		
Integral Calculus	4	0	4	Differential Calculus
Environmental Engineering	2	0	2	General Chemistry
Principles of Geology	3	0	3	General Chemistry or Instructor's consent
Computer Fundamentals & Programming	0	6	2	2nd year Standing
Probability & Statistics	3	0	3	College Algebra
Social Science 2	3	0	3	Social Science 1
PE 4			2	PE 3
NSTP 2			3	NSTP 1
TOTAL	**15**	**6**	**22**	

THIRD YEAR

3rd Year – First Semester

Courses	No. of Hours		Units	Pre-requisites
	Lec.	Lab		
Differential Equations	3	0	3	Integral Calculus
Statics of Rigid Bodies	3	0	3	Physics 1, Integral Calculus
Principles of Mining	3	0	3	Co-Requisite Principles of Geology
Principles of Metallurgy	3	0	3	General Chemistry, Analytic Geometry
Elementary Mineralogy	3	0	3	Principles of Geology, General Chemistry
Social Science 3	3	0	3	Social Science 2
TOTAL	**18**	**0**	**18**	

3rd Year – Second Semester

Courses	No. of Hours		Units	Pre-requisites
	Lec.	Lab		
Dynamics of Rigid Bodies	2	0	2	Statics of Rigid Bodies
Underground Mining	3	0	3	Principles of Mining, Principles of Geology
Techniques of Mining Analysis	1	3	2	Principles of Metallurgy
Petrology	2	3	3	Elementary Mineralogy
Safety Management	1	0	1	3rd year standing
Engineering Management	3	0	3	General Chemistry
Social Science 4	3	0	3	Social Science 3
TOTAL	**15**	**6**	**17**	

FOURTH YEAR

4th Year – First Semester

Courses	No. of Hours		Units	Pre-requisites
	Lec.	Lab		
Mechanics of Deformable Bodies	3	0	3	Statics of Rigid Bodies
Surface Mining	3	0	3	Principles of Mining, Principles of Geology
Mine Environmental Management	3	0	3	Principles of Mining, Environmental Engineering, Engineering Management
Mine Safety	3	0	3	Principles of Mining , Safety Management
Computer Aided Drafting	0	3	1	3rd year standing
Basic Electrical Engineering	3	0	3	College Algebra, Plane and Spherical Trigonometry, Physics 2
TOTAL	**15**	**3**	**16**	

4th Year – Second Semester

Courses	No. of Hours		Units	Pre-requisites
	Lec.	Lab		
Mechanics of Fluids	3	0	3	Dynamics of Rigid Bodies, Mechanics of Deformable Bodies
Rock Mechanics	3	0	3	Underground Mining, Surface Mining, Mechanics of Deformable Bodies, Petrology
Engineering Economy	3	0	3	3rd year standing
Mineral Processing	2	3	3	Principles of Metallurgy, Mineralogy, Petrology
Structural Geology	2	3	3	Petrology
Elective 1 (Energy)	3	0	3	4th year Standing
TOTAL	**16**	**6**	**18**	

(Senior Standing)

MINE AND PLANT PRACTICE (On-the-Job-Training, OJT): 384 hours of actual practice/ 8 weeks

FIFTH YEAR

5th Year – First Semester

Courses	No. of Hours		Units	Pre-requisites
	Lec.	Lab		
Mine Research and Studies	3	0	3	Mine and Plant Practice, Senior Standing
Mine Management	3	0	3	Mine and Plant Practice, Senior Standing
Mine Economics	3	0	3	Probability &Statistics, Engineering Economics, Senior Standing
Mineral Deposits	3	0	3	Structural Geology, Senior Standing
Elective 2 (Mining)	3	0	3	Elective 1 (Energy), Senior Standing
TOTAL	**15**	**0**	**15**	

5th Year – Second Semester

Courses	No. of Hours		Units	Pre-requisites
	Lec.	Lab		
Mine Ventilation	3	0	3	Mechanics of Fluids, Senior Standing
Mine Design	2	3	3	Mine and Plant Practice, Senior Standing, Consent of Adviser
Mining & Environmental Laws and Ethics	3	0	3	Senior Standing
Elective 3 (Computer Applications in Mining)	3	0	3	Elective 2, Senior Standing
Life & Works of Rizal	3	0	3	None
TOTAL	**14**	**3**	**15**	

Section 11. Thesis/ Research/ Project Requirements

Suggested topics maybe any of the following:

11.1 Application of the different fields of specifications as listed in Section 4.3
11.2 Industry-based projects related to mining engineering fields
11.3 Socio-economic projects related to mining engineering
  11.3.1 Social Development Management Program
  11.3.2 Environmental Best Practices

Section 12. On-the-Job-Training or Practicum Requirements

12.1 To expose the student to the actual practice of mineral exploration, mining operation, and mineral processing;
12.2 Three hundred eighty four (384) hours of actual practice;
12.3 On-the-Job Training (OJT) in a Mining Operation or any facility include but not limited to the following:
- 12.3.1 Mineral Exploration: geologic principles, mineralogy, mineral resource/ore reserve estimations and evaluations, and mineral economics
- 12.3.2 Mining Operation: mine engineering and development, mine planning and management, mine design, draw control, mine ventilation and safety, mine economics, environmental engineering and management.
- 12.3.3 Mineral Processing: Size reduction and concentration processes, dewatering stages, auxiliary operations, tailings disposal, and environmental and legal considerations.

ARTICLE VI - COURSE SPECIFICATION

Section 13. The course specifications for the BS Mining Engineering program contained in **Annex III** of this Memorandum. **ANNEX IV** shall contain the summary of the Laboratory requirements.

1. Course Name
2. Course Description
3. Number of units for lecture and laboratory
4. Number of contact hours per week
5. Prerequisite
6. Course Objectives
7. Course Outlines
8. Equipment
9. References

ARTICLE VII – GENERAL REQUIREMENTS

Section 14. The general requirements for the BS Mining Engineering Program are contained in **"CMO 25, s. 2005 - revised Policies, Standards & Guidelines (PSG) for Engineering Education"**, a separate Memorandum issued by the Commission.

Compliance with the policies on the following was hereby required:

1. Instructional Program Quality
2. Research
3. Community Involvement
4. Administration and Support

ARTICLE VIII - TRANSITORY PROVISION

Section 14. HEIs that have been granted permit or recognition for Bachelor of Science in Mining Engineering degree program are hereby given a non-extendable period of four (4) years from the effectivity thereof, within which to fully complied with. State Universities and Colleges (SUCs) and Local Colleges and Universities (LCUs) shall also comply with the requirements herein set forth.

Student currently enrolled in the Bachelor of Science in Mining Engineering program shall be allowed to graduate under the old curriculum. However, students enrolling for the abovementioned program beginning school year 2008-2009 shall be covered by this CMO.

ARTICLE IX- SANCTIONS

Section 15. For violation of this Order, the Commission may impose such administrative sanction as it may deem appropriate pursuant to the pertinent provisions of Republic Act No. 7722, in relation to Section 69 of BP 232 otherwise known as the Higher Education Act of 1982, and Sections 24 and 101 of the Manual of Regulations for Private Schools (MRPS), and other related laws.

ARTICLE X – SEPARABILITY AND REPEALING CLAUSE

Section 16. Any provision of this Order, which may thereafter be held invalid, shall not effect the remaining provisions.

Section 17. All issuances, including but not limited to CMO No. 49, s. 1997, and CMO 34, s. 2001 and/ or any part thereof inconsistent herewith, are deemed repealed or modified accordingly.

ARTICLE XI- EFFECTIVITY CLAUSE

Section 18. This CMO shall take effect starting 1st semester of SY 2008-2009, after publication in an official gazette or in newspaper of general circulation.

Section 19. An educational institution applying to offer the new BSEM program shall likewise comply with all the provisions of this CMO.

Pasig City, Philippines _____

For the Commission:

ROMULO L. NERI
Chairman

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Pasig City, Philippines April 10, 2008

For the Commission:

ROMULO L. NERI
Chairman

ANNEX I

COMPETENCY STANDARDS FOR BS MINING ENGINEERING

TECHNICAL PANEL FOR ENGINEERING, TECHNOLOGY AND ARCHITECTURE

Workshop on the Identification of Competency Standards for the Mining Engineering
Days Hotel, Tagaytay City
March 25-26, 2004

PROFILE OF DUTIES AND COMPETENCIES OF A MINING ENGINEER

DUTIES		TASKS				
1. Conceptual design and Project Planning	1.Apply mathematical, computer and engineering tools	Adapt geological model for mining application	Delineate ore reserves by grid drilling activities	Use specialized mining software (e.g. Data Mine, Gemcom, etc.)	Estimate ore reserves	Apply engineering concepts in mining projects
	2. Conceptualization, planning and implementation	Undertake the various stages of mining feasibility studies	Apply knowledge on mining methods (surface and underground)	Formulate and prepare mining plans and design		
2. Research	1. Identify mine engineering problems	Understand mining process	Conduct literature survey	Identify the significance and objectives	Writing of project study	
	2. Develop methodologies and strategies	Apply probability and statistical tools				
	3. Gather data	Use various data gathering techniques	Process data			
	4. Analyze and evaluate results	Validate data	Test hypothesis	Make conclusions and recommendations		
	5. Convey and disseminate results	Prepare technical reports for presentation or publication	Demonstrate presentation skills			
3. Technology development and innovations	1. Apply new mining techniques and methods	Conceptualize new mining techniques and methods	Develop implementation plan	Operationalize the plan		
	2. Optimize mining operations	Understand new trends in mining	Modify mining techniques to suit local conditions	Adapt the best alternative		

4. Operations management	1. Formulate plans, programs, strategies and budget	Prepare mine plans and engineering design	Evaluate mining and milling data and report	Prepare action plan		
	2. Operationalize the plan	Execute mine development program	Extend essential mine services	Implement sound safety and health program	Implement maintenance programs	Implement environmental program
		Perform mine administrative function	Implement mine budget and cost control	Does personnel training, evaluation and management		
5. Related Practice	1. Teach mining engineering and related courses	Understand an d convey basic and applied mining engineering concept	Strengthen the basic mining engineering skills of the student	Guide/supervise and perform academic and R&D activities	Collaborate with other disciplines	Conduct continuing engineering education and extension activities
		Publish and disseminate academic and R&D output				
	2. Engage in mineral trade and entrepreneurship	Provide the technical and supply requirements of the mining industry				
	3. Render government service	Understand organizational set-up/network of government	Understand/implement relevant mining laws, regulations, other policies	Coordinate with all stakeholders in the mining sector		
	4. Provide technical assistance	Undertake mine contracting work	Offer computer application services	Supply mine environmental services	Participate in land use planning	

Engineer - A professional who applies the knowledge of mathematics, natural and applied sciences, humanities and social sciences gained through study, experience and practice with ingenuity and judgment based on ethical values to harness economically and safely the materials and forces of nature for the benefit of society and the environment.

Mining Engineering- is a profession that deals with the application of mathematics, natural and applied sciences, humanities and social sciences in mineral deposit assessment; mine feasibility study; mine design, development and construction; management of mining operations and associated activities and processes; environmental protection; mine decommissioning and rehabilitation, to harness economically and safely mineral resources for social and economic benefits of the country.

Mining Engineer- A graduate of Bachelor of Science in Mining Engineering (BSEM) from a duly recognized school, college or university, who possesses the necessary technical knowledge and skills in mineral deposit assessment; mine feasibility study; mine design, development and construction; management of mining operations and associated activities and processes; environmental protection; and mine decommissioning and rehabilitation programs.

ANNEX II

PROGRAM OUTCOMES FOR BS MINING ENGINEERING

ANNEX 2

Program Outcomes of the BS Mining Engineering

Column LEGEND:

Letter	Program Outcomes
a	An ability to apply principles of mathematics, engineering, and other sciences to the practice of mining engineering;
b	An ability to design and conduct experiments, as well as to analyze and interpret data;
c	An ability to design a system, build, improve, and install systems or processes that can meet desired standards and needs within realistic constraints;
d	An ability to work effectively and efficiently in multi-disciplinary and multi-cultural teams;
e	An ability to identify, analyze, formulate, and solve basic mining engineering problems;
f	A knowledge and appreciation of the professional, ethical, social & environmental responsibilities;
g	An ability to communicate effectively in verbal and non-verbal interactions;
h	A broad knowledge necessary to understand impact/s of engineering solutions in a global/ societal context;
i	An ability to engage in life-long learning and to keep current on developments in a specific field of specialization;
j	A knowledge of contemporary issues; and,
k	An ability to use the appropriate techniques, skills and modern engineering tools necessary for the practice of mining engineering to be locally and globally competitive.

I. TECHNICAL COURSES	a	b	c	d	e	f	g	h	i	j	k
A. Mathematics											
College Algebra	x	x	x	x	x		x	x	x		x
Advanced Algebra	x	x	x	x	x		x	x	x		x
Plane and Spherical Trigonometry	x	x	x	x	x		x	x	x		x
Analytic Geometry	x	x	x	x	x		x	x	x		x
Solid Mensuration	x	x	x	x	x		x	x	x		x
Differential Calculus	x	x	x	x	x		x	x	x		x
Integral Calculus	x	x	x	x	x		x	x	x		x
Differential Equations	x	x	x	x	x		x	x	x		x
Probability and Statistics	x	x	x	x	x		x	x	x		x
B. Natural/Physical Sciences											
General Chemistry	x	x	x	x	x		x	x	x		x
Physics 1	x	x	x	x	x		x	x	x		x
Physics 2	x	x	x	x	x		x	x	x		x
C. Basic Engineering Sciences											
Computer Fundamentals and	x	x	x	x	x		x	x	x		x

ANNEX III

COURSE SPECIFICATIONS FOR BS MINING ENGINEERING

ANNEX III
COURSE SPECIFICATIONS FOR THE BSEM

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ANNEX III
COURSE SPECIFICATIONS FOR THE BSEM

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COURSE SPECIFICATIONS
Bachelor of Science in Mining Engineering

I. TECHNICAL COURSES

A. MATHEMATICS

Course Name	**COLLEGE ALGEBRA**
Course Description	Algebraic expressions and equations; solution sets of algebraic equations in one variable: linear, quadratic, polynomial of degree *n*, fractional, radical equations, quadratic in form, exponential and logarithmic equations; decomposition of fractions into partial fractions; solution sets of systems of linear equations involving up to three variables.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Operate and simplify algebraic expressions; 2. Determine the solution sets of all types of algebraic equations, exponential and logarithmic equations; and inequalities; 3. Use the manipulative and analytical skills acquired in Objectives 1 to 2 to solve word problems; and 4. Identify the domain and range of a given relation/function.

Course Outline	1. The Set of Real Numbers 1.1. Integer Exponents 1.2. Polynomials, Operations, Special Products 1.3. Binomial Expansion (Binomial Theorem) 1.4. Factoring Polynomials 2. Rational Expressions 2.1. Rules of Exponents; Simplification of Rational Expressions; Operations on Rational Expressions 2.2. Properties of Radicals; Simplification of Radicals 2.3. Operations on Radicals 2.4. Complex Numbers 3. Equations in One Variable 3.1. Linear Equations; Literal Equations 3.2. Quadratic Equations in One Variable 3.3. Word Problems 3.4. Other Equations in One Variable: Radical, Fractional, Quadratic in Form 3.5. Polynomial Equation of Degree *n* 4. Functions 4.1. Inverse Functions 4.2. Exponential and Logarithmic Functions 4.3. Exponential and Logarithmic Equations 5. Systems of Linear Equations (by Elimination Methods) 6. Decomposition of Rational Expressions into Partial Fractions
Laboratory Equipment	None

Course Name	**ADVANCED ALGEBRA**
Course Description	Matrices and determinants; arithmetic and geometric series; solution sets of different types of inequalities and systems involving quadratics; solution of linear equations using determinants and matrices.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisites	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Determine the solution sets of inequalities; 2. Determine the solution sets of systems involving quadratics; 3. Use the manipulative and analytical skills acquired in Objective 2 to solve word problems; 4. Operate and manipulate matrices and determinants; 5. Solve systems of linear equations using matrices and determinants; and 6. Determine the indicated sum of the elements in an arithmetic and geometric sequence.

Course Outline	1. Inequalities 1.1. Linear, Quadratic, and Polynomial Inequality 1.2. Linear Inequalities with Absolute Value 2. Ratio, Proportion, and Variation 3. Determinants 3.1. Expansion by Minors 3.2. Solution of Linear Systems by Cramer's Rule 4. Matrices 4.1. Identity Matrix 4.2. Cofactor Matrix 4.3. Transpose of a Matrix 4.4. Adjoint Matrix 4.5. Inverse of a Matrix 4.6. Algebra on Matrices (Sum and Difference, Scalar Multiplication, Matrix Multiplication) 4.7. Solution of Linear Systems Using Matrices 5. Sequence and Series 5.1. Arithmetic and Geometric Means 5.2. Arithmetic and Geometric Sequences 5.3. Arithmetic and Geometric Series 5.4. Infinite Series 6. Combinatorial Mathematics 6.1. Sequences 6.2. The Factorial of a Number 6.3. Fundamental Principles of Counting, Permutation, and Combination 6.4. Binomial Theorem 6.5. Mathematical Induction
Laboratory Equipment	None

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

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

Course Name	**ANALYTIC GEOMETRY**
Course Description	Equations of lines and conic sections; curve tracing in both rectangular and polar coordinates in two-dimensional space.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisites	College Algebra Plane and Spherical Trigonometry

Course Objectives	After completing this course, the student must be able to: 1. Set up equations given enough properties of lines and conics; 2. Draw the graph of the given equation of the line and the equation of the conic section; and 3. Analyze and trace completely the curve, given their equations in both rectangular and polar coordinates, in two-dimensional space.
Course Outline	1. Plane Analytic Geometry 1.1. The Cartesian Planes 1.2. Distance Formula 1.3. Point-of-Division Formulas 1.4. Inclination and Slope 1.5. Parallel and Perpendicular Lines 1.6. Angle from One Line to Another 1.7. An Equation of a Locus 2. The Line 2.1. Point-Slope and Two-Point Forms 2.2. Slope-Intercept and Intercept Forms 2.3. Distance from a Point to a Line 2.4. Normal Form 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

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

Course Name	**DIFFERENTIAL CALCULUS**
Course Description	Basic concepts of calculus such as limits, continuity and differentiability of functions; differentiation of algebraic and transcendental functions involving one or more variables; applications of differential calculus to problems on optimization, rates of change, related rates, tangents and normals, and approximations; partial differentiation and transcendental curve tracing.
Number of Units for Lecture and Laboratory	4 units lecture
Number of Contact Hours per Week	4 hours lecture

Prerequisites	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

Course Name	**INTEGRAL CALCULUS**
Course Description	Concept of integration and its application to physical problems such as evaluation of areas, volumes of revolution, force, and work; fundamental formulas and various techniques of integration applied to both single variable and multi-variable functions; tracing of functions of two variables.
Number of Units for Lecture and Laboratory	4 units lecture
Number of Contact Hours per Week	4 hours lecture

Prerequisite	Differential Calculus
Course Objectives	After completing this course, the student must be able to: 1. Properly carry out integration through the use of the fundamental formulas and/or the various techniques of integration for both single and multiple integrals; 2. Correctly apply the concept of integration in solving problems involving evaluation of areas, volumes, work, and force; 3. Sketch 3-dimensional regions bounded by several surfaces; and 4. Evaluate volumes of 3-dimensional regions bounded by two or more surfaces through the use of the double or triple integral.
Course Outline	1. Integration Concept / Formulas 1.1. Anti-Differentiation 1.2. Simple Power Formula 1.3. Simple Trigonometric Functions 1.4. Logarithmic Function 1.5. Exponential Function 1.6. Inverse Trigonometric Functions 1.7. Hyperbolic Functions 1.8. General Power Formula 1.9. Constant of Integration 1.10. Definite Integral 2. Integration Techniques 2.1. Integration by Parts 2.2. Trigonometric Integrals 2.3. Trigonometric Substitution 2.4. Rational Functions 2.5. Rationalizing Substitution 3. Application 3.1. Improper Integrals 3.2. Plane Area 3.3. Areas Between Curves 4. Other Applications 4.1. Volumes 4.2. Work 4.3. Hydrostatics Pressure and Force 5. Surfaces Multiple Integral as Volume 5.1. Surface Tracing: Planes 5.2. Spheres 5.3. Cylinders 5.4. Quadratic Surfaces 5.5. Double Integrals 5.6. Triple Integrals 6. Multiple Integral as Volume 6.1. Double Integrals 6.2. Triple Integrals
Laboratory Equipment	None

Course Name	**DIFFERENTIAL EQUATIONS**
Course Description	Differentiation and integration in solving first order, first-degree differential equations, and linear differential equations of order *n*; Laplace transforms in solving differential equations.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Integral Calculus
Course Objectives	After completing this course, the student must be able to: 1. Solve the different types of differential equations; and 2. Apply differential equations to selected engineering problems.
Course Outline	1. Definitions 1.1. Definition and Classifications of Differential Equations (D.E.) 1.2. Order Degree of a D.E. / Linearity 1.3. Solution of a D.E. (General and Particular) 2. Solution of Some 1st Order, 1st Degree D.E. 2.1. Variable Separable 2.2. Homogeneous 2.3. Exact 2.4. Linear 2.5. Equations Linear in a Function 2.6. Bernoulli's Equation 3. Applications of 1st Order D.E. 3.1. Decomposition / Growth 3.2. Newton's Law of Cooling 3.3. Mixing (Non-Reacting Fluids) 3.4. Electric Circuits 4. Linear D.E. of Order *n* 4.1. Standard Form of a Linear D.E. 4.2. Linear Independence of a Set of Functions 4.3. Differential Operators 4.4. Differential Operator Form of a Linear D.E. 5. Homogeneous Linear D.E. with Constant Coefficients 5.1. General Solution 5.2. Auxiliary Equation 6. Non-Homogeneous D.E. with Constant-Coefficients 6.1. Form of the General Solution 6.2. Solution by Method of Undetermined Coefficients 6.3. Solution by Variation of Parameters
Laboratory Equipment	None

Course Name	**PROBABILITY AND STATISTICS**
Course Description	Basic principles of statistics; presentation and analysis of data; averages, median, mode; deviations; probability distributions; normal curves and applications; regression analysis and correlation; application

	to engineering problems.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Define relevant statistical terms; 2. Discuss competently the following concepts: 2.1. Frequency distribution 2.2. Measures of central tendency 2.3. Probability distribution 2.4. Normal distribution 2.5. Inferential statistics 3. Apply accurately statistical knowledge in solving specific engineering problem situations.
Course Outline	1. Basic Concepts 1.1. Definition of Statistical Terms 1.2. Importance of Statistics 2. Steps in Conducting a Statistical Inquiry 3. Presentation of Data 3.1. Textual 3.2. Tabular 3.3. Graphical 4. Sampling Techniques 5. Measures of Central Tendency 5.1. Mean 5.2. Median 5.3. Mode 5.4. Skewness and Kurtosis 6. Measures of Variation 6.1. Range 6.2. Mean Absolute Deviation 6.3. Variance 6.4. Standard Deviation 6.5. Coefficient of Variation 7. Probability Distributions 7.1. Counting Techniques 7.2. Probability 7.3. Mathematical Expectations 7.4. Normal Distributions 8. Inferential Statistics 8.1. Test of Hypothesis 8.2. Test Concerning Means, Variation, and Proportion 8.3. Contingency Tables 8.4. Test of Independence 8.5. Goodness-of-Fit Test 9. Analysis of Variance 10. Regression and Correlation
Laboratory Equipment	None

B. NATURAL/PHYSICAL SCIENCES

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

	Properties 1.3. Measurement and Handling of Numbers 2. Atoms, Molecules, and Ions 2.1. The Atomic Theory 2.2. The Structure of the Atom 2.3. Atomic Number, Mass Number, Isotopes 2.4. The Periodic Table 2.5. Molecules and Ions 2.6. Chemical Formulas 2.7. Naming Compounds 3. Mass Relationships in Chemical Reaction 3.1. Atomic Mass 3.2. Molar Mass of an Element and Avogadro's Number 3.3. Molecular Mass 3.4. Percent Composition of Compounds 3.5. Chemical Reactions and Chemical Equations 3.6. Amounts of Reactants and Products 3.7. Limiting Reagents 3.8. Reaction Yield 4. Gases 4.1. Substances That Exist as Gases 4.2. Pressure of a Gas 4.3. The Gas Laws 4.4. The Ideal Gas Equation 4.5. Gas Stoichiometry 4.6. Dalton's Law of Partial Pressure 4.7. The Kinetic Molecular Theory of Gases 4.8. Deviation from Ideal Behavior 5. Thermochemistry 5.1. Energy Changes in Chemical Reactions 5.2. Introduction to Thermodynamics 5.3. Enthalpy 6. Quantum Theory and the Electronic Structure of Atoms 6.1. From Classical Physics to Quantum Theory 6.2. Bohr's Theory of the Hydrogen Atom 6.3. The Dual Nature of the Electron 6.4. Quantum Mechanics 6.5. Quantum Numbers 6.6. Atomic Orbitals 6.7. Electron Configuration 6.8. The Building-Up Principle 7. Periodic Relationships Among the Elements 7.1. Periodic Classification of the Elements 7.2. Periodic Variation in Physical Properties 7.3. Ionization Energy 7.4. Electron Affinity 8. Chemical Bonding: Basic Concepts 8.1. Lewis Dot Structure 8.2. The Ionic Bond 8.3. The Covalent Bond 8.4. Electronegativity 8.5. Writing Lewis Structure 8.6. The Concept of Resonance 8.7. Bond Energy

	9. Chemical Bonding: Molecular Geometry and Hybridization 9.1. Molecular Geometry 9.2. Dipole Moments 9.3. The Valence Bond Theory 9.4. Hybridization of Atomic Orbitals 9.5. Hybridization in Molecules Containing Double and Triple Bonds 10. Intermolecular Forces in Liquids and Solids 10.1. The KMT of Liquids and Solids 10.2. Intermolecular Forces 10.3. Properties of Liquids 10.4. Crystalline vs. Amorphous Solids 10.5. Phase Changes 10.6. Phase Diagrams 11. Physical Properties of Solutions 11.1. Types of Solutions 11.2. A Molecular View of the Solution Process 11.3. Concentration Units 11.4. Effect of Temperature and Pressure on Solubility 11.5. Colligative Properties
Laboratory Equipment	Chemistry Laboratory(see attached)

Course Name	**PHYSICS 1**
Course Description	Vectors; kinematics; dynamics; work, energy, and power; impulse and momentum; rotation; dynamics of rotation; elasticity; and oscillation.
Number of Units for Lecture and Laboratory	4 units: 3 units lecture, 1 unit laboratory
Number of Contact Hours per Week	6 hours: 3 hours lecture, 3 hours laboratory
Prerequisites	College Algebra Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Differentiate a vector from a scalar; 2. Determine the resultant of concurrent vectors; 3. Solve problems in kinematics; 4. Apply Newton's Laws of Motion; 5. Determine the gravitational force between different masses; 6. Solve problems involving centripetal force for horizontal and vertical curves; 7. Compute the work done on a given body; 8. Relate work and energy; 9. Solve problems by applying the law of conservation of energy; 10. Solve problems in impulse and momentum and collisions; 11. Determine the stress and strain on a body; and 12. Determine the period of a body in simple harmonic motion.
Course Outline	1. Work, Energy and Power

	1.1. Definition of Work, Energy and Power 1.2. Conservation of Energy 2. Impulse and Momentum 2.1. Definition of Impulse and Momentum 2.2. Conservation of Momentum 3. Vector 3.1. Vectors and Scalars 3.2. Graphical Method 3.3. Analytical Method 4. Vector Subtraction 5. Kinematics 5.1. Equations of Kinematics 5.2. Freely Falling Bodies 5.3. Projectile Motion 6. Dynamics 6.1. Newton's Laws of Motion 6.2. Friction 6.3. First Condition of Equilibrium 7. Work, Energy and Power 7.1. Definition of Work, Energy and Power 7.2. Conservation of Energy 8. Impulse and Momentum 8.1. Definition of Impulse and Momentum 8.2. Conservation of Momentum 8.3. Collisions, Coefficient of Restitution 9. Rotation 9.1. Definition of torque 9.2. Second Condition of Equilibrium 9.3. Center of Gravity 10. Dynamics of Rotation 10.1. Kinematics of Rotation 10.2. Dynamics of Rotation 10.3. Center of Gravity 11. Elasticity 11.1. Hooke's Law 11.2. Stress and Strain 11.3. Modulus of Elasticity 12. Oscillations 12.1. Definition of Vibration Motion and Simple Harmonic Motion 12.2. Kinematics of Simple Harmonic Motion 12.3. Simple Pendulum
Laboratory Equipment	Physics Laboratory (see attached)

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 (see attached)

C. BASIC ENGINEERING SCIENCES

Course Name	**ENGINEERING DRAWING**
Course Description	Practices and techniques of graphical communication; application of drafting instruments, lettering scale, and units of measure; descriptive geometry; orthographic projections; auxiliary views; dimensioning; sectional views; pictorial drawings; requirements of engineering working drawings; and assembly and exploded detailed drawings.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Understand the importance of technical drawing knowledge and skills as applied to the various areas of engineering; 2. Apply the basic concepts of technical drawing and sketching; and 3. Prepare technical drawings.

Course Outline	1. Engineering Lettering 2. Instrumental Figures 3. Geometric Construction 4. Orthographic Projection 5. Dimensioning 6. Orthographic Views with Dimensions and Section View 7. Sectional View 8. Pictorial Drawing 9. Engineering Working Drawings 10. Assembly and Exploded Detailed Drawings
Laboratory Equipment	1. Drafting table 2. Drawing instruments 2.1. One 30-60 degree triangle 2.2. One 45 degree triangle 2.3. One technical compass 2.4. One protractor

Course Name	**COMPUTER FUNDAMENTALS AND PROGRAMMING**
Course Description	Basic information technology concepts; fundamentals of algorithm development; high-level language and programming applications; computer solutions of engineering problems.
Number of Units for Lecture and Laboratory	2 units laboratory
Number of Contact Hours per Week	6 hours laboratory
Prerequisite	Second Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand basic information technology concepts; 2. Use application software and the Internet properly; 3. Acquire proficiency in algorithm development using a high-level programming language; 4. Use the computer as a tool in engineering practice.
Course Outline	1. Introduction to Computers 1.1. Computer Organization 1.2. Number Systems and Data Representation 1.3. Application Software: Word Processing and Spreadsheet 1.4. The Internet 2. Programming 2.1. Algorithm Development 2.2. Programming Fundamentals
Laboratory Equipment	1. Personal computer with: 1.1. Operating system 1.2. Word processing software 1.3. Spreadsheet software 1.4. High-level programming language 1.5. Internet browser and Internet connection

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

Course Name	**STATICS OF RIGID BODIES**
Course Description	Force systems; structure analyses; friction; centroids and centers of gravity; and moments of inertia.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisites	Physics 1 Integral Calculus

Course Objectives	After completing this course, the student must be able to: 1. Understand the principles of equilibrium of particles; 2. Undertake vector operations such as vector cross and dot product; 3. Determine forces of 2D and 3D structures; 4. Understand the principles of static, wedge and belt friction; 5. Determine centroids, center of mass and center of gravity of objects; 6. Determine moment of inertia, mass moment of inertia; and 7. Analyze the stresses of trusses, beams and frames.
Course Outline	1. Introduction to Mechanics; Vector Operations 2. Force Vectors and Equilibrium of Particles 3. Vector Cross and Dot Product 4. Moment of a Force 5. Couples; Moment of a Couple 6. Equivalent Force Systems in 2D and 3D 7. Dry Static Friction, Wedge and Belt Friction 8. Centroid; Center of Mass; and Center of Gravity 9. Distributed Loads and Hydrostatic Forces; Cables 10. Moment of Inertia; Mass Moment of Inertia 11. Trusses; Frames and Machines; Internal Forces 12. Beams; Shear and Bending Moment Diagrams
Laboratory Equipment	None

Course Name	**DYNAMICS OF RIGID BODIES**
Course Description	Kinetics and kinematics of a particle; kinetics and kinematics of rigid bodies; work energy method; and impulse and momentum.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	Statics of Rigid Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles governing the motion of particles, velocity and acceleration; 2. Understand the principles of Newton's Second Law and its applications; 3. Understand kinetics of particles in particular energy and momentum methods; and 4. Understand kinematics of rigid bodies, its energy and momentum.
Course Outline	1. Introduction to Dynamics 2. Position, Velocity, and Acceleration 3. Determination of the Motion of the Particles 4. Uniform Rectilinear Motion 5. Uniformly Accelerated Rectilinear Motion 6. Position Vector, Velocity, and Acceleration 7. Derivatives of Vector Functions 8. Rectangular Components of Velocity and Acceleration 9. Motion Relative to a Frame in Translation

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

	16.12. Three-Dimensional Motion of a Particle Relative to a Rotating Frame; Coriolis Acceleration 16.13. Frame of Reference in General Motion 17. Plane Motion of Rigid Bodies: Forces and Accelerations 17.1. Equation of Motions 17.2. Angular Momentum of a Rigid Body in Plane Motion 17.3. Plane Motion of a Rigid Body. D' Alembert's Principle 17.4. Solution of Problems involving the Motion of a Rigid Bodies 17.5. Systems of Rigid Bodies 17.6. Constrained Plane Motion 18. Plane Motion of Rigid Bodies: Energy and Momentum Methods 18.1. Principle of Work and Energy for a Rigid Body 18.2. Work of Forces Acting on a Rigid Body 18.3. Kinetic Energy of a Rigid Body in Plane Motion 18.4 Systems of Rigid Bodies 18.5 Conservation of Energy 18.6 Principle of Impulse and Momentum 18.7 Conservation of Angular Momentum 18.8 Impulsive Motion 18.9 Eccentric Impact
Laboratory Equipment	None

Course Name	**MECHANICS OF DEFORMABLE BODIES**
Course Description	Axial stress and strain; stresses for torsion and bending; combined stresses; beam deflections; indeterminate beams; and elastic instability.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Statics of Rigid Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the concepts of stress and strain; 2. Calculate stresses due to bending, shears, and torsion under plain and combined loading; 3. Analyze statically determinate and indeterminate structures; and 4. Determine the elastic stability of columns.
Course Outline	1. Load Classification 2. Concept of Stress, Normal and Shear Stress 3. Stresses under Centric Loading 4. Stress Concentration 5. Plane Stress 6. Principal Stresses for Plane Stress 7. Mohr's Circle for Plane Stress 8. Deformations, Normal and Shear Strains 9. Material Properties 10. Working Stresses 11. Deformation in a System of Axially Loaded Members

	12. Temperature Effects on Axially Loaded Members 13. Statically Indeterminate Members 14. Thin-Walled Pressure Vessel 15. Torsional Stresses; Elastic Torsion Formula 16. Torsional Deformation; Power Transmission 17. Flexural Stresses by the Elastic Curve 18. Moment Equation Using Singularity Function 19. Beam Deflection by the Double Integration Method 20. Area Moment Theorems 21. Moment Diagram by Parts 22. Beam Deflection by Area Moment Method 23. Statically Indeterminate Beams 24. Buckling of Long Straight Columns 25. Combined Loadings 26. Analysis of Riveted Connections by the Uniform Shear Method 27. Welded Connections
Laboratory Equipment	None

Course Name	**ENGINEERING ECONOMY**
Course Description	Concepts of the time value of money and equivalence; basic economy study methods; decisions under certainty; decisions recognizing risk; and decisions admitting uncertainty.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Solve problems involving interest and the time value of money; 2. Evaluate project alternatives by applying engineering economic principles and methods and select the most economically efficient one; and 3. Deal with risk and uncertainty in project outcomes by applying the basic economic decision making concepts.
Course Outline	1. Introduction 1.1. Definitions 1.2. Principles of Engineering Economy 1.3. Engineering Economy and the Design Process 1.4. Cost Concepts for Decision Making 1.5. Present Economy Studies 2. Money-Time Relationships and Equivalence 2.1. Interest and the Time Value of Money 2.2. The Concept of Equivalence 2.3. Cash Flows 3. Basic Economy Study Methods 3.1. The Minimum Attractive Rate of Return

	3.2. The Present Worth Method 3.3. The Future Worth Method 3.4. The Annual Worth Method 3.5. The Internal Rate of Return Method 3.6. The External Rate of Return Method 3.7. The Payback Period Method 3.8. The Benefit/Cost Ratio Method 4. Decisions Under Certainty 4.1. Evaluation of Mutually Exclusive Alternatives 4.2. Evaluation of Independent Projects 4.3. Depreciation and After-Tax Economic Analysis 4.4. Replacement Studies 4.5. Break win Analysis 5. Decisions Recognizing Risk 5.1. Expected Monetary Value of Alternatives 5.2. Discounted Decision Tree Analysis 6. Decisions Admitting Uncertainty 6.1. Sensitivity Analysis 6.2. Decision Analysis Models
Laboratory Equipment	None

Course Name	**ENGINEERING MANAGEMENT**
Course Description	Decision-making; the functions of management; managing production and service operations; managing the marketing function; and managing the finance function.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the field of engineering management; 2. Know and apply the different functions of engineering management.

Course Outline	1. Introduction to Engineering Management 2. Decision Making 3. Functions of Management 3.1. Planning / Coordinating 3.2. Organizing 3.3. Staffing 3.4. Communicating 3.5. Motivating 3.6. Leading 3.7. Controlling 4. Managing Product and Service Operations 5. Managing the Marketing Function 6. Managing the Finance Function
Laboratory Equipment	None

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

Course Outline	1. Ecological Concepts 1.1. Introduction to Environmental Engineering 1.2. Ecology of Life 1.3. Biogeochemical Cycles 1.4. Ecosystems 2. Pollution Environments 2.1. Water Environment 2.2. Air Environment 2.3. Solid Environmental 2.4. Toxic and Hazardous Waste Treatment 3. Environmental Management System 3.1. Environmental Impact Assessment 3.2. Environmental Clearance Certificate 3.3. Environmental Monitoring
Laboratory Equipment	None

Course Name	**SAFETY MANAGEMENT**
Course Description	Evolution of safety management; safety terminology; safety programs adopted by high risk industries; hazards in the construction, manufacturing, gas and power plants, and other engineering industries and how to prevent or mitigate them; techniques in hazard identification and analysis in workplaces; off-the-job safety; disaster prevention and mitigation; and incident investigation.
Number of Units for Lecture and Laboratory	1 unit lecture
Number of Contact Hours per Week	1 hour lecture
Prerequisites	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the importance and the value of safety; 2. Know the health hazards and their prevention; 3. Identify mitigate measures to prevent possible hazards; and 4. Apply the concepts and principles of safety in engineering practice.

Course Outline	1. Overview of Safety 2. Basic Safety Procedures in High Risk Activities and Industries 2.1. Procedure in Hazards Analysis in the Workplace 2.2. Control of Hazardous Energies 2.3. Confined Space Entry 2.4. Basic Electrical Safety 2.5. Fall Protection 2.6. Barricades and Scaffolds 2.7. Fire Safety and the Fire Code 2.8. Industrial Hygiene 2.9. Hazard Communication and Chemical Safety 3. Value Based Safety and Off-the-Job Safety 3.1. Safety as a Value; Choice vs. Compliance 3.2. Off-the-Job Safety (Residences and Public Places) 3.3. Safety as Related to Health Practices 4. Disaster Prevention and Mitigation 4.1. Rationale for Disaster Prevention and Loss Control 4.2. Planning for Emergencies 4.3. Emergency Response Procedures 5. Incident Investigation and Reporting 5.1. Accident Escalation, Incident Investigation and Reporting 5.2. Causal Analysis; Recognition of Root Cause 5.3. Identification of Corrective or Preventive Actions
Laboratory Equipment	None

D. ALLIED COURSES

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 wiring, and lighting are introduced
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per week	3 hours lecture
Prerequisite	College Algebra, Plane Trigonometry, Physics 2
Course Objectives	At the end of the course, the student must be able to: 1. Understanding and appreciation electric circuits. 2. Apply the operating principles of AC-DC equipment. 3. Recognize and understand the basic electrical blueprint reading, house wiring and lighting and electrical safety. 4. Appreciate the importance of the course to the student's field of study.
Course Outline	DIRECT CURRENT. Ohm's Law, Series, Parallel Connections, Batteries and Power. ALTERNATING CURRENT. Voltage, Current & Phase, Peak, rms, Average Values. MAGNETISM. Fundamentals, Magnetic Circuits, Units of Magnetics.

	ELECTRICAL MATERIALS. Conductors, Insulators, Semiconductors. DC MACHINES / EQUIPMENT. Fundamental Concepts, Motors, Meters. AC MACHINES / EQUIPMENT. Fundamental Concepts, Motors, Transformers. ELECTRICAL SAFETY. Equipment Protection, Personnel Protection. BLUEPRINT READING. Electrical Symbols, Electrical Diagrams. HOUSE WIRING AND LIGHTING
Laboratory Equipment	None

Course Name	**ELEMENTARY MINERALOGY**
Course Description	A systematic approach in identifying and understanding the different rocks and ore forming silicates as well as non- silicate minerals. An introduction to mineral crystallography, to the physical and chemical properties and occurrences and uses on minerals.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hrs per Week	3 hours lecture
Prerequisite	Principles of Geology, General Chemistry
Course Objectives	At the end of the Course, the student must be able to: 1. Identify, understand the major properties of minerals and the principles that govern their behavior; 2. Acquire the skills in identifying the common mineral species and know their common economic uses. 3. Appreciate the role of minerals and their socio-economic values.
Course Outline	1. Crystallography – crystal morphology, crystal symmetry, crystallographic axes, miller indices, forms, zones, crystal projection and morphological calculations, lattice theory 2. Physical properties – X-Ray Crsytallogrphy,X0ray spectra, Bragg's Law, Laue method and other single crystal technique, Crystallographic tables, powder technique, ASTMS cards Uses of poeder data; Indexing refraction, Crystal habit and aggregates, cleavage, parting, fracture,mhardness luster streak, tenacity, specific gravity color,chatoyancy and asterism, luminisence, electrical and magnetic properties, optival properties 3. Crystal Chemistry
Laboratory Equipment	none

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 and Laboratory	3 units lecture
Number of Contact Hours per week	3 hours lecture
Prerequisite/Co-requisite	Dynamics of Rigid Bodies, Mechanics of Deformable Bodies
Course Objectives	At the end of the 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. Develop skill in solving practical problems, which involve numerical calculations from working formulas, often with the conclusion of experimentally determined coefficient. 4. Develop awareness in all of you that your solutions and decisions on a particular problem have social and moral impacts. 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 3.2 Dams 3.3 Principle of Archimedes 3.4 Stability of Submerged Bodies 3.5 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 4.1 Reynold's Transport Theorem 4.2 Mass Transport/Continuity Equation 4.3 Momentum Equations 4.4 Energy Systems 4.5 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

	7.2.1 Trajectories 7.2.2 Measuring Devices 7.2.3 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 Flow master Pondpack

Course Name	**GENERAL SURVEYING**
Course Description	Use of principal surveying instruments; surveying measurements and error theory; basic plane surveying operations and computational method of position, traverses and areas; basic cartography
Number of Units for Lecture and Laboratory	3 units: 2 units Lecture, 1 unit laboratory
Number of Contact Hours per week	5 hours: 2 hrs. lecture, 3 hrs. laboratory
Prerequisite	College Algebra & Plane & Spherical Trigonometry
Course Objectives	At the end of the course, the students must be able to: 1. Understand the theory and use of surveying instruments; 2. Acquire and understand the field procedures of executing plane surveys; 3. Compute traverses, areas and subdivision problems; 4. Prepare survey plans.
Course Outline	1. General Concepts of Surveying 1.1 Introduction to Surveying and Mapping 1.1.1 Definition of Terms 1.1.2 Purpose of Surveys 1.1.3 Uses and/or Applications of Surveys 1.1.4 Classification of Surveys 1.1.5 Drawings of Surveys 1.2 Survey Measurements and Adjustments 1.2.1 Observations and Measurements 1.2.2 The Mathematical Order 1.2.3 Classification of Errors 1.2.4 Basic Statistics 2. Basic Survey Measurements 2.1 Distance Measurements 1.1.1 Methods 1.1.2 Instruments 1.1.3 Errors and Corrections 2.2 Angle and Direction Measurements 2.2.1 Definition of Terms 2.2.2 Methods 2.2.3 Instruments

	2.2.4 Field Procedures and the Field Notebook 2.2.5 Errors 3. Survey Operations 3.1 Traverse and Areas 3.1.1 Definition of Terms 3.1.2 Types of Traverse 3.1.3 Traverse Computations and Adjustment 3.1.4 Linear Error of Closure 3.1.5 Methods of Area Computation 3.1.6 Area Subdivision 3.2 Land Surveys 3.2.1 Introduction to Land Surveys 3.2.2 Organization and Equipment 3.2.3 Kinds of Boundary Surveys 3.2.4 Technical Description of a Property 3.2.5 Legal Aspects of Land Surveys 4. Mapping (Map and Plan Drafting) 4.1 Methods of Plotting 4.2 Preparation of Plans of Land Surveys
Laboratory Equipment	Engineering transit, Automatic Level, Steel Tape, etc

Course Name	**MINERAL DEPOSITS**
Course Description	Ore deposit types and origin of mineral deposits with emphasis on Philippine examples.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hrs per Week	3 hours lecture
Prerequisite Co-Requisite	Structural Geology, senior standing
Course Objectives	At the end of the Course, the student must be able to: Understand the occurrences of the various types of ore deposit and elucidate the origin of different mineral deposits.
Course Outline	1. Introduction 2. Features of ore deposits and ore-forming processes 3. The exploration for mineral deposits 4. Major ore deposit types
Laboratory Equipment	None

Course Name	**MINERAL PROCESSING**
Course Description	Comminution (crushing and grinding), concentration (gravity, magnetic and electrostatic separation), screening, classification, dewatering treatments, materials handling, material balance and accounting, tailings disposal
Number of Units for Lecture and Laboratory	3 units: 2 unit lecture, 1 unit laboratory

Number of Contact Hours per Week	5 hours: 2 hour lecture, 3 hours laboratory
Prerequisite	Analytical chemistry, Principles of metallurgy
Course Objectives	At the end of the course, the student must be able to: 1. Understand the basic principles of the different processes involved in mineral processing – from comminution to concentration; 2. Gain the knowledge on the auxiliary operations on mineral dressing– screening and classification, materials handling, and dewatering; 3. Apply the basic principles and operations involved in concentration/ separation; 4. Acquire problem solving skills on material balances as applied to mineral processing; 5. Understand the selection of mineral processing techniques / equipment appropriate for specific minerals; and, 6. Understand the importance of material balances and metallurgical accounting in evaluating operations in relation to technical, economic and environmental considerations.
Course Outline	1. Properties of minerals in relation to processing 2. Comminution Energy laws 3. Crushing - types of crushers, equipment selection, crushing circuits 4. Grinding - work indices, types of tumbling mills, critical speeds, grinding circuits 5. Screening/classification – principles, types of screens/classifiers, screening/classification efficiencies 6. Material balances and Metallurgical accounting 7. Gravity concentration - basic principles, equipment 8. Dense media separation - basic principles, equipment 9. Low and high intensity magnetic separation - basic principles, equipment 10. Dewatering – thickening, filtering, flocculation, coagulation, application of surface properties/ phenomena 11. Environmental Considerations (Mine and Mill tailings disposal and treatment)
Laboratory Equipment	Laboratory crushers and grinders, laboratory ball and rod mills, laboratory gravity and magnetic separators, complete series of Tyler screens, flotation facilities, filters, weighing scales

Course Name	**PETROLOGY**
Course Description	Concepts of rock origin- distribution, mineral association and chemical composition of rocks that compose the crust and upper mantle. The use of chemical and physics in interpreting rock forming processes. Megascopic examination (modal constitution, texture, and fabric) and classification of igneous, sedimentary and metamorphic rocks.
Number of Units for Lecture and Laboratory	3 units: 2 units lecture, 1 unit laboratory
Number of Contact Hrs per Week	5 hours: 2 hours lecture, 3 hours laboratory

Prerequisite Co-Requisite	Elementary Mineralogy
Course Objectives	At the end of the Course, the student must be able to: 1. Understand and interpret the origin of minerals and rocks; and, 2. Acquire the basic principles of the megascopic examination (modal constitution, texture, and fabric) of the various classification of igneous, sedimentary and metamorphic rocks.
Course Outline	1. introduction – Tectonics, Geochemistry of the Earth, Phase equilibrium 2. Igneous Rocks – Classification and description, origin and evolution, tectonic setting 3. Sedimentary Rocks – siliclastic sediment textures, sedimentary structures, classification of sedimentary rocks, composition and classification of sand stones, mudrocks, carbonates, volcanic sediments, siliceous sediments and the origin of chert, organic sediments 4. Metamorphic rocks – classification and description, physio-chemical processes, Tectonic setting
Laboratory Equipment	Brunton compass, tape, sample picks

Course Name	**PRINCIPLES OF GEOLOGY**
Course Description	Study of earth materials, the nature and consequences of endogenic and exogenic geologic processes; Plate Tectonics
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hrs per Week	3 hours lecture
Prerequisite	General Chemistry or Instructor's Consent
Course Objectives	At the end of the Course, the student must be able to: Acquire and understand the basic principles of geology, the nature and consequences of endogenic and exogenic geologic processes and plate tectonics.
Course Outline	1. Introduction to geology 2. The planet earth 3. Minerals 4. Igneous rocks 5. Volcanism 6. Sedimentary rocks 7. Sedimentary environments 8. Ground water 9. Mass wasting 10. Metamorphic rocks 11. Rock deformation 12. Earthquakes 13. Plate Tectonics 14. Historical geology
Laboratory Equipment	none

Course Name	**PRINCIPLES OF METALLURGY**
Course Description	An introduction to mineral processing, hydrometallurgy, pyrometallurgy , and electro-metallurgy, and to adaptive metallurgy. Terminology, principles, processes , flow diagrams and overview of local and foreign metallurgical industries
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hrs per Week	3 hours lecture
Prerequisite	General Chemistry 2, Analytic Geometry
Course Objectives	At the end of the Course, the student must be able to: 1. Understand a general/introductory knowledge on metallurgy – from mineral processing to extractive metallurgy to adaptive metallurgy. 2. Apply the basic principles to familiarize with process flow diagrams vis-a –vis metallurgical processes. 3. Understand and apply the basic concepts on material and energy balances and metallurgical accounting. 4. Gain a general knowledge to understand the various conditions affecting the Philippine mineral processing and metallurgical industries.
Course Outline	1. Overview of different processes: 2. Mineral processing 3. Pyrometallurgy 4. Smelting 5. Calcination 6. Hydrometallurgy 7. Leaching, etc 8. Electrometallurgy 9. Electrowinning 10. Electro-refining 11. Adaptive metallurgy 12. Foundry 13. Metal forming 14. Semiconductor packaging
Laboratory Equipment	none

Course Name	**STRUCTURAL GEOLOGY**
Course Description	Mechanics of structural geological deformation; nature, origin, types, and field examples of primary and secondary rock structures; photo-interpretation of geologic structures.
Number of Units for Lecture and laboratory	3 units: 2 units lecture, 1 unit laboratory
Number of Contact Hrs per Week	5 hours: 2 hours lecture, 3 hours laboratory
Prerequisite Co-Requisite	Prerequisite: Petrology
Course Objectives	At the end of the Course, the student must be able to:

	1. Recognize maps and profiles the different rock formation/ structures and faults, fractures, joints folds, etc. 2. Describe the processes responsible for the deformation in rocks 3. Apply tools of strain analysis for interpretation of structural history of an area 4. Relate structural geology to plate tectonic theory 5. Solve graphically and mathematically common problems affecting geologic structures,
Course Outline	1. Introduction 2. Concepts of structural analysis 3. Three-point Problem 4. Introduction to faults 5. Rock mechanics 6. Stress and Strain 7. Folds and Folding 8. Fabrics 9. Plate Tectonics – The anatomy of organic belts
Laboratory Equipment	Brunton Compass, Lens, Meter - tape

Course Name	**TECHNIQUES OF METALLURGICAL ANALYSIS**
Course Description	The course is designed to provide basic knowledge on the conventional/classical and modern methods of analyzing minerals and metallurgical products, both in solid and liquid forms. These include fire assaying, Atomic Adsorption Spectrophotometer, gravimetric and volumetric methods, X-ray diffraction and similar methods.
Number of Units for Lecture and Laboratory	2 units: 1 unit lecture, 1 unit laboratory
Number of Contact Hrs per Week	4 hours: 1 hour lecture, 3 hours laboratory
Prerequisite	Analytical Chemistry
Course Objectives	At the end of the course, the student must be able to: 1. Understand the basic principles and fundamentals of the different methods of metallurgical analysis. 2. Familiarize with the different laboratory procedures, equipment, and instrumentations involved in metallurgical analysis of metals and materials. 3. Acquire problem solving skills in charge and flux calculations as applied to fire assaying of ores and minerals. 4. Understand and select metallurgical analytical techniques appropriate for specific minerals. 5. Understand the importance of metallurgical analysis in material balances and metallurgical accounting in evaluating operations related to technical, economic and environmental considerations.

Course Outline	1. Review of basic chemistry 2. General Consideration Sampling 3. Sample preparation 4. Accuracy and precision 5. Sensitivity 6. Fire Assay of Precious Metals 7. Definition of Terms 8. Reagents and apparatus 9. Assay fusions and related smelting processes 10. Slag calculations for acidic and basic slags 11. Inquartation 12. Scorification assay 13. Bullion assay and solution assay 14. Classical Methods of Analysis 15. Copper assays 16. Lead assays 17. Zinc assays 18. Iron assays 19. Instrumentation Methods of Analysis 20. Spectrophotometry 21. X-ray Diffraction/Fluorescence 22. Microanalysis
Laboratory Equipment	Manual and mechanical samplers, fire assaying furnaces and facilities, weighing balance, Atomic Absorption Spectrophotometry (AAS), XRray Diffraction (XRD) facilities

E. PROFESSIONAL COURSES

Course Name	**MINE ECONOMICS**
Course Description	Fundamentals of feasibility studies, methods of sampling, ore reserve estimations and statistical analysis for evaluating mineral deposits, engineering economic principles with emphasis on the economic evaluation of mineral development and mining projects.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Probability and Statistics, Engineering Economics, Senior Standing
Course Objectives	At the end of the course, the student must be able: 1. Acquire the basic principles of economics in relation to mine engineering applications; 2. Understand and apply basic knowledge in making technical economic analysis for mine operation and allied projects; and, 3. Understand the importance of economics factors as well as other related factors affecting the Philippine Mining Industry.
Course Outline	1. Peculiar features of the mining industry 2. Introduction to investment decision making 3. Cash flows, depreciation, depletion and amortization 4. Production cost variations, profit and breakeven point

	5. Compound interest formulas and equivalence 6. Present worth, annual worth, and future worth equations 7. Evaluation of investment alternatives 8. Tax consideration and leverage concepts 9. Sensitivity analysis
Laboratory Equipment	none

Course Name	**MINE ENVIRONMENTAL MANAGEMENT**
Course Description	The course is designed to provide knowledge on the environmental management, design and rehabilitation in the mine.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Principles of Mining, Environmental Engineering, Engineering Management
Course Objectives	At the end of the course, the student must be able to: 1. Familiarize with the various environmental impacts brought about by mining operations and production, and mineral processing and tailings disposal; 2. Appreciate the social and environmental responsibilities that are essential to future mining engineers; and, 3. Formulate mitigation measures, monitoring plans, and best practices for the environmental management of a mining operation.
Course Outline	1. International Perspective of Sustainable Development; 2. Corporate Responsibilities; 3. Legislation & Regulatory Framework; 4. Environmental Impact Assessment; 5. Environmental Management Systems & Company Initiatives - corporate reporting/code for environmental management/case studies, 6. Environmental Auditing; 7. Mine Planning/Feasibility; 8. Studies/Documentation to Avoid Environmental Impact; 9. Environmental Management - an introduction, Environmental issues in mining; 10. Management of Mine Wastes; 11. Mine Tailings Disposal and Storage; 12. Environmental issues in tailings management; 13. Tailings dam incidents; 14. Chemical (Cyanide) Management; 15. Water pollution/Acid Mine Drainage and its remediation; 16. Environmental Monitoring; 17. Environmental Impacts and Management: o Air Quality; o Mineral Exploration, Quarries/extractives/industrial minerals, o Small scale & placer mining, o Uranium mining, (optional)

	18. Mining in developing countries - a case study, Social impact, Rehabilitation and closure.
Laboratory Equipment	none

Course Name	**MINE MANAGEMENT**
Course Description	Introduction to mine administration, corporate planning, organization, maintenance management, mine labor cost analysis, industrial relations and human resource development. Concept of corporate social responsibilities and quantitative management techniques.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Mine and Plant Practice, Senior Standing
Course Objectives	At the end of the course, the student must be able to: Acquire and understand the basic principles of mine administration, corporate planning, organization, maintenance and management; mine labor cost analysis, industrial relations and human resources development.
Course Outline	1. Introduction to mine management. 2. Corporate Planning 3. Organization 4. Management by Objectives 5. Performance Appraisal System 6. Education, Training and Development 7. Management Information system. 8. Mine productivity 8. Underground Incentive Bonus System. 9. Maintenance Management. 10. Material Management. 11. Industrial Relations and Corporate Social Responsibility. 12. Introduction to Quantitative Management Techniques
Laboratory Equipment	none

Course Name	**MINE DESIGN**
Course Description	Analysis and design of materials handling systems including hauling and hoisting, mineral resource and ore reserve estimation, mine ventilation, mine dewatering, compressed air and power systems. Application of operations research in mining.
Number of Units for Lecture & Laboratory	3 units: 2 units lecture, 1 unit laboratory
Numbers of Contact Hours per Week	5 hours: 2 hours lecture, 3 hours laboratory
Prerequisites	Mine and Plant Practice, Senior Standing and Consent of Adviser
Course Objectives	At the end of the course, the student must be able to:

	1. Understand the concepts and principles of mine plant design; 2. Recognize the different aspects of mine operation and planning as applied to surface and/ or underground; and, 3. Apply the various principles and techniques in solving practical mining problems pertaining to mine design.
Course Outline	1. Engineering Design Process 2. Facilities planning, process, manufacturing engineering, and reengineering 3. Design Problems (Mineral resource and ore reserve estimation; Surface mine fleet design; Mine dewatering; Underground fleet design; Ventilation: Underground track haulage; Conveyors and Hoist design)
Laboratory Equipment	Computer facilities and mining softwares (mine operation and planning)

Course Name	**MINE SAFETY**
Course Description	Causes and prevention of mine accidents; safety management and organization; mine rescue training; mine safety and health regulations; introduction to the principles of quantitative risk assessment in a mining context.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Principles of Mining, and Safety Management
Course Objectives	At the end of the course, the student must be able to: 1. Recognize the causes of mine-related accidents; 2. Incorporate safe operation practices and procedures into the designs of all types of earth excavations to prevent mine-related accidents; 3. Understand the basic aspect of safety management and organization; 4. Apply basic knowledge of mine rescue; 5. Acquire an overview of mine safety and health regulations; and, 6. Acquire an overview of the principles of quantitative risk assessment in a mining context.

Course Outline	1. Primary causes of mining accidents 2. Hazard recognition relative to explosives, mine gases, electrical and mechanical devices 3. "Best Practices" to help reduce serious accidents in work sites 4. Establishment of Health and Safety Organizations in Mines, Qualification, Duties & Responsibilities of Safety Men, Rights and Duties of Employees, record Keeping 5. Mine mapping as regards to escape ways, first-aid stations, fire extinguishers, emergency evacuation plan, barricading 6. Procedures of safely entering and leaving the mine; transportation; communications 7. Procedures regarding ground control systems 8. Safe procedures dealing with the usage, transport and storage of explosives 9. Safe procedures of using welding and cutting equipment 10. Methods of fighting mine fires 11. Proper procedure of donning self-rescue device and care of such devices 12. Elements of basic first aid 13. Mine Safety rules and regulations 14. Introduction to the principles of quantitative risk assessment in a mining context.
Laboratory Equipment	none

Course Name	**MINE RESEARCH AND STUDY**
Course Description	Research methodology, technical report writing and presentation on selected topics with emphasis on mine practices and current issues.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Mine and Plant Practice, Senior Standing
Course Objectives	At the end of the course, the student must be able to: Conduct independent research on basic mining principles, mine engineering and environmental issues.
Course Outline	1. Basic principles and methodologies of scientific/technical research. 2. Development and selection of research topics 3. Writing of research proposals 4. Formulate research methodology 5. Evaluation and analysis of research data and results. 6. Interpretation and presentation of research output 7. Submission of progress reports 8. Technical report writing – elements and style. 9. Technical paper presentation – pointers for preparation and presentation.
Laboratory Equipment	None

Course Name	**MINE VENTILATION**
Course Description	Fundamentals of mine ventilation, including gas, dust, temperature and humidity control. Economics of airflow, natural and mechanical ventilation. Analysis and design of ventilation systems.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Mechanics of Fluid, Senior Standing
Course Objectives	At the end of the course, the student must be able to: 1. Understand the basic principles/ fundamentals of mine underground ventilation; 2. Acquire a thorough knowledge and understand mine ventilation systems; 3. Understand and familiarize with the different mine ventilation techniques including the equipment, instrument or apparatus used; and, 4. Understand and apply the basic aspects in mine ventilation planning and design.
Course Outline	1. Introduction. Definitions. Control Process 2. Properties and behavior of air. 3. Quality control (Contaminants, gas and dust control) 4. Quality control in ventilation. 5. Types of ventilation and economics of airflow 6. Temperature and humidity control. 7. Ventilation surveys
Laboratory Equipment	none

Course Name	**MINING AND ENVIRONMENTAL LAWS AND ETHICS**
Course Description	The mining and environmental laws, policies, implementing rules and regulations, legal and ethical issues affecting the practice of Mining Engineering, Mine safety rules and regulations.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Senior Standing
Course Objectives	At the end of the course, the student must be able to: 1. Understand the legal framework of the mining industry notably the Philippine Mining Act and its implementing rules and regulations; 2. Apply the principles of safety and ethical behavior to the practice of the mining profession.
Course Outline	1. Evolution of Philippine mining legislation. 2. Philippine Mining Act and its Implementing Rules and Regulations. 3. Mine safety and health standards

	4. Mining Engineering Law 5. Code of Ethics for Mining Engineers 6. Philippine Mineral Resource and Reserves Classification System 7. Philippine Environmental Laws 8. IPRA, LGC, NIPAS and other related laws 9. Decided cases related to the mining industry.
Laboratory Equipment	none

Course Name	**PRINCIPLES OF MINING**
Course Description	Principles of mineral exploration, mine development, exploitation and rehabilitation. Introduction to surface and underground mining methods. Socioeconomic importance and characteristics of the mineral industry.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Co-requisite Principles of Geology
Course Objectives	At the end of the course the students must be able to: 1. Acquire the necessary knowledge about the history and overview of the mining industry. 2. Understand the basic principle of mining and its application to the mineral industry in general.
Course Outline	1. Introduction: Mining laws and government regulations; 2. Prospecting and Exploration – Techniques and methods; 3. Introduction to mineral resource/ore reserve estimation; 4. Mine development; 5. Mine exploitation; 6. Introduction of mineral deposits; 7. Mine production cycles. Drilling, Blasting, Loading, Hauling; 8. Surface and underground mining methods; and, 9. Miscellaneous topics.
Laboratory Equipment	none

Course Name	**ROCK MECHANICS**
Course Description	Introduction to rock mechanics. Physical and engineering properties of rocks, rock failures and fundamentals of rock mass and rock response to applied loads. Principle of the design of underground openings and pit slopes, ground support, tunneling, and other practical applications.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Underground Mining, Surface Mining, Mechanics of Deformable Bodies, Petrology
Course Objectives	At the end of the course, the student must be able to:

	1. Understand the basic principles of rock mechanics and its related fields; 2. Know the different engineering properties of rocks; 3. Know the different rock exploration and logging/ examination techniques; and 4. Acquire the necessary knowledge to apply rock mechanics in mining engineering and related structures.
Course Outline	1. Introduction, definitions and applications. 2. Rock classification system. 3. Intact rock strength classification 4. Rock mass classification 5. Rock strength and failure criteria. (Modes of failure, laboratory tests, stress-strain behavior, and failure criterion) 6. Application of rock mechanics in engineering for underground openings. 7. Observational methods of design. (Monitoring techniques, tunneling method, and convergence-confinement method) 8. Analytical methods of design 9. Integrated designs 10. Design of Mine Pillars
Laboratory Equipment	none

Course Name	**SURFACE MINING**
Course Description	Merits of surface mining, engineering and economic factors in the selection and use of various equipment and systems in surface mining, ore estimations, grade control, mine planning, cost estimation, slope stability and control, placer and coal mining operations.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Principles of Mining, Principles of Geology
Course Objectives	At the end of the course, the student must be able to: 1. Acquire knowledge and skills in planning and designing of open pit and other surface mining methods; 2. Understand the important concepts on the mine management including selection of mine equipment, stripping ratios, grade control and mine planning.
Course Outline	1. Overview of surface mining methods. 2. Surface and open pit design considerations. 3. Orebody modeling. Grade determination and sampling techniques. Mineral resource/Ore reserve estimation and surface mapping. 4. Mine planning and design 5. Economics of surface mining. 6. Pit optimization 7. Production scheduling and operations. Equipment considerations, cycle of operations and sample problems. 8. Pit maintenance and auxiliary operations. 9. Rehabilitation of Mined-out areas
Laboratory Equipment	none

Course Name	**UNDERGROUND MINING**
Course Description	Criteria for the selection of underground mining method including coal mining. Techniques, unit operations and mine systems involved in the different underground mining methods. Development planning, engineering layout and extraction. Underground haulage systems, draw and grade control.
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Principles of Mining, Principles of Geology
Course Objectives	At the end of the course, the student must be able to: Acquire the knowledge and understanding of the different underground mining methods and the associated mining basic operations.
Course Outline	1. Introduction (Definition of terms. Surface versus Underground Mining. Classification of underground mining methods. Guidelines and considerations in the selection of underground mining methods.) 2. Unsupported Mining Methods 3. Supported Mining Methods 4. Caving Methods 5. Basic operations in underground mining. (Drilling/Boring, Blasting, Shaft Sinking, Raise Driving, Hauling and Hoisting, Underground Support Systems)
Laboratory Equipment	none

Course Name	**MINE AND PLANT PRACTICE (OJT)**
Course Description	On- the- job training in mineral exploration, mining operation and mineral processing plant or facility.
Number of Units for Lecture and Laboratory	n/a
Number of Contact Hrs per Week	Three Hundred Eighty Four (384) hours of actual practice is distributed as follows: 1. Two Hundred Sixty Eight (268) hours for Mine Operation 2. Fifty Eight (58) hours for Mineral Exploration 3. Fifty Eight (58) hours for Mineral Processes
Prerequisite	Must have finished the major subjects related to mining, geologic and metallurgical principles. A background of environmental engineering and mine safety is also essential in the actual exposure to mining operations and mineral processing, Senior Standing
Course Objectives	To expose the student to the actual operations of a mining operation, mine exploration, and mineral processing plant or facility.

Course Outline	On –the- Job Training in a Mining Operation or any facility involved in processes which include but not limited to the: 1. Mineral Exploration: geologic principles, mineralogy, mineral resource/ore reserve estimation and evaluation, and mineral economics. 2. Mining Operation: Mine Engineering, mine development, mine planning and management, and mine design, draw control, mine ventilation and safety, environmental engineering and management. 3. Mineral processing: Size reduction and concentration processes, dewatering stages, auxiliary operations, tailings disposal, and environmental and legal considerations.
Laboratory Equipment	None

F. ELECTIVES

Course Name	**ELECTIVE (SPECIAL TOPICS IN MINE ENGINEERING)**
Course Description	Discussion of current practices in mining and other relevant issues..
Number of Units for Lecture & Laboratory	3 units lecture
Numbers of Contact Hours per Week	3 hours lecture
Prerequisites	Senior Standing
Course Objectives	At the end of the course, the student must be able to: Acquire additional knowledge and understanding of various mining related topics that are not specifically taken into account by the regular mining courses.
Course Outline	Course outline will differ from semester to semester depending on the topics to be discussed. Topics include the following: **I. MINING** 1. Coal Mining 2. Drilling and Blasting 3. Tunneling 4. Mine Feasibility Studies 5. Mine Surveying 6. Mine Project Development 7. Contract Mining 8. Best Practices **9. Computer Applications in Mining** **II. ENERGY RESOURCE EXTRACTION** 1. Introduction to Petroleum Engineering 2. Introduction to Geothermal Engineering 3. Energy related courses 4. Geotechnical Engineering
Laboratory Equipment	none

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

ANNEX IV - A

LABORATORY REQUIREMENTS
for
CHEMISTRY & PHYSICS

GENERAL CHEMISTRY LABORATORY

Exercise	Required Equipment	Required Quantity*
1. Basic Laboratory Techniques a. Use of burner b. Preparation of solutions • Determination of mass • Measurements of volume • Calculation of density	 Burner Beaker Graduated cylinder Triple beam balance NaCl solution $Pb(NO_3)_2$ solution	 5 pcs. 5 pcs. 5 pcs. 5 pcs. 25 mL 25 mL
2. Separation techniques a. Filtration/decantation b. Sublimation c. Adsorption d. Distillation	Glass funnel Beaker Evaporating dish Filter stand Distillation apparatus Activated charcoal Staple wire Food color $KMnO_4$ solution	5 pcs. 5 pcs. 5 pcs. 5 pcs. 1 set-up 5 g 25 pcs. 5 g 25 mL
3. Classification of matter a. Differentiation of elements, compounds mixtures, colloids b. Differentiation of electrolyte from non-electrolyte c. Differentiation of acid, bases, salts.	Test tube pH paper Conductivity apparatus I_2 crystals $KClO_3$ solid NaOH solution HCl solution NaCl solution Sugar solution	50 pcs. 20 pcs. 1 set-up 3 g 3 g 25 mL 25 mL 25 mL 25 mL
4. Changes of matter and energy transformation a. Differentiation of physical from chemical change b. Law of conservation of mass c. Types of chemical reactions	Test tube Burner Evaporating dish Beaker Alcohol I_2 crystals Zn strips HCl solution Staple wire $CuSO_4$ solution	50 pcs. 5 pcs. 5 pcs. 5 pcs. 5 mL 5 g 5 pcs. 25 mL 25 pcs. 25 mL
5. Gas Laws a. Boyle's Law b. Charles's Law c. Graham's Law	Beaker Thermometer Syringe Glass tubing Sand bag NH_4OH solution HCl solution	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 mL 5 mL
6. Solutions a. Factors affecting solubility b. Colligative properties	Test tube Beaker Alcohol	50 pcs. 5 pcs. 25 mL

	Hexane Sugar NaCl Urea Oil	25 mL 5 g 5 g 5 g 5 mL
7. Rates of chemical reactions, chemical equilibrium	Test tube Beaker Mg ribbon HCl solution $FeCl_3$ solution KSCN solution KCl solution Fe $(NO_3)_3$ solution	50 pcs. 5 pcs. 5 pcs. 25 mL 25 mL 25 mL 25 mL 25 mL
8. Redox reaction and electrochemistry	Battery Test tube Zn strips Cu strips Pb strips Pb $(NO_3)_2$ solution Zn $(NO_3)_2$ solution Alligator clip	5 pcs. 50 pcs. 5 pcs. 5 pcs. 5 pcs. 25 mL 25 mL 10 pcs.
9. Corrosion	Petri dish Battery Alligator clip Cu strips Zn strips Al strips Mg strips Electrolyte solution	5 pcs. 5 pcs. 10 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 25 mL

* Required Quantity is based on a class size of 25 students

PHYSICS 1 LABORATORY

Exercise	Required Equipment	Required Quantity*
1. An exercise to illustrate the principles, use, and precision of the vernier caliper and micrometer caliper	Ruler Vernier caliper Micrometer caliper Objects for measuring	5 pcs. 5 pcs. 5 pcs. 5 sets
2. An exercise to verify the graphical and analytical methods of determining resultant forces.	Force table Weight holder Masses Meter stick Protractor	5 pcs. 20 pcs. 5 sets 5 pcs. 5 pcs.

	Alternate apparatus: Force frame Spring balance Weight holder Masses Ruler	 5 pcs. 15 pcs. 15 pcs. 5 sets 5 pcs.
3. An exercise to observe and verify the elements of motion along the straight line	Linear air track with blower and trolley Timer/stopwatch Meter stick Free fall apparatus Metal balls of different sizes Clamp Support rod *Alternate apparatus:* Spark timer/ticker timer Paper tape Stopwatch Plane board with stand Clamp Wooden cart Scissors Carbon paper Masking tape Meter stick	5 pcs. 5 pcs. 5 pcs. 5 pcs. 12 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 1 set 5 pcs.
4. An exercise to observe and verify the elements of motion in two dimensions	Blackwood ballistic pendulum Metal ball Meter stick Carbon paper Inclined plane Protractor *Alternate apparatus:* Projectile apparatus Metal ball/plastic solid ball Photogate Timer/stopwatch Time of flight receptor pad Carbon paper White paper Meter-stick	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
5. An exercise to verify the laws of motion	Atwood's machine Masses Stopwatch String *Alternate apparatus:* Frictionless dynamic track Smart pulley Stopwatch Weight holder	5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.

	String Clamp	5 pcs. 5 pcs.
6. An exercise to determine the coefficients of static and kinetic friction of various surfaces	Friction board with pulley Friction block with different surfaces Glass plate of size similar to friction board Platform/triple beam balance Weight holder Meter stick Slotted masses, 5-500g	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets
7. An exercise to verify the work-energy theorem	Dynamic cart Frictionless dynamic track Masses Weight holder Clamp String Timer/stopwatch Platform/triple beam balance Support rod	5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
8. An exercise to verify the principles of conservation of mechanical energy	Metal stand Clamp Metal ball String Meter stick Cutter blade Hanging mass Carbon paper White paper Masking tape	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 10 pcs. 10 pcs. 1 set
9. An exercise to verify the principles of conservation of momentum	Ramp/launcher Metal stand Clamp Metal balls of different sizes Meter stick Carbon paper White paper Masking tape	5 pcs. 5 pcs. 5 pcs. 10 pcs. 5 pcs. 10 pcs. 10 pcs. 1 set
10. An exercise to verify the condition of the body in rotational equilibrium	Demonstration balance Vernier caliper Platform/triple beam balance Masses Meter stick	5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs.
11. An exercise to verify the forces involved in uniform circular motion	Centripetal force apparatus Meter stick Mass with hook Platform/triple beam balance Stopwatch	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.

12. An exercise to verify the principle of simple harmonic motion	Clamp Masses Weight holder Meter stick Support rod Spring *Alternate apparatus:* Hooke's Law apparatus	5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
13. An exercise to measure specific gravity	*Liquids:* Hydrometer jar U-tube Inverted U-tube Beaker Masses Meter stick Vernier caliper Specimen of liquids *Solids*: Beam balance Hydrometer jar Beaker Thread Thermometer Specimen of solids *Alternate apparatus:* Mohr-Westpal Balance	 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs.
14. An exercise to observe and verify the elements of transverse wave motion	Sonometer Weight holder Set of masses Tuning forks of three different frequencies Rubber hammer Meter stick	5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs.

* Required Quantity is based on a class size of 25 students

PHYSICS 2 LABORATORY

Exercise	Required Equipment	Required Quantity*
1. An exercise to determine the specific heats of solids by the methods of mixture	Calorimeter Stirrer for shot Specimen for shot Thermometer Platform/triple beam balance Beaker	5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs.

	Ice Water	5 sets
2. An exercise to measure the coefficient of linear expansion	Thermal expansion apparatus Steam generator Ohmmeter/VOM Connectors Basin/container Hot and cold water	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
3. An exercise to measure the mechanical equivalent of heat	Mechanical equivalent of heat apparatus Ohmmeter/VOM Mass (10 kg) Thermometer Vernier caliper Platform/triple beam balance	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
4. An exercise to observe and verify the elements of electric charge	Van de Graff generator Tissue paper Aluminum foil Metal conductor with insulated handle Fluorescent lamp Masking Tape Power Source Galvanometer Conducting paper Field mapper kit/mapping Apparatus Connectors	2 sets 2 sets 2 sets 2 sets 2 sets 1 set 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets
5. An exercise to illustrate Ohm's Law	Panel board/circuit board VOM or multitester DC power supply Bridging plugs/connecting wires Fixed resistor SPST switch SPDT switch *Alternate apparatus:* Bread board Jumper	5 pcs. 5 pcs. 5 pcs. 5 sets 15 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets
6. An exercise to determine and compare the resistance of different conductors	1-m slide wire/ wheatstone bridge Power supply VOM or multitester Galvanometer Potentiometer Fixed resistor Unknown resistor SPST switch Connecting wires	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets

7. An exercise to verify the principles of series and parallel connections	Panel board/circuit board VOM or multitester DC power supply Bridging plugs/connecting wires Fixed resistors *Alternate apparatus:* Bread board Jumper	5 pcs. 5 pcs. 5 pcs. 5 sets 15 pcs. 5 pcs. 5 sets
8. An exercise to verify the relationship among the electromotive force, current, and resistance of cells in series and parallel	Dry cells Switch VOM or multitester Resistors Panel board/circuit board Bridging plugs/connecting wires *Alternate apparatus:* Bread board Jumper	10 pcs. 5 pcs. 5 pcs. 10 pcs. 5 pcs. 5 sets 5 pcs. 5 sets
9. An exercise to observe the applications of Kirchhoff's Law	Power supply Fixed resistors VOM or multitester Bridging plugs/connecting wires Panel board/circuit board *Alternate apparatus:* Bread board Jumper	10 pcs. 25 pcs. 10 pcs. 5 sets 5 pcs. 5 pcs. 5 sets
10. An exercise to determine the electrical equivalent of heat	Electric calorimeter Thermometer Beam balance Masses Stop watch VOM or multitester Rheostat DC power source Connecting wires Switch	5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs.
11. An exercise to observe the relationships between resistance and capacitance in the circuit	Power source Fixed capacitor (330 microfarad) Fixed Resistor (100 ohms) Connecting wires VOM or multitester Stopwatch	5 pcs. 5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs.
12. An exercise to observe the principle of magnetic field	Natural magnets Horseshoe magnets Bar magnets	5 pcs. 5 pcs. 10 pcs.

	Ring Glass plate Iron fillings Frame for bar magnets Compass Mounted straight wire Coil Solenoid Battery Reversing switch *Alternate apparatus:* Tesla meter / tangent galvanometer	5 pcs. 5 pcs. 5 sets 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 2 sets
13. An exercise to demonstrate the Faraday's law of electromagnetic induction	Coils Galvanometer VOM or multitester AC power supply Bar magnets Connecting wires	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
14. An exercise to verify the law of reflection and refraction	Optics bench Light source, sodium/mercury lamps Ray table and base Component holder Slit plate Slit mask Ray optics mirror Cylindrical lens	5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
15. An exercise to investigate and study the image formation in mirror and lenses	Optic bench Light source Ray table and base Component holder Parallel ray lens Slit plate Ray optics mirror 5 cm focal length spherical mirror -15cm focal length concave lens 10cm/7.5 cm focal length convex lens 15 cm focal length convex lens Viewing screen Crossed arrow target	5 pcs. 5 pcs. 5 pcs. 15 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.

* Required Quantity is based on a class size of 25 students

ANNEX IV - B

LABORATORY REQUIREMENTS
for
BS MINING ENGINEERING

LABORATORY REQUIREMENTS FOR MINING ENGINEERING

GENERAL SURVEYING

Laboratory Exercise	Specifications	Minimum Required Quantity	Units (Based on 10 students per lab class)
1. Determination of Pace Factor	Steel tape, 50m	1 unit/ 5 stud	2 units
	Steel tape, 100m	1 unit/ 5 stud	2 units
	Chaining pins	10 pcs/ 5 stud	20 pcs
	Range poles	5 units	5 units
2. Measuring Distances on Horizontal and Inclined Surfaces Using Pacing or Chaining	Steel tape, 50m	1 unit/ 5 stud	2 units
	Steel tape, 100m	1 unit/ 5 stud	2 units
	Chaining pins	10 pcs/ 5 stud	20 pcs
	Range poles	5 units	5 units
	Plumb bob	5 units	5 units
3. Use, Care, Adjustment and Operating Principles of a Transit	Engineer's transit, at least 1' reading, with tripod	1 unit/ 5 stud	2 units
	Range poles	5 units	5 units
4. Prolonging a Line by the Use of Tape or Transit	Engineer's transit, at least 1' reading, with tripod	1 unit/ 5 stud	2 units
	Steel tape, 50m	1 unit/ 5 stud	2 units
	Steel tape, 100m	1 unit/ 5 stud	2 units
	Chaining pins	10 pcs/ 5 stud	20 pcs
	Range poles	5 units	5 units
5. Measuring Obstructed Distance by Transit and Tape	Engineer's transit, at least 1' reading, with tripod	1 unit/ 5 stud	2 units
	Steel tape,50m	1 unit/ 5 stud	2 units
	Steel tape, 100m	1 unit/ 5 stud	2 units
	Chaining pins	10 pcs/ 5 stud	20 pcs
	Range poles	5 units	5 units
6. Determination of an Area by Tape	Steel tape, 50m	1 unit/ 5 stud	2 units
	Steel tape, 100m	1 unit/ 5 stud	2 units
	Chaining pins	10 pcs/ 5 stud	20 pcs
	Range poles	5 units	5 units
7. Measurement of Horizontal & Vertical Angles Using Transit	Steel tape,50m	1 unit/ 5 stud	2 units
	Steel tape, 100m	1 unit/ 5 stud	2 units
	Chaining pins	10 pcs/ 5 stud	20 pcs
	Range poles	5 units	5 units
8. Running a Traverse by Measuring Azimuth or Reading Interior or Deflection Angles	Engineer's transit, at least 1' reading, with tripod	1 unit/ 5 stud	2 units
	Steel tape,50m	1 unit/ 5 stud	2 units
	Steel tape, 100m	1 unit/ 5 stud	2 units
	Chaining pins	10 pcs/ 5 stud	20 pcs
	Range poles	5 units	5 units
9. Differential Leveling by Single and Double Rod Method	Level, wye or dumpy. with tripod	1 unit/ 5 stud	2 units
	Graduated rods	5 units	5 units

PETROLOGY

Laboratory Exercise	Specifications	Minimum Required Quantity	Units (Based on 10 students per lab class)
1. Rock – Forming Minerals 2. Basis if Classification of Rocks	• Physical Property Tester Set	1 set/ student	10 set/
• Identification of Igneous Rocks	• Rack (mineral) specimen	1 set/ 2 stud	5 sets
• Identification of Sedimentary Rocks	• Rack (minerals) in Thin Sections	1 set/ 2 stud	5 sets
• Identification of Metamorphic Rocks	• Petrographic microscope	1 unit/ 5 stud	2 units
	• X-Ray Diffraction	1 Facility	1 Facility

STRUCTURAL GEOLOGY

Laboratory Exercise	Specifications	Minimum Required Quantity	Units (Based on 10 students per lab class)
Determination of Altitude of Planes	Bruton Compass	1 unit/ 2 stud	5 units
	Lens	1 unit/ stud	10 units
	Meter - tape	1 unit/ 2 stud	5 units
	Topographic map	1 set	
Circulating Thickness, Depth and Apparent Dips of Inclined Strata			
Outcrop Problems and Three-Point Problems			
Reconstructing Folds			
Fault Displacement			
Structure Contour and Isopach Maps			
Topographic Map Interpretation			
Geographic Maps and Cross Sections Interpretation			
Core Logging and Stratigraphy			

TECHNIQUES OF METALLURGICAL ANALYSIS

Laboratory Exercise	Specifications	Minimum Required Quantity *	Units (Based on 10 students per lab class)
1. Sampling	Jones riffle	1 unit	1 unit
	Rolling matt	1pc/ 2 stud	10 pcs
	Shovel	5 pcs	5 pcs
	Bucket	10 pcs	10 pcs
	Spatula	5 pcs	5 pcs

	Sieve screens	1 set	1 set
	Sieve shaker (optional)	1 unit	1 unit
	Weighing balance	1 unit	1 unit
2. Fire Assaying of Ores	Crusher	1 unit	1 unit
	Pulverizer	1 unit	1 unit
	Muffle furnace	1 unit	1 unit
	Crucible Tongs	2 pcs	2 pcs
	Pouring mold	1 pc	1 pc
	Fire clay Crucibles	20 pcs	20 pcs
	Parting cups	20 pcs	20 pcs
	Cupel	40 pcs	40 pcs
	Cupel machine	1 unit	1 unit
	Weighing balance	1 unit	1 unit
	Gold balance	1 unit	1 unit
	Hammer and anvil	2 pairs	2 pairs
	Tweezer	2 pcs	2 pcs
	Personal Protective	2 sets	2 sets
	Equipment	1 unit	1 unit
	Bunsen burner	1 unit	1 unit
	hot plate	5 pcs	5 pcs
	Spatulas and scoops	2 sets	2 sets
3. Determination of gold in cyanide solution	Bunsen burner	1 unit	1 unit
	hot plate	1 unit	1 unit
	Weighing balance	1 unit	1 unit
	Gold balance	1 unit	1 unit
	beaker (600 ml)	10 pcs	10 pcs
	stirring rod	10 pcs	10 pcs
	vacuum filter	1 unit	1 unit
	Cupel	10 pcs	10 pcs
	Cupel machine (optional)	1 unit	1 unit
4. Determination of Free Cyanide in solutions	Furnace	1 unit	1 unit
	Burette	2 pcs	2 pcs
	pipette	2 pcs	2 pcs

	Erlenmeyer flask	10 pcs	10 pcs
	stirring rod	10 pcs	10 pcs
	funnel filter	10 pcs	10 pcs
5. Atomic Absorbtion Spectrophotometry Experiment	hot plate	1 pc	1 pc
	beaker (600 ml)	10 pcs	10 pcs
	stirring rod	10 pcs	10 pcs
	funnel filter	10 pcs	10 pcs
	Volumetric flask, 250 ml	5 pcs	5 pcs
	Volumetric flask, 100 ml	5 pcs	5 pcs
	AAS	1 unit-AAS Facility/ access to existing units in the other laboratories or universities	1 unit
6. Iodide Method for Copper	hot plate	1 pc	1 pc
	beaker (600 ml)	10 pcs	10 pcs
	stirring rod	10 pcs	10 pcs
	funnel filter	10 pcs	10 pcs
	burette	2 pcs	2 pcs
	Erlenmeyer flask	10 pcs	10 pcs
	Fume hood	1 unit	1 unit
7. X'Ray Diffraction or XRF experiment	XRD/XRF machine (optional) and accessories	1 unit XRD/XRD Facility /access to existing private or public institutions	1 unit

MINERAL PROCESSING (for Mining Students)

Exercise	Specifications	Minimum Required Quantity	Units (Based on 10 students per lab class)
1. Comminution Experiments (mesh-of-grind and Bond's work index determination)	Crusher Ball/rod mill Weighing Balance Drying oven Sieve screens Sieve shaker	1 unit 1 unit 1 unit 1 unit 1 set 1 unit	1 unit 1 unit 1 unit 1 unit 1 set 1 unit
2. Gravity Concentration Experiments (panning, wet tabling, dense media separation)	Crusher Ball/rod mill Weighing Balance Drying oven Miner's pan or equivalent 2 liter beaker Shaking table Sluice box	1 unit 1 unit 1 unit 1 unit 5 units 5 units 1 unit 1 unit	1 unit 1 unit 1 unit 1 unit 5 units 5 units 1 unit 1 unit
3. Flotation Experiments (bubble pick-up and froth flotation)	Crusher Ball/rod mill Weighing Balance Drying oven Flotation machine Vacuum filter Optical Microscope	1 unit 1 unit 1 unit 1 unit 1 unit 1 unit 1 unit/ 5 stud	1 unit 1 unit 1 unit 1 unit 1 unit 1 unit 2 units
4. Dewatering Experiments (continuous thickener design based on sedimentation test, flocculation)	Weighing Balance Drying oven Timer Graduated cylinder (1000 ml)	1 unit 1 unit 5 units 5 units	1 unit 1 unit 5 units 5 units

MINE DESIGN

Laboratory Exercise	Specifications	Minimum Required Quantity	Units (Based on 10 students per lab class)
Mine Design • Ore modeling • Mine Planning • Mine ventilation • Rock mechanics • Drilling & Blasting • Support Design • Optimization	Personal Computers Printer Scanner Digitizer (optional) Planimeter Mine Softwares • Ore modeling • Mine planning	1 unit / 2 stud 1unit / 2 stud 1 unit I unit 2 units 1 set	5 units 5 units 1 unit 1 unit 2 units 1 set

Re public of the Philippines
OFFICE OF THE PRESIDENT
COMMISSION ON HIGHER EDUCATION

TECHNICAL PANEL FOR ENGINEERING, TECHNOLOGY AND ARCHITECTURE

TPETA RESOLUTION No. 15
August 14, 2007

RECOMMENDATION FOR THE APPROVAL OF THE POLICIES AND STANDARDS (PS) FOR BACHELOR OF SCIENCE IN MINING ENGINEERING

Whereas, CMO 49, s. 1997- Curricular Guidelines for Engineering Education (Mining Engineering) were reviewed and revised by the Task Force on Mining Engineering;

Whereas, the said revision was done in consultation with the academe, industry and other government agencies;

Whereas, the said PS had undergone National Public Hearing on March 29, 2007 in Baguio City

Whereas, the proposed revision is in conformity with the harmonized format indicated in CSO 42, S. 2003;

WHEREFORE, TPETA hereby resolves to strongly recommend to CHED for the approval of the Proposed Policies and Standards for the Bachelor of Science in Mining Engineering.

ENGR. RODOLFO PEÑALOSA
Chairman

USEC. FORTUNATO DELA PEÑA
Co-Chairman

PROF. EDGARDO G. ATANACIO
Member

ATTY. JULITO D. VITRIOLO
Member

DIR. IRENE ISAAC
Member

ENGR. ENRICO NERA
Member

ENGR. AUGUSTO C. SOLIMAN
Member

ENGR. CARLA FALCONIT
Member

ENGR. EFREN SISON
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ARCHT. EDRIC MARCO FLORENTINO
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August 14, 2007

RECOMMENDATION FOR THE APPROVAL OF THE POLICIES AND STANDARDS (PS) FOR BACHELOR OF SCIENCE IN MINING ENGINEERING

Whereas, CMO 49, s. 1997- Curricular Guidelines for Engineering Education (Mining Engineering) were reviewed and revised by the Task Force on Mining Engineering;

Whereas, the said revision was done in consultation with the academe, industry and other government agencies;

Whereas, the said PS had undergone National Public Hearing on March 29, 2007 in Baguio City

Whereas, the proposed revision is in conformity with the harmonized format indicated in CSO 42, S. 2003;

WHEREFORE, TPETA hereby resolves to strongly recommend to CHED for the approval of the Proposed Policies and Standards for the Bachelor of Science in Mining Engineering.

ENGR. RODOLFO PEÑALOSA
Chairman

USEC. FORTUNATO DELA PEÑA
Co-Chairman

PROF. EDGARDO G. ATANACIO
Member

ATTY. JULITO D. VITRIOLO
Member

DIR. IRENE ISAAC
Member

ENGR. ENRICO NERA
Member

ENGR. AUGUSTO C. SOLIMAN
Member

ENGR. CARLA FALCONIT
Member

ENGR. EFREN SISON
Member

ARCHT. EDRIC MARCO FLORENTINO
Member

Republic of the Philippines
OFFICE OF THE PRESIDENT
COMMISSION ON HIGHER EDUCATION

TECHNICAL PANEL FOR ENGINEERING, TECHNOLOGY AND ARCHITECTURE

TFEM RESOLUTION No. 1
August 14, 2007

RECOMMENDATION FOR THE APPROVAL OF THE POLICIES AND STANDARDS (PS) FOR THE BACHELOR OF SCIENCE IN MINING ENGINEERING (BSEM)

Whereas, the Task Force on Mining Engineering (TFEM) was appointed and was tasked to review and revise the existing Curricular Guidelines for the BS Mining Engineering;

Whereas, CMO 49, s. 1997- Curricular Guidelines for Engineering Education (Mining Engineering) was reviewed and revised by the Task Force on Mining Engineering;

Whereas, the said revision was done in consultation with the representatives from academe, industry and other government agencies;

Whereas, the proposed PS is in conformity with the harmonized format indicated in CSO 42, S. 2003;

Whereas, the proposed PS will be implemented starting SY 2008-2009;

Wherefore, the Task Force on Mining Engineering hereby resolves to endorse to the Technical Panel for Engineering, Technology and Architecture (TPETA) the herein attached PS for the BSEM for recommendation to the CHED for approval.

DR. HERMAN MENDOZA
Chairman

ENGR. CORNELIO CASIDO
Member

ENGR. EMILIO FIGUEROA III
Member

ENGR. VICENTE MADAMBA
Member

5/F Upper DAP Bldg., San Miguel Avenue, Ortigas Center, Pasig City, 1605 Philippines
Website: www.ched.gov.ph Tel. Nos. 638-54-59; 638-70-76; 638-48-69; 634-68-68

TECHNICAL PANEL FOR ENGINEERING, TECHNOLOGY AND ARCHITECTURE

TFEM RESOLUTION No. 1
August 14, 2007

RECOMMENDATION FOR THE APPROVAL OF THE POLICIES AND STANDARDS (PS) FOR THE BACHELOR OF SCIENCE IN MINING ENGINEERING (BSEM)

Whereas, the Task Force on Mining Engineering (TFEM) was appointed and was tasked to review and revise the existing Curricular Guidelines for the BS Mining Engineering;

Whereas, CMO 49, s. 1997- Curricular Guidelines for Engineering Education (Mining Engineering) was reviewed and revised by the Task Force on Mining Engineering;

Whereas, the said revision was done in consultation with the representatives from academe, industry and other government agencies;

Whereas, the proposed PS is in conformity with the harmonized format indicated in CSO 42, S. 2003;

Whereas, the proposed PS will be implemented starting SY 2008-2009;

Wherefore, the Task Force on Mining Engineering hereby resolves to endorse to the Technical Panel for Engineering, Technology and Architecture (TPETA) the herein attached PS for the BSEM for recommendation to the CHED for approval.

DR. HERMAN MENDOZA
Chairman

ENGR. CORNELIO CASIDO
Member

ENGR. EMILIO FIGUEROA III
Member

ENGR. VICENTE MADAMBA
Member