A. Mining Engineering and Management Course Syllabi

MEM 120 – INTRODUCTION TO MINING, MANAGEMENT & SUSTAINABLE DEVELOPMENT <u>Required</u> Meets MONDAYS, 2:00 – 3:50 in MI 222

Catalog Data:

(2-0) 2 Credits – Prerequisites: None. Principles and definitions related to mining engineering discipline. Introductory overview of current mining practices and the mining technology in general. Presentation of mining faculty and their areas of expertise. Discussion of various career paths in mining engineering. Principles, terminology and definitions of sustainable development in mining. Elements and indicators of sustainable development: environment, economics, society and governance. Introductory concepts in management dealing with mining and global issues.

Textbook:

SME, *Surface Mining*, 2nd Edition, 1990. Mining Explained, The Northern Miner

References:

IIED Report on Sustainable Development

Outcomes:

Students completing this class will be able to demonstrate:

- an understanding of the preliminary concepts of Mining & Sustainable Development relating to surface & underground mining techniques, equipment and operations
- the ability to use the techniques, skills and modern engineering & management tools necessary to function effectively in the mining environment (introductory level)

Course Requirements:

Course Evaluation: The final grade in this class will be based upon:

- Attendance & class participation (80%)
- ➢ Exams & homework assignments (10%)
- Projects & accompanying reports (10%)

Topics:

- o Introduction, history of mining and basic definitions & Careers in mining engineering
- Surface, Quarrying & Underground mining Basic introduction
- Tunneling and shaft sinking Basic
- Basic elements if equipment in the mining environment
- HIGH-TECH Mining What's new (Computer applications in mining and mining software)
- o Management Concepts such as, Project Management, Team dynamics, Meeting skills etc.
- Historical overview of the role of the mining industry in the modern world
- Explore one of the hundreds of sustainable development projects through the Internet: Choose a mining project and discuss the approach and the solution.

Prepared By:	Shashi Kanth		Date:	January 2009
	MI 327C			
	Ph: 394-1973			
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E-mail: shashi.kanth@sdsmt.edu

Contr	ibutio	n of Course to Meeting the Requirements of:			
Crite	(a) or experi	Curriculum e year of a combination of college level mathematics and basic sciences (some with experimental ence) appropriate to the discipline: College level mathematics Basic sciences		Credits A	attributed
		ne and one-half years of engineering topics , consisting of engineering sciences and engineering design priate to the student's field of study.			
	>	eering Topics: Engineering Sciences Engineering Design			attributed
Crite	ion 9.	Program Criteria	Low	Med.	High
(1)	the ab	ility to apply mathematics through differential equations			
(2)	calcul	us-based physics			
(3)	genera	al chemistry			
(4)		bility and statistics as applied to mining engineering problems applications			
(5)	funda	mental knowledge in the geological sciences including			
	(5a)	characterization of mineral deposits			
	(5b	physical geology			
	(5c)	structural or engineering geology			
	(5d)	mineral and rock identification and properties			
(6)	profic	iency in			
	(6a)	statics			
	(6b)	dynamics			
	(6c)	strength of materials			
	(6d)	fluid mechanics			
	(6e)	thermodynamics			
	(6f)	electrical circuits			
(7)	profic	iency in engineering topics related to both surface and underground mining, including:			
	(7a)	mining methods		X	
	(7b)	planning and design	Х		
	(7c)	ground control and rock mechanics			
	(7d)	health and safety	X		
	(7e)	environmental issues		X	
	(7f)	ventilation			
(8)	profic	iency in additional engineering topics such asas appropriate to the program objectives.			
	(8a)	rock fragmentation,			
	(8b)	materials handling			
	(8c)	mineral or coal processing			
	(8d)	mine surveying		_	
	(8e)	valuation and resource/reserve estimation			
(9)		boratory experience must lead to proficiency in			
	(9a)	geologic concepts			
	(9b)	rock mechanics		_	
	(9c)	mine ventilation		_	

MEM 120-Introduction to Mining, Management and Sustainable Development

(9c)	mine ventilation
(9d)	other topics appropriate to the program objectives

Relationship of Course to ABET Criterion 3 Program Outcomes:

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs c.
- d.
- Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems Understanding of professional and ethical responsibility e.
- f.
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context

- i. Recognition of the need for, and ability to engage in life-long learning
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Level of Emphasis				
Low	Med.	High		
	Х			
		Х		
		Х		
	Х			

MEM 201—SURVEYING FOR MINERAL ENGINEERS <u>Required</u> Meets Tu & Th, 1:00 – 3:50 in MI 222

Catalog Data:

(0-2) 2 credits. Prerequisite: Sophomore standing. Principles of surface and underground surveying, including measurements, data collection, calculations, error analysis, topographic mapping, and application of the Global Positioning System.

Textbook:

Wolf, Paul R & Charles D. Ghilani, *Elementary Surveying An Introduction to Geomatics*, 10th ed., Prentice hall, 2002.

Outcomes:

After completion of this course, students will be able to demonstrate:

- an ability to apply knowledge of mathematics, science, and engineering to mine surveying problems;
- an ability to design and conduct proper mine surveys, as well as accumulate, analyze and interpret the field data;
- an ability to function as a member of a survey team;
- an ability to identify, formulate, and solve typical engineering problems associated with mine surveying; and
- an ability to properly use the techniques, skills, and equipment necessary for good surveying practices.

Course Requirements:

<u>Course Evaluation</u>: The final grade in this class will be based upon:

Two examinations ($\sim 40\%$)

- \blacktriangleright Homework problems (~20%)
- \blacktriangleright Group project reports (~30%)
- ➢ Group & class participation (~10%)

Topics:

- 1. Introduction
- 2. Units and Significant Figures
- 3. Theory of Errors In Observations
- 4. Angles, Azimuths and Bearings
- 5. Coordinate Calculations
- 6. Boundary Surveys
- 7. Alignment surveys
- 8. GPS
- 9. Field survey projects

Prepared By: Dr. C.A. Kliche MI 327B Ph: 394-1972 Date: August 2008

MI 327B Ph: 394-1972 E-mail: charles.kliche@sdsmt.edu

 (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline: College level mathematics 	
➤ Basic sciences	
(b) one and one-half years of engineering topics , consisting of engineering sciences and engineering design appropriate to the student's field of study.	
Engineering Topics:	
Engineering Sciences	
Engineering Design	
riterion 9. Program Criteria	
 the ability to apply mathematics through differential equations 	

MEM 201-Surveying for Mineral Engineers

- (2) calculus-based physics
- (3) general chemistry
- probability and statistics as applied to mining engineering problems applications (4)
- (5) fundamental knowledge in the geological sciences including
 - (5a) characterization of mineral deposits

Contribution of Course to Meeting the Requirements of:

- (5b physical geology
- (5c) structural or engineering geology
- mineral and rock identification and properties (5d)
- (6) proficiency in
 - (6a) statics
 - (6b) dynamics
 - (6c) strength of materials
 - (6d) fluid mechanics (6e) thermodynamics
 - electrical circuits (6f)
- (7) proficiency in engineering topics related to both surface and underground mining, including:
 - (7a) mining methods
 - planning and design (7b) (7c) ground control and rock mechanics

 - (7d) health and safety (7e) environmental issues
 - (7f) ventilation
- (8) proficiency in additional engineering topics such as.....as appropriate to the program objectives.
 - (8a) rock fragmentation,
 - (8b) materials handling
 - (8c) mineral or coal processing
 - (8d) mine surveying
- valuation and resource/reserve estimation (8e) (9) The laboratory experience must lead to proficiency in
 - (9a) geologic concepts
 - (9b) rock mechanics
 - (9c) mine ventilation
 - other topics appropriate to the program objectives (9d)

Relationship of Course to ABET Criterion 3 Program Outcomes:

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs с
- d.
- Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems e. Understanding of professional and ethical responsibility
- f.
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal h.
- context
- Recognition of the need for, and ability to engage in life-long learning i.
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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Credits Attributed
1
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Low	Med.	High
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Level of Emphasis				
Low	Med.	High		
		Х		
		Х		
		Х		
Х				
		Х		

MEM 202 Materials Handling and Transportation <u>Required</u> Meets M & W, 9:00 – 9:50 a.m., MI 220

Catalog Data:

(2–0) 2 credits Prerequisites EM 216 and MEM 120. The theory of operation of mining equipment, and its selection and application to materials handling in surface and underground mines. Emphasis is on economics, productivity, reliability and safety.

Textbook:

None

References:

SME Mining Engineering Handbook, 1992. SME
Underground Mining Methods Handbook, 1982.
Zbigniew J. Hladysz, -- Lectures (PP).
Ronald M. Hayes & Assoc., Modern Materials Handling, McGraw-Hill Publications.
Kliche, C.A., Surface Mining Systems PPT.

Outcomes:

- Ability to apply basic knowledge of mathematics and engineering science to problems in mine design and planning;
- Ability to apply basic knowledge of mining engineering fundamentals, relevant technologies as well as techniques, skills and tools needed in mine design, planning and mine operation;
- Ability to develop problem solving capabilities and apply them in mine design, planning and mine operation;
- Ability to communicate effectively.

Course Requirements:

- 1. Students are expected to perform to a high standard and honesty, according to the rules currently at SDSM&T.
- 2. Class attendance is mandatory
- 3. No late homework assignments will be accepted, nor will tests be given other than at the scheduled time without prior written excuse that is approved by the instructor.

Grading: 50% - Tests and Final Exam; 50% - Homework Assignments

Topics:

- 1. Principles and fundamental concepts of materials handling
- 2. Cyclic and continuous mining operations
- 3. Underground Materials Handling Systems: Loading equipment; Rubber-tired haulage; Rail haulage; Conveyors; Crushing; Hoisting; Supply haulage and transportation.
- 4. Surface Mining Materials Handling Systems: Continuous unit operations; Multi-bucket machines; Non-continuous unit operations; In-pit crushing and conveying

Prepared by: Dr. Charles A. Kliche Date: January, 2009 MI 327B Ph: 394-1972 E-mail: charles.kliche@sdsmt.edu

	 (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline: College level mathematics Basic sciences 	Cred	its Attribute
	(b) one and one-half years of engineering topics , consisting of engineering sciences and engineering design appropriate to the student's field of study.	_	
	Engineering Topics: > Engineering Sciences	Cred	its Attribute
	 Engineering Design 		2
rite	ion 9. Program Criteria	ow Me	l. High
1)	the ability to apply mathematics through differential equations		
2)	calculus-based physics		
3)	general chemistry		
4)	probability and statistics as applied to mining engineering problems applications		
(5)	fundamental knowledge in the geological sciences including		
	(5a) characterization of mineral deposits		
	(5b physical geology		
	(5c) structural or engineering geology		
	(5d) mineral and rock identification and properties		
6)	proficiency in		
	(6a) statics		
	(6b) dynamics		
	(6c) strength of materials		
	(6d) fluid mechanics		
	(6e) thermodynamics		
	(6f) electrical circuits		
(7)	proficiency in engineering topics related to both surface and underground mining, including:		
	(7a) mining methods		
	(7b) planning and design		
	(7c) ground control and rock mechanics		
	(7d) health and safety		
	(7e) environmental issues		
	(7f) ventilation		
(8)	proficiency in additional engineering topics such asas appropriate to the program objectives.		
	(8a) rock fragmentation,		
	(8b) materials handling		X
	(8c) mineral or coal processing		
	(8d) mine surveying		
•	(8e) valuation and resource/reserve estimation		
9)	The laboratory experience must lead to proficiency in		
	(9a) geologic concepts		_
	(9b) rock mechanics		
	(9c) mine ventilation (9d) other topics appropriate to the program objectives	_	
	VALUE ODER ADDIODITATE TO THE DIOGRAM ODJECTIVES		1

MEM 202-Materials Handling and Transportation

Relationship of Course to ABET Criterion 3 Program Outcomes:

Contribution of Course to Meeting the Requirements of:

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems Understanding of professional and ethical responsibility Ability to communicate effectively c.
- d.
- e. f.
- g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- i. Recognition of the need for, and ability to engage in life-long learning
- j. Knowledge of contemporary issues
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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		Х	
Level of Emphasis Low Med. High			
Low	Med.	High	
		Y	

Level of Emphasis				
Low	Med.	High		
		Х		
		Х		
	Х			

MEM 203 – INTRODUCTION TO MINE HEALTH AND SAFETY Required Meets Wednesdays, 3:00 - 4:00 in MI 222

Catalog Data:

1(1-0). Prerequisite: Sophomore standing. Introduction to mine health and safety and to the MSHA regulations. A study of mine regulations, and the recognition of mine hazards along with their prevention and control. Fulfills MSHA requirements for new miner training.

Textbook:

None

References:

MSHA Training Materials & Various Videos

Outcomes:

Students completing this class will be able to demonstrate:

- a supervisory knowledge of mine health and safety issues •
- an understanding of MSHA requirements for new miner and annual safety training •
- a familiarity with 45 CFR Parts 46 and 48 •

Course Requirements:

Course Evaluation: The final grade in this class will be based upon:

- \geq Attendance (25%)
- \triangleright Class participation (25%)
- ▶ Completion and presentation of mid-term & final reports (50%)

Topics:

- 1. Introduction and course review
- 2. Rights of Miners and Authority and Responsibility of Supervisors
- 3. Introduction to the Work Environment Including Transportation Systems, Control Systems, and Communication Systems.
- 4. Self-Rescue, Escape, and Emergency Evacuation
- 5. Firefighting and Firewarning
- 6. Ground Control Highwalls, Water Hazards, Pits, and Spoil Banks
- 7. Electrical Hazards
- 8. Health
- 9. First Aid
- 10. Explosives
- 11. Hazard Recognition and Avoidance.

Prepared By:

Date: August 2008

Dr. C.A. Kliche MI 327B Ph: 394-1972 E-mail: charles.kliche@sdsmt.edu

Contr	ibution of Course to Meeting the Requirements of:	
Criter	rion 5. Curriculum	
	(a) one year of a combination of college level mathematics and basic sciences (some with experimental	
	experience) appropriate to the discipline:	Credits Attributed
	College level mathematics	
	Basic sciences	
	(b) one and one-half years of engineering topics , consisting of engineering sciences and engineering design appropriate to the student's field of study.	
	Engineering Topics:	Credits Attributed
	Engineering Sciences	1
	 Engineering Design 	
	ion 9. Program Criteria	Low Med. High
(1)	the ability to apply mathematics through differential equations	
(2)	calculus-based physics	
(3)	general chemistry	
(4)	probability and statistics as applied to mining engineering problems applications	
(5)	fundamental knowledge in the geological sciences including	
	 (5a) characterization of mineral deposits (5b) physical geology 	
	 (5c) structural or engineering geology (5d) mineral and rock identification and properties 	
(6)	(5d) mineral and rock identification and properties proficiency in	
(6)	(6a) statics	
	(6b) dynamics	
	(6c) strength of materials	
	(6d) fluid mechanics	
	(6e) thermodynamics	
	(6f) electrical circuits	
(7)	proficiency in engineering topics related to both surface and underground mining, including:	
(,)	(7a) mining methods	
	(7b) planning and design	
	 (7c) ground control and rock mechanics 	
	(7d) health and safety	Х
	(7e) environmental issues	
	(7f) ventilation	
(8)	proficiency in additional engineering topics such asas appropriate to the program objectives.	
	(8a) rock fragmentation,	
	(8b) materials handling	
	(8c) mineral or coal processing	
	(8d) mine surveying	
	(8e) valuation and resource/reserve estimation	
(9)	The laboratory experience must lead to proficiency in	
	(9a) geologic concepts	
	(9b) rock mechanics	
	(9c) mine ventilation	
	(9d) other topics appropriate to the program objectives	

MEM 203-Introduction to Mine Health and Safety

Relationship of Course to ABET Criterion 3 Program Outcomes:

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems Understanding of professional and ethical responsibility Ability to communicate effectively c.
- d.
- e. f.
- g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context

- i. Recognition of the need for, and ability to engage in life-long learning
- j. Knowledge of contemporary issues
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Level of Emphasis						
Low	Med.	High				
	Х					
	Х					

160

MEM 204 – SURFACE MINING METHODS AND UNIT OPERATIONS Required Meets MW, 2:00 - 2:50 in MI 220

Catalog Data:

(2-0) 2 Credits - Prerequisite: ENVE/MEM 120 or permission of instructor. A study of surface mining techniques and unit operations applicable to metal mining, coal mining, quarrying and other surface mining operations. Topics include mine design and planning, surface drilling and blasting, the applicability and performance characteristics of earthmoving equipment, and an introduction of mine drainage. This course is cross listed with ENVE 204.

Textbook:

SME, Surface Mining, 2nd Edition, 1990.

References:

B-E, Surface Mine Supervisory Training Program, Shovel/Truck. B-E, Surface Mine Supervisory Training Program, Dragline. Malhotra, D., Politics of Mining. What They Don't Teach You in School, SME

Outcomes:

Students completing this class will be able to demonstrate:

- an understanding of the engineering principles relating to surface mining techniques, equipment and operations
- the ability to design a simple mining system, component or process to meet a desired need
- the ability to identify, formulate, and solve surface mine engineering problems
- the ability to use the techniques, skills and modern engineering tools necessary to function effectively in a surface mining environment

Course Requirements:

Course Evaluation: The final grade in this class will be based upon:

- ➤ Attendance & class participation (20%)
- Exams & homework assignments (50%): Exams (2) & homework problems (3-5). \geq
- \geq Projects & accompanying reports (30%)

Topics:

- A. Introduction
- B. Major U.S. Surface Mining Districts
- C. Mine Planning
- D. Surface Mining Methods
- E. Ore reserve estimation
- F. Surface Mining Equipment
- G. Mining Law and Reclamation

Prepared By: Dr. C.A. Kliche MI 327B Ph: 394-1972

H. Mine Management Case Situations

Date: January 2009

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Citerion 5. Curiculum one year of a combination of college level mathematics and basic sciences (some with experimental experimes) appropriate to the discipline: College level mathematics College level mathematics Does and one-haft years of engineering topics, consisting of engineering sciences and engineering design appropriate to the studen's field of study. Engineering Topics: Pagineering Sciences Engineering Sciences Engineering Sciences Control N-Program Criteria Curterion 9. Program Criteria	Contr	ibution of Course to Meeting the Requirements of:			
a) one year of a combination of college tevel mathematics and basic sciences (some with experimental experimental sciences appropriate to the discipline: College level mathematics Basic sciences b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the students field of study. Digineering Sciences Engineering Topics: Engineering Sciences Credits Attributed I (1) the ability to apply mathematics through differential equations Implication of mineral deposits Galcular-based physics Galcular-based physics					
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(9d) other topics appropriate to the program objectives			L	I	
		(9d) other topics appropriate to the program objectives			

MEM 204-Surface Mining Methods and Unit Operations

Relationship of Course to ABET Criterion 3 Program Outcomes:

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems Understanding of professional and ethical responsibility Ability to communicate effectively c.
- d.
- e. f.
- g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context

Contri

- i. Recognition of the need for, and ability to engage in life-long learning
- j. Knowledge of contemporary issues
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Level of Emphasis						
Low	Low Med. High					
	Х					
	Х					
		Х				
		х				
		А				

MEM 301 Computer Applications in Mining <u>Required</u> Tu. 9:00 – 10:50, Th. 9:00 – 10:50 AM, MI 223

Catalog Data:

(1–1) 2 credits. Prerequisites: GES 115, Professionalism in Engineering and Science. Computer Hardware and software. Applications in exploration and resource modeling, equipment selection and simulations, mine planning and design, rock stability analysis, and economics and cost estimates. Emphasis on three-dimensional modeling and visualization. Vulcan software and other software applications.

Textbook:

None

References:

Mining Software Library - User Manuals, lecture PP presentations.

Relationship of Course to Program Outcomes:

MEM 301Computer Applications in Mining, meets the following outcomes for the mining engineering and management program:

- Ability to apply basic knowledge of mining engineering fundamentals, relevant technologies as well as techniques, skills and tools needed in mine design, planning and mine operation;
- Ability to develop problem solving capabilities and apply them in mine design, planning and mine operation;
- Ability to work as a team member and practically apply this skill in mining engineering analysis, design and planning, and mine operation;
- Ability to communicate effectively;
- Ability to design and conduct experiments, as well as to analyze and interpret data;
- Laboratory, technical, and computer competence;

Course Requirements:

- Students are expected to perform to a high standard and honesty, according to the rules currently at SDSM&T.
- Class attendance is mandatory
- No late homework assignments will be accepted, nor will tests be given other than at the scheduled time without prior written excuse that is approved by the instructor.
- Grading: 50% Tests and Final Exam; 50% Homework and Laboratory Assignments, Projects, and class attendance

Topics:

- 1. Computer hardware and operating systems
- 3. Computer software
- 5. Integrated modeling
- 7. Mapping
- 9. Mineral resources
- 11. Cost estimating
- 13. Engineering analysis
- 15. Data acquisition

- 2. Basic concepts of computer applications
- 4. General applications
- 6. Databases
- 8. CAD
- 10. Equipment selection
- 12. Mine economics
- 14. Numerical analysis
- Prepared by: Z. J. Hladysz, Ph.D. Dat MI 327A Ph: 394-1971 E-mail: Zbigniew.Hladysz@sdsmt.edu

Date: August 29, 2007

	MEM 301-Computer Applications in Mining
the Requirements of:	

Criterion 5. Curriculum

Contribution of Course to Meeting

(a) one year of a combination of college level mathematics and basic sciences (some with experimental

- experience) appropriate to the discipline:
 - College level mathematics

➢ Basic sciences

(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.

Engineering Topics:

- Engineering Sciences
- Engineering Design

Criterion 9. Program Criteria

- (1) the ability to apply mathematics through differential equations
- (2) calculus-based physics
- (3) general chemistry
- probability and statistics as applied to mining engineering problems applications (4)
- (5) fundamental knowledge in the geological sciences including
 - (5a) characterization of mineral deposits
 - (5b physical geology
 - structural or engineering geology (5c)
 - mineral and rock identification and properties (5d)
- (6) proficiency in
 - (6a) statics
 - (6b) dynamics
 - (6c) strength of materials (6d) fluid mechanics
 - (6e) thermodynamics
 - (6f) electrical circuits
- (7) proficiency in engineering topics related to both surface and underground mining, including: (7a) mining methods
 - (7b)
 - planning and design (7c) ground control and rock mechanics
 - (7d) health and safety
 - (7e) environmental issues
 - (7f) ventilation

(8) proficiency in additional engineering topics such as.....as appropriate to the program objectives.

- (8a) rock fragmentation,
- (8b) materials handling
- mineral or coal processing (8c)
- (8d) mine surveying
- valuation and resource/reserve estimation (8e) (9) The laboratory experience must lead to proficiency in
 - (9a) geologic concepts
 - (9b) rock mechanics
 - (9c) mine ventilation
 - other topics appropriate to the program objectives (9d)

- Ability to apply knowledge of mathematics, science and engineering
- b. Ability to design and conduct experiments
- с Ability to design a system, component, or process to meet desired needs
- d. Ability to function on multi-disciplinary teams
- e. Ability to identify, formulate, and solve engineering problems
- Understanding of professional and ethical responsibility f.
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- Recognition of the need for, and ability to engage in life-long learning i.
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Credits Attributed

Credits Attributed
2

Low	Med.	High
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Level of Emphasis						
Low Med. Hig						
		Х				
	Х					
	Х					
		Х				

MEM 302 – MINERAL ECONOMICS & FINANCE <u>Required</u> Meets MWF, 12:00 – 12:50 in MI 220

Catalog Data:

(3-0) 3 Credits – Prerequisite: Junior Standing. An introduction to the concepts of the time value of money and the application of time value of money decision criteria to mineral project evaluation situations. Both before-tax and after-tax investment situations are discussed. A discussion of the financing options available to a company for expansion, new project development or acquisitions. This course is cross-listed with ENVE 302.

Textbook:

Stermole, F.J., and J.M. Stermole, *Economic Evaluation and Investment Decision Methods*, 10th ed., Investment and Evaluations Corp., 2000.

References:

Gentry, D.W., and T.J. O'Neil, Mine Investment Analysis, SME, 1984.

Outcomes:

Upon completing this course, the student will be able to:

- 1. Solve basic time-value-of-money economic problems
- 2. Conduct a mineral project economic analysis
- 3. Evaluate equipment replacement options
- 4. Determine cost of capital to the firm and know how it's applied
- 5. Follow and understand various aspects of the commodities market and players in the market.

Course Requirements:

Course Evaluation: The final grade in this class will be based upon:

- ▶ Attendance & class participation (20%)
- Exams & homework assignments (60%)
- Final project & report (20%)

Topics:

- 1. Introduction
- 2. Compound interest formulas
- 3. Present worth, annuities, future worth, rate of return, and break-even analysis
- 4. Project analysis
- 5. Escalated dollar analysis, constant dollar analysis and inflation
- 6. Sensitivity analysis and risk analysis
- 7. Depreciation, depletion and amortization
- 8. Income tax, cash flow, DCFROR
- 9. After-tax investment decisions
- 10. Replacement analysis
- 11. Leverage concepts
- 12. Cost of capital to the firm
- 13. Cut-off grades and ore accounting
- 14. Stock/bond investments

Prepared By:	C.A. Kliche			Date:	January 2009
	MI 327B				
	Ph: 394-1972				
		-		111 1 0	

E-mail: charles.kliche@sdsmt.edu

Crite	 rion 5. Curriculum (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline: College level mathematics Basic sciences 		Credits A	Attributed
	 (b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. Engineering Topics: Engineering Sciences Engineering Design 		Credits A	-
(1)	rion 9. Program Criteria the ability to apply mathematics through differential equations	Low	Med.	High
(2)	calculus-based physics			
(3)	general chemistry			
(4)	probability and statistics as applied to mining engineering problems applications			
(5)	fundamental knowledge in the geological sciences including			
	(5a) characterization of mineral deposits			
	(5b physical geology			
	(5c) structural or engineering geology			
(0)	(5d) mineral and rock identification and properties			
(6)	proficiency in			
	(6a) statics (6b) dynamics			
	(6b) dynamics(6c) strength of materials			
	 (6c) strength of materials (6d) fluid mechanics 			
	(6e) thermodynamics			
	(6f) electrical circuits			
(7)	proficiency in engineering topics related to both surface and underground mining, including:			
(/)	(7a) mining methods			
	(7b) planning and design			
	(7c) ground control and rock mechanics			
	(7d) health and safety			
	(7e) environmental issues	X		
	(7f) ventilation			
(8)	proficiency in additional engineering topics such asas appropriate to the program objectives.			

MEM 302-Mineral Economics and Finanace

proficienc

- (8a) rock fragmentation,(8b) materials handling
- mineral or coal processing (8c)
- (8d) mine surveying
- valuation and resource/reserve estimation (8e) (9)

Contribution of Course to Meeting the Requirements of:

- The laboratory experience must lead to proficiency in
 - (9a) geologic concepts
 - (9b) rock mechanics (9c)
 - mine ventilation
 - other topics appropriate to the program objectives (9d)

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs c.
- d. Ability to function on multi-disciplinary teams
- Ability to identify, formulate, and solve engineering problems e.
- f. Understanding of professional and ethical responsibility
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- i. Recognition of the need for, and ability to engage in life-long learning
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

cicults intributed

Credits Attributed
1
1

Low	Med.	High
Х		
		Х

Level of Emphasis				
Low	Med.	High		
	Х			
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	х			
	Х			
		Х		

MEM 303 – UNDERGROUND MINING METHOD AND EQUIPMENT <u>Required</u> Meets WF, 9:00 – 9:50 in MI 320

Catalog Data:

(2-0) 2 credits. Prerequisite: Sophomore or junior standing. A study of underground mining techniques, unit operations, and equipment applicable to coal mining, metal mining, quarrying and tunneling operations. Topics include mining method selection, mine design and planning, drilling and blasting, and novel underground mining methods.

Textbook:

Power point Presentation slides

References:

Introduction to Mining Engineering, H.L Hartman, SME

Outcomes:

Students completing this class will be able to demonstrate:

- An understanding of the engineering principles relating to underground mining techniques, equipment and operations
- The ability to design a simple mining system, component or process to meet a desired need
- The ability to identify, formulate, and solve underground mine engineering problems
- The ability to use the techniques, skills and modern engineering tools necessary to function effectively in an underground mining environment

Course Requirements:

<u>Course Evaluation</u>: The final grade in this class will be based upon:

 \triangleright Quiz and term paper (20%)

- Homework assignments (50%):
- ➢ Exams (30%)

Topics:

- A. Introduction
- B. Ore deposits
- C. Mine Development
- D. Drilling
- E. Blasting
- F. Rock Breakage
- G. Unsupported Methods
- H. Supported Mining Methods
- I. Caving Methods
- J. Novel methods
- K. Supports
- L. Non mining-Use of underground Space
- M. Mine Management

Prepared By: Dr. Brijes Mishra Date: February 2009 MI 112B Ph: 394-1273 E-mail: Brijes.Mishra@sdsmt.edu

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ontrib	MEM 303-Underground Mining Methods and Equipment ution of Course to Meeting the Requirements of:			
ontrib	ution of Course to Meeting the Requirements of:			
riterio	n 5. Curriculum			
(a) one year of a combination of college level mathematics and basic sciences (some with experimental			
e	xperience) appropriate to the discipline:		Credits A	Attributed
	College level mathematics			
	Basic sciences			
	b) one and one-half years of engineering topics , consisting of engineering sciences and engineering design ppropriate to the student's field of study.		_	_
I	Engineering Topics:		Credits A	Attributed
	> Engineering Sciences			1
	 Engineering Design 			1
	, zingineering besign			-
		T		TT 1
	n 9. Program Criteria he ability to apply mathematics through differential equations	Low	Med.	High
	alculus-based physics		-	
	eneral chemistry		+	I
	probability and statistics as applied to mining engineering problems applications		+	
	undamental knowledge in the geological sciences including			
	5a) characterization of mineral deposits			
	5b physical geology			
	5c) structural or engineering geology			
	5d) mineral and rock identification and properties			
	roficiency in			
	6a) statics			
	6b) dynamics			
	6c) strength of materials			
	6d) fluid mechanics			
	6e) thermodynamics			
	6f) electrical circuits			
7) F	roficiency in engineering topics related to both surface and underground mining, including:			
(7a) mining methods			X
	7b) planning and design	X		
	7c) ground control and rock mechanics			
	7d) health and safety			
	7e) environmental issues	X		
	7f) ventilation	X		
	roficiency in additional engineering topics such asas appropriate to the program objectives.			
	8a) rock fragmentation,			
(8b) materials handling			
	8c) mineral or coal processing			
(8d) mine surveying		1	
(8e) valuation and resource/reserve estimation			
9)]	The laboratory experience must lead to proficiency in			
(9a) geologic concepts			
(9b) rock mechanics			
(9c) mine ventilation			
	9d) other topics appropriate to the program objectives			

Level of Emphasis			
Low	Med.	High	
		Х	
		Х	
		х	
		л	

i.	Recognition of the need for, and ability to engage in life-long learning
j.	Knowledge of contemporary issues

Relationship of Course to ABET Criterion 3 Program Outcomes:

Ability to design and conduct experiments

a. b.

c. d. e. f. g.

h.

context

Ability to apply knowledge of mathematics, science and engineering

Ability to design a system, component, or process to meet desired needs Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems Understanding of professional and ethical responsibility Ability to communicate effectively

k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Broad education necessary to understand the impact of engineering solutions in a global and sociatal

MEM 304 – Theoretical and Applied Rock Mechanics <u>Required</u> MI 327 lecture 10:00 – 10:50 AM MWF MI 120 laboratory 1:00 – 3:50 PM TH

Catalog Data:

(4-1) 4 credits. Prerequisite: EM 216 and junior standing. Principles of rock mechanics and mechanics of materials. Concept of stress, strain and the theory of elasticity. Applications in mining, geological engineering and tunneling. Emphasis on the design of safe structures in rocks. Laboratory experience for determining the basic physical and mechanical properties of rocks.

Textbook:

Zbigniew J. Hladysz, *Rock Mechanics -- Principles and Applications*, SDSM&T, 1997. Zbigniew J. Hladysz, *A Laboratory Manual for Rock Mechanics*, SDSMT, 1994

References:

B. Brady and E. T. Brown, *Rock Mechanics for Underground Mining*, George Allen & Unwin, 1985. E. Hoek and E. T. Brown, *Rock Slope Engineering*, IMM, 1981

Relationship of Course to Program Outcomes:

- Ability to apply basic knowledge in mathematics, science, and engineering;
- Field, laboratory, technical, and computer competence;
- Ability to communicate effectively;
- Broad, general knowledge of the role of engineering solutions in society;
- An understanding of professional and ethical responsibility;
- Ability to identify, formulate, and solve engineering problems;
- Ability to design a system or process to meet desired needs; and
- Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Requirements and Expectations:

- 1. Students are expected to perform to a high standard and honesty, according to the rules currently at SDSM&T.
- 2. Class attendance is mandatory.
- 3. No late homework assignments will be accepted, nor will test be given other than at the scheduled time without prior written excuse that is approved by the instructor.
- 4. Grading: 10% Lab Quizzes; 20% Successful completion of all required rock tests, analyses and reports; 20% Homework Assignments; 50% Tests and Final Exam

Topics:

- 1. Analysis of stresses and strains
- 3. Physical properties of rocks
- 5. Mechanical properties of rocks
- 7. Stresses in earth's crust
- 9. Stress distribution around underground structures
- 11. Engineering design
- 13. Rock mechanics classifications -empirical design
- 15. Numerical methods

Prepared By: Zbigniew J. Hladysz Dat MI 327A Ph: 394.1971 E-mail: Zbigniew.Hladysz@sdsmt.edu

- 2. Theory of elasticity
- 4. Rock behavior
- 6. Theories of failure
- 8. Rock mechanics instrumentation
- 10. Stability of underground structures
- 12. Design of supports and rock reinforcement
- 14. Slope stability
- 16. Time-dependent properties of rocks
- Date: January, 2007

	 (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline: College level mathematics Basic sciences 		Credits A	Attri
	 (b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. Engineering Topics: > Engineering Sciences > Engineering Design 		Credits A	Attr i 4
Crite	rion 9. Program Criteria	Low	Med.	
(1)	the ability to apply mathematics through differential equations			
(2)	calculus-based physics			
(3)	general chemistry			
(4)	probability and statistics as applied to mining engineering problems applications			
(5)	fundamental knowledge in the geological sciences including			
	(5a) characterization of mineral deposits			
	(5b physical geology			
	(5c) structural or engineering geology			
	(5d) mineral and rock identification and properties			
(6)	proficiency in			
	(6a) statics			
	(6b) dynamics			
	(6c) strength of materials		Х	
	(6d) fluid mechanics			
	(6e) thermodynamics			
	(6f) electrical circuits			
(7)	proficiency in engineering topics related to both surface and underground mining, including:			
	(7a) mining methods			

MEM 304-Theoretical And Applied Rock Mechanics

- (7a) m
- (7b) planning and design

Contribution of Course to Meeting the Requirements of:

Criterion 5. Curriculum (a) one

- (7c) ground control and rock mechanics
- (7d) health and safety (7e) environmental issues
- (7f) ventilation

proficiency in additional engineering topics such as.....as appropriate to the program objectives. (8)

- (8a) rock fragmentation,
- (8b) materials handling
- (8c) mineral or coal processing
- (8d) mine surveying (8e)
- valuation and resource/reserve estimation (9) The laboratory experience must lead to proficiency in
 - (9a) geologic concepts
 - (9b) rock mechanics
 - (9c) mine ventilation
 - other topics appropriate to the program objectives (9d)

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs c.
- d.
- Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems e.
- Understanding of professional and ethical responsibility f.
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- i. Recognition of the need for, and ability to engage in life-long learning
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Credits Attributed

Credits Attributed	
4	

Low	Med.	High
	Х	
		Х
		Х

Level of Emphasis			
Low	Med.	High	
		Х	
		Х	
	Х		
		Х	
		Х	
	Х		
		Х	

MEM 305 – INTRODUCTION TO EXPLOSIVES ENGINEERING <u>Required</u> Meets MWF, 2:00 – 2:50 in MI 220

Catalog Data:

(3-0) 3 Credits – Prerequisite: MEM 202. An introduction to explosives products; the theory of rock breakage by explosives; and the design of blast patterns for different applications including surface blasting techniques, underground blasting techniques, controlled blasting and specialized techniques. The techniques and equipment used to control and/or monitor airblast, ground vibration and flyrock are studied.

Textbook:

Konya, C.J., Rock Blasting and Overbreak Control, 3rd Ed., U.S. DOT, 2006.

References:

ISEE, *Blaster's Handbook*, 17th Edition. ISEE, Cleveland, OH. 1998. Konya, C.J. and E.J. Walter, *Surface Blast Design*, Prentice Hall, 1990. Siskind, D.E., *Vibrations From Blasting*, ISEE, 2000. Oriard, L.L., *The Effects of Vibrations and Environmental* Forces, ISEE, 1999. Dowding, C.H., *Blast Vibration Monitoring and Control*, Prentice Hall, 1985. Atlas Powder Co., *Explosives and Rock Blasting*, 1987.

Outcomes:

After completion of this course, students will be able to demonstrate:

- a knowledge of various types of explosives products and accessories,
- an ability to design a blast pattern to meet production goals,
- an ability to design a blast pattern to minimize environmental impacts,
- an ability to identify, formulate, and solve typical explosives engineering problems, and
- a general knowledge of the pertinent laws applicable to the explosives industry.

Course Requirements:

<u>Course Evaluation</u>: The final grade in this class will be based upon:

- Two examinations ($\sim 50\%$)
- ➢ Homework problems (~40%)
- Class & field trip participation (~10%)

Topics:

- 1. Explosives engineering
- 2. Explosives products
- 3. Initiators and blast hole delay devices
- 4. Mechanics of rock breakage
- 5. Priming and boosting
- 6. Blast design
- 7. Pattern design
- 8. Overbreak control
- 9. Site conditions and field procedures
- 10. Ground vibration, airblast and pre-blast surveys
- 11. Blasting safety
- 12. Estimating

Prepared By: Dr. C.A. Kliche MI 327B Ph: 394-1972 E-mail: charles.kliche@sdsmt.edu

Date: August 2008

Contr	ibution of Course to Meeting the Requirements of:	
"ritor	ion 5. Curriculum	
Inci	(a) one year of a combination of college level mathematics and basic sciences (some with experimental	
	experience) appropriate to the discipline:	Credits Attributed
	 College level mathematics 	ereales intributed
	> Basic sciences	
	(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design	
	appropriate to the student's field of study.	
	Engineering Topics:	Credits Attributed
	> Engineering Sciences	1
	Engineering Design	2
riter	ion 9. Program Criteria	w Med. High
(1)	the ability to apply mathematics through differential equations	
(2)	calculus-based physics	
(3)	general chemistry	
(4)	probability and statistics as applied to mining engineering problems applications	
(5)	fundamental knowledge in the geological sciences including	
	(5a) characterization of mineral deposits	
	(5b physical geology	
	(5c) structural or engineering geology	
	(5d) mineral and rock identification and properties	
(6)	proficiency in	
	(6a) statics	
	(6b) dynamics	
	(6c) strength of materials	
	(6d) fluid mechanics	
	(6e) thermodynamics	
	(6f) electrical circuits	
(7)	proficiency in engineering topics related to both surface and underground mining, including:	
	(7a) mining methods	
	(7b) planning and design	
	(7c) ground control and rock mechanics	
	(7d) health and safety	
	(7e) environmental issues	
	(7f) ventilation	
(8)	proficiency in additional engineering topics such asas appropriate to the program objectives.	
	(8a) rock fragmentation,	X
	(8b) materials handling	
	(8c) mineral or coal processing	
	(8d) mine surveying	
(0)	(8e) valuation and resource/reserve estimation	
(9)	The laboratory experience must lead to proficiency in	
	(9a) geologic concepts	
	(9b) rock mechanics	
	(9c) mine ventilation (0d) ather torics comparises to the program philoticity	
	(9d) other topics appropriate to the program objectives	

MEM 305-Introduction to Explosives Engineering

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs Ability to identify, formulate, and solve engineering problems Understanding of professional and ethical responsibility Ability to communicate effectively c.
- d.
- e. f.
- g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- i. Recognition of the need for, and ability to engage in life-long learning
- j. Knowledge of contemporary issues
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Low	Med.	High	
		Х	
Laval of Emphasis			
Level of Emphasis			

Level of Emphasis				
Low Med. High				
	Х			
		Х		
		Х		
	Х			

MEM 307 – MINERAL EXPLORATION & GEOSTATISTICS <u>Required</u> Meets MWF, 10:00 – 10:50 in MI 320

Catalog Data:

(3-0) 3 Credits – Prerequisite: GeoE 221. The application of the theory of geostatistics to quantify the geological concepts of (1) area of influence of a sample, (2) the continuity of the regionalized variable within a deposit, and (3) the lateral changes in the regionalized variable according to the direction. Basic concepts and theory of probability and statistics will be introduced, including probability distributions, sampling distributions, treatment of data, the mean, variance, and correlation. Computer techniques will be extensively used for geostatistical estimation of grade, volume and variance.

Textbook:

None

References:

Journal, A.G., and Ch.J. Huijbregts, *Mining Geostatistics*. The Blackburn Press, Caldwell, NJ, 2003. -----, *GS*⁺ *GeoStatistics for the Environmental Sciences*, Gamma Design Software v.7 manual. Barnes, M.P., *Computer-Assisted Mineral Appraisal and Feasibility*. SME, 1980. Crawford & Hustrulid, eds., *Open Pit Mine Planning and Design*. SME, 1979. Miller, I. & John E. Freund, *Probability and Statistics for Engineers*. Prentice-Hall, 1985.

Outcomes:

After completion of this course, students will be able to demonstrate:

- a knowledge of basic statistical concepts,
- a working knowledge of mining geostatistics,
- an ability to solve typical statistics problems,
- a working knowledge of mineral resource exploration
- a knowledge of computer assisted mineral reserve estimation

Course Requirements:

Course Evaluation: The final grade in this class will be based upon:

- Attendance & class participation (20%)
- Exams & homework assignments (50%)
- ➢ Final project & report (30%)

Topics:

1. Basic Engineering Statistics: Statistical Parameters (mean, variance, standard deviation, coefficient of variation); Probability Theory; Probability Distributions; Histograms; The Normal Distribution; The Lognormal Distribution; The Uniform, Gamma and Exponential Distributions; Sampling Distribution of the Mean; Inferences Concerning Means; Regression Analysis.

2. Geostatistics: Introduction to Matheronian Geostatistics; The Variogram; Block and Volume Variance; Estimation Variance; GS⁺ Geostatistics Computer Package; Cross Validation; Grade Estimation; Example of Point Kriging.

3. Exploration: Concept of Prospecting and Exploration; Geologic Mapping; Geologic Data Collection and Data Recording; Sample Collection Techniques; Drilling and Coring Techniques; Drill Logging; Digital Database; Basic Definitions of Mineral Resources; Classification of Economic Minerals; Resource Modeling; Exploration Geochemistry; Geophysical Exploration; Remote Sensing; Exploration Program Management.

Prepared By: Dr. C.A. Kliche Date: August 2008 MI 327B Ph: 394-1972 E-mail: charles.kliche@sdsmt.edu

 Criterion 5. Curriculum (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline: > College level mathematics > Basic sciences 	Credits Attributed
(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.	
Engineering Topics: > Engineering Sciences > Engineering Design	Credits Attributed 2
Criterion 9. Program Criteria (1) the ability to apply mathematics through differential equations	Low Med. High X
(2) calculus-based physics	
(3) general chemistry(4) probability and statistics as applied to mining engineering problems applications	
 (4) probability and statistics as applied to mining eighteeting probability applications (5) fundamental knowledge in the geological sciences including 	
(5a) characterization of mineral deposits	
(5b physical geology	X
(5c) structural or engineering geology	
(5d) mineral and rock identification and properties	
(6) proficiency in	
(6a) statics	
(6b) dynamics (6c) strength of materials	
(6c) strength of materials(6d) fluid mechanics	
(6d) india mechanics (6e) thermodynamics	
(6f) electrical circuits	
(7) proficiency in engineering topics related to both surface and underground mining, including:	
(7a) mining methods	
(7b) planning and design	
(7c) ground control and rock mechanics	
(7d) health and safety	
(7e) environmental issues	
(7f) ventilation	
 (8) proficiency in additional engineering topics such asas appropriate to the program objectives. (8a) rock fragmentation, 	
(8b) materials handling	
(8c) mineral or coal processing	
(8d) mine surveying	
(8e) valuation and resource/reserve estimation	X
(9) The laboratory experience must lead to proficiency in	
(9a) geologic concepts	
(9b) rock mechanics	
(9c) mine ventilation(9d) other topics appropriate to the program objectives	
(20) one opes appropriate to the program objectives	

MEM 307-Mineral Exploration and Geostatistics

Relationship of Course to ABET Criterion 3 Program Outcomes:

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments

Contribution of Course to Meeting the Requirements of:

- Ability to design a system, component, or process to meet desired needs Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems Understanding of professional and ethical responsibility Ability to communicate effectively c.
- d.
- e. f.
- g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- i. Recognition of the need for, and ability to engage in life-long learning
- j. Knowledge of contemporary issues
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Level of Emphasis				
Low				
		Х		
		Х		
		Х		
		х		

MEM 401 – THEORETICAL AND APPLIED MINE VENTILATION <u>Required</u> Meets MWF 11:00 – 11:50 AM in MI 223 and 1:00 – 3:50 PM Vent Lab

Catalog Data:

(3–1) 4 Credits. Prerequisites: MEM 303 Underground Mining Methods and Equipment; EM 328Applied Fluid Mechanics. Analysis of mine atmosphere and the control of airflow in an underground mine. Basic principles of thermodynamics and air conditioning. Emphasis is on solutions of airflow networks and the design principles for mine ventilation systems. Laboratory experience for determining the basic pressure and airflow parameters, ventilation network analysis and fan characteristics.

Textbook:

H. L. Hartman, *Mine Ventilation and Air Conditioning*, John Wiley and Sons, 1997. Zbigniew J. Hladysz, *A Laboratory Manual for Mine Ventilation*, SDSM&T, 2007.

References:

SME Mining Engineering Handbook, SME, 1992

Outcomes:

After completion of this course, students will be able to demonstrate:

- an understanding of the engineering principles relating to mine ventilation,
- the ability to design a ventilation network, component or process to meet a desired need,
- the ability to identify, formulate, and solve ventilation problems, and
- the ability to use the techniques, skills and modern engineering tools necessary to function effectively in an underground mining environment.

Course Requirements:

<u>Course evaluation</u>: Tests (50%), Homework (25%) and Laboratory (25%) Mandatory class attendance.

Topics:

- Thermodynamics of air, air properties, gas laws and air quality
- Airflow, ventilation circuits and ventilation networks
- Natural ventilation and mine fans
- Ventilation control
- Thermodynamics of compressible Airflow
- Ventilation Network Analysis
- Ventilation System Design
- Mine Fires
- Air Conditioning
- Network analysis using VNETPC and Vulcan software
- Laboratory experiments

Prepared By:	Dr. Zbigniew J. Hladysz	Date:	September 2008
	MI 327A		
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Crite	rion 5. Curriculum			
	(a) one year of a combination of college level mathematics and basic sciences (some with experimental			
	experience) appropriate to the discipline:		Credits A	Attributed
	College level mathematics			
	> Basic sciences			
	(b) one and one-half years of engineering topics , consisting of engineering sciences and engineering design appropriate to the student's field of study.		_	_
	Engineering Topics:		Credits A	Attributed
	 Engineering Sciences 			2
	 Engineering Design 			2
			ļ	2
Crite	ion 9. Program Criteria	Low	Med.	High
(1)	the ability to apply mathematics through differential equations			
(2)	calculus-based physics			
(3)	general chemistry			
(4)	probability and statistics as applied to mining engineering problems applications			
(5)	fundamental knowledge in the geological sciences including			_
	(5a) characterization of mineral deposits			
	(5b physical geology			
	(5c) structural or engineering geology			
	(5d) mineral and rock identification and properties			
(6)	proficiency in			
	(6a) statics			
	(6b) dynamics			
	(6c) strength of materials		1	
	(6d) fluid mechanics			
	(6e) thermodynamics		Х	
	(6f) electrical circuits			
(7)	proficiency in engineering topics related to both surface and underground mining, including:			
	(7a) mining methods			
	(7b) planning and design			
	(7c) ground control and rock mechanics			
	(7d) health and safety		1	
	(7e) environmental issues			
	(7f) ventilation		1	Х
(8)	proficiency in additional engineering topics such asas appropriate to the program objectives.			
	(8a) rock fragmentation,			

MEM 401-Theoretical and Applied Mine Ventilation

- (8a) rock fragmentation,(8b) materials handling
- mineral or coal processing (8c)
- (8d) mine surveying
- valuation and resource/reserve estimation (8e) (9) The laboratory experience must lead to proficiency in

Contribution of Course to Meeting the Requirements of:

Criterion 5. Curriculum

- (9a) geologic concepts
- (9b) rock mechanics
- (9c) mine ventilation
- other topics appropriate to the program objectives (9d)

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs c.
- d.
- Ability to function on multi-disciplinary teams Ability to identify, formulate, and solve engineering problems e.
- Understanding of professional and ethical responsibility f.
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- i. Recognition of the need for, and ability to engage in life-long learning
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Creans Auributeu

Credits Attributed	
2	
2	

Low	Med.	High
	Х	
	Λ	
		Х
		Х

Level of Emphasis			
Low	Med.	High	
		Х	
		Х	
		Х	
		Х	
		Х	
	Х		
		Х	

MEM 405 – MINE PERMITTING AND RECLAMATION <u>Required</u> Meets MWF, 1:00 – 1:50 p.m. in MI 220

Catalog Data:

(3-0) 3 Credits – Prerequisite: Junior standing. A study of environmental problems associated with both surface and underground mining and the reclamation practices that have been developed or are being evaluated to alleviate these problems. Federal, state and local reclamation regulations are examined for their effects on present and future mining practices and costs. Field trips to several mining operations in the Black Hills or the Powder River Basin will be taken for on-site observation of actual reclamation practices. This course is cross-listed with ENVE 405.

Textbook:

Kubasek, Nancy K. & Gary S. Silverman, Environmental Law, 5th edition, Prentice Hall, 2005.

References:

American Assoc. of Agronomy, *Reclamation of Drastically Disturbed Lands*, 1978. Various EPA reports.

Lehr, J.H., *Rational Readings on Environmental Concerns*, Van Nostrand Reinhold, 1992. -----, *Code of Federal Regulations for Mineral Resources*, Office of the Federal Register.

Outcomes:

After completion of this course, students will be able to demonstrate:

- an understanding of the professional and ethical responsibility of the mining professional towards man and his environment
- a knowledge of some of the more important contemporary environmental issues facing the mining professional
- an ability to use basic research skills and appropriate documentation of sources to write effectively of issues facing the mining professional

Course Requirements:

<u>Course Evaluation</u>: The final grade in this class will be based upon:

- Attendance & class participation (20%)
- \blacktriangleright Two (2) term reports (80%)

Topics:

- 1. Introduction: Important Environmental and Related Political Terminology
- 2. Part 1: Environmental & Mining Law—The American Legal System; Ecology's Ancestry; The National Environmental Policy Act (NEPA) of 1969; Air-Quality Control; Water-Quality Control; Waste Management and Hazardous Releases; The Surface Mining Control and Reclamation Act (SMCRA) of 1977; The Federal Land Policy and Management Act (FLPMA) of 1976; The Mining Law of 1872, the Mineral Leasing Act of 1920, and the Materials Act of 1955; State Mining and Reclamation Laws and Regulations; Mining and Sustainable Development
- 3. Part 2: Mined Land Reclamation—Seedbed Preparation; Soil Stabilization Measures; Restoring Problem Soils; Primary Factors Affecting Seed Germination, Plant Establishment, and Growth; Vegetative Stabilization; Plant Materials and Requirements for Growth in Dry Regions; Soil Erosion and Sedimentation; Acid Mine Drainage
- 4. Guest Speakers
- 5. Videos

Prepared By:	Dr. C.A. Kliche	Date:	January 2007
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Crite	 rion 5. Curriculum (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline: College level mathematics Basic sciences 	Credits Attributed
	(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.	
	Engineering Topics:	Credits Attributed
	 Engineering Sciences 	2
	 Engineering Design 	
<i>.</i>		
		Low Med. High
(1)	the ability to apply mathematics through differential equations	
(2)	calculus-based physics	
(3) (4)	general chemistry probability and statistics as applied to mining engineering problems applications	
	fundamental knowledge in the geological sciences including	
(5)		
	(5a) characterization of mineral deposits (5b) physical geology	
	(50) physical geology (5c) structural or engineering geology	
	(5c) structural of engineering geology (5d) mineral and rock identification and properties	
(6)	proficiency in	
(6)	(6a) statics	
	(b) dynamics	
	(6c) strength of materials	<u> </u>
	(6d) fluid mechanics	
	(6e) thermodynamics	
	(6f) electrical circuits	
(7)	proficiency in engineering topics related to both surface and underground mining, including:	
(/)	(7a) mining methods	
	(7b) planning and design	
	(7c) ground control and rock mechanics	
	(7d) health and safety	
	(7e) environmental issues	X
	(7f) ventilation	
(8)	proficiency in additional engineering topics such asas appropriate to the program objectives.	
()	(8a) rock fragmentation,	
	(8b) materials handling	
	(8c) mineral or coal processing	
	(8d) mine surveying	
	(8e) valuation and resource/reserve estimation	
(0)	The laboratory experience must lead to readicionaria	

MEM 405-Mine Permitting and Reclamation

(8e) valuat (9) The laboratory experience must lead to proficiency in

Contribution of Course to Meeting the Requirements of:

- (9a) geologic concepts
- (9b)
- rock mechanics (9c) mine ventilation
- other topics appropriate to the program objectives (9d)

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs c.
- d. Ability to function on multi-disciplinary teams
- Ability to identify, formulate, and solve engineering problems e.
- Understanding of professional and ethical responsibility f.
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- i. Recognition of the need for, and ability to engage in life-long learning
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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Credits Attributed	
2	

Low	Med.	High
		Х

Level of Emphasis			
Low	Med.	High	
		Х	
	Х		
		Х	
		Х	

MEM 450/550 – ROCK SLOPE ENGINEERING <u>Elective</u> Meets MWF, 11:00 – 11:50, MI 220

Catalog Data:

(3-0) 3 Credits – Prerequisite: MinE 411, MEM 304, or CEE 346, or equivalent. Topics include: modes of slope failure; economic consequences of instability in mining and construction; geologic factors controlling stability of rock slopes; shear strength of highly jointed rock masses and discontinuities; projection methods; vectoral analysis of 3-D problems by means of the stereographic projection method; analytical, graphical and computer analysis of planar, wedge and toppling failures; and probabilistic methods.

Textbook:

Kliche, C.A., Rock Slope Stability, SME, 1999.

References:

Hoek, E., and J.W. Bray, *Rock Slope Engineering*, E. & F.N. Spon, 1981.
Brawner, C.O., and V. Milligan, *Stability in Open Pit Mining*, SME, 1971.
Brawner, C.O., and V. Milligan, *Geotechnical Practice for Stability in Open Pit Mining*, SME, 1972.
Brawner, C.O., *Stability in Surface Mining*, SME, 1982.
Priest, S.D., *Hemispherical Projection Methods In Rock Mechanics*, George Allen & Unwin, 1985.
Coates, D.F., *Pit Slope Manual*, CANMET, 1977.
Schuster, R.L., & R.K. Krizek, *Landslides, Analysis and Control*, National Academy of Sciences, 1978.

Outcomes:

The student completing this class will have a comprehensive understanding of:

- rock slope stability analysis techniques
- rock slope stabilization techniques
- rock slope stability analysis techniques, including limit equilibrium, probabilistic and finite difference
- computer analysis techniques

Course Requirements:

Course Evaluation: The final grade in this class will be based upon:

- \blacktriangleright Attendance & class participation (25%)
- ► Exams & homework assignments (75%)

Topics:

- 1. Terminology
- 2. Landslide causes and processes
- 3. Economic consequences of slope failure
- 4. Modes of rock slope failure
- 5. Introduction to the probabilistic concept
- 6. Engineering properties of discontinuities
- 7. Groundwater
- 8. Geologic data collection
- Prepared By: C.A. Kliche MI 327B Ph: 394-1972 E-mail: charles.kliche@sdsmt.edu

- 9. Engineering rock mass classification schemes
- 10. Hemispherical projection techniques
- 11. Limiting equilibrium
- 12. Planar failure
- 13. Toppling failure
- 14. Wedge failure
- 15. Stabilization techniques
- 16. Computer applications

Date: September 2008

MEM	450/550	-Rock	Slope	Engineering	

Contribution of Course to Meeting the Requirements of:

Criterion 5. Curriculum

(a) one year of a combination of college level mathematics and basic sciences (some with experimental

- experience) appropriate to the discipline:
 - College level mathematics

➢ Basic sciences

(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.

Engineering Topics:

- Engineering Sciences
- Engineering Design

Criterion 9. Program Criteria

- (1) the ability to apply mathematics through differential equations
- (2) calculus-based physics
- (3) general chemistry
- probability and statistics as applied to mining engineering problems applications (4)
- (5) fundamental knowledge in the geological sciences including
 - (5a) characterization of mineral deposits
 - (5b physical geology
 - structural or engineering geology (5c)
 - mineral and rock identification and properties (5d)
- (6) proficiency in
 - (6a) statics
 - (6b) dynamics
 - (6c) strength of materials
 - (6d) fluid mechanics
 - (6e) thermodynamics (6f) electrical circuits
- proficiency in engineering topics related to both surface and underground mining, including: (7)
 - (7a) mining methods
 - (7b) planning and design (7c)
 - ground control and rock mechanics (7d)
 - health and safety (7e) environmental issues
 - (7f) ventilation
- proficiency in additional engineering topics such as.....as appropriate to the program objectives. (8)
 - (8a) rock fragmentation,
 - (8b) materials handling
 - mineral or coal processing (8c)
 - (8d) mine surveying
- valuation and resource/reserve estimation (8e) (9) The laboratory experience must lead to proficiency in
- - (9a) geologic concepts (9b)
 - rock mechanics (9c)
 - mine ventilation
 - other topics appropriate to the program objectives (9d)

- Ability to apply knowledge of mathematics, science and engineering
- b. Ability to design and conduct experiments
- с Ability to design a system, component, or process to meet desired needs
- d. Ability to function on multi-disciplinary teams
- Ability to identify, formulate, and solve engineering problems e.
- Understanding of professional and ethical responsibility f.
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal h.
- context
- Recognition of the need for, and ability to engage in life-long learning i.
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Credits	Attributed

Credits Attributed
3

Low	Med.	High
	Х	
		Х
		Λ
		Х

Level of Emphasis			
Low	Med.	High	
		Х	
	Х		
	Х		
		Х	
		Х	

MEM 464 - MINE DESIGN AND FEASIBILITY STUDY <u>Required</u> MI223, MWF, 2:00 – 2:50 PM

Catalog Data:

MINE 431 - Underground Mine Design (3-1) 4 credits. Prerequisite: MEM 204, MEM 302, MEM 303, MEM 304, MEM 305, MEM 306, MEM 307 AND MEM 401. A complete mine feasibility study conducted as a senior design project. Students will have a choice of designing one of the following: a surface or underground coal mine, a quarry, a surface or underground hard rock mine, or sub-surface space (tunneling, large excavations, industrial/environmental underground storage site, or underground science laboratory). A comprehensive study of principles and practices involved in developing an ore deposit (surface or underground) starting with drill hole data following through with a complete feasibility study (based on financial returns on investments and sensitivity analysis) covering ore reserve calculations, and selection of mining methods and equipment. Computerized approach will be an integral part of the course: SurvCADD software and Vulcan software are available to use. In addition to a computerized model of the mine, a final written report and presentation in front of the class will be required.

Textbook:

None

References:

All previous mining engineering course notes, pertinent library resources, and manufacturers technical and product specifications.

Outcomes

- an ability to apply the knowledge of mathematics and engineering science to problems in mine design and planning,
- an ability to apply the knowledge of mining engineering fundamentals, relevant technologies as well as techniques, skills and tools needed in mine design, planning and mine operation, and
- an ability to develop problem solving capabilities and apply them in mine design, planning and mine operation.

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Course Requirements:

- Project progress 10%
- ➢ Oral presentation 25%
- ➢ Final design report 65%

Topics:

- 1. Requirements and scope
- 2. Mine Modeling
- 3. Reserves
- 4. Mine design algorithms and mining method selection
- 5. Introduction to the probabilistic concept
- 6. Development and production requirements

Prepared By:

Dr. Z.J. Hladysz MI 327A Ph: (605) 394-1971 E-Mail: Zbigniew.Hladysz@silver.sdsmt.edu

Prepared:

January 2009

- 7. Drainage, power distribution and haulroads
- 10. Manpower, organization and management
- 11. Equipment selection
- 12. Surface facilities and infrastructure
- 13. Hydrology and dewatering
- 14. Cost estimation and economic analysis

Dr. C.A. Kliche MI 327B Ph: 394-1972 charles.kliche@sdsmt.edu

Criterior	5. Curriculum
(a	one year of a combination of college level mathematics and basic sciences (some with experimental
ex	perience) appropriate to the discipline:
	College level mathematics
	Basic sciences
) one and one-half years of engineering topics , consisting of engineering sciences and engineering design propriate to the student's field of study.
Eı	gineering Topics:
	Engineering Sciences

MEM 464-Mine Design and Feasibility Study

Engineering Design

Criterion 9. Program Criteria

- (1) the ability to apply mathematics through differential equations
- (2) calculus-based physics
- (3) general chemistry
- probability and statistics as applied to mining engineering problems applications (4)
- fundamental knowledge in the geological sciences including (5)
 - (5a) characterization of mineral deposits

Contribution of Course to Meeting the Requirements of:

- physical geology (5b
- structural or engineering geology (5c)
- mineral and rock identification and properties (5d)
- (6) proficiency in
 - (6a) statics
 - (6b) dynamics
 - (6c) strength of materials
 - (6d) fluid mechanics
 - (6e) thermodynamics
 - electrical circuits (6f)
- (7) proficiency in engineering topics related to both surface and underground mining, including: (7a) mining methods
 - (7b) planning and design
 - (7c) ground control and rock mechanics
 - (7d) health and safety
 - (7e) environmental issues
 - (7f) ventilation
- (8) proficiency in additional engineering topics such as.....as appropriate to the program objectives.
 - (8a) rock fragmentation,
 - (8b) materials handling
 - (8c) mineral or coal processing
 - (8d) mine surveying (8e)
- valuation and resource/reserve estimation (9) The laboratory experience must lead to proficiency in
 - (9a) geologic concepts
 - (9b) rock mechanics
 - (9c) mine ventilation
 - other topics appropriate to the program objectives (9d)

Relationship of Course to ABET Criterion 3 Program Outcomes:

- Ability to apply knowledge of mathematics, science and engineering
- b. Ability to design and conduct experiments
- Ability to design a system, component, or process to meet desired needs с
- d. Ability to function on multi-disciplinary teams
- e. Ability to identify, formulate, and solve engineering problems
- f. Understanding of professional and ethical responsibility
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal
- h. context
- Recognition of the need for, and ability to engage in life-long learning i.
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Credits Attributed

4

Credits Attributed

Low	Med.	High
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	_	_
	Х	
		Х
	X X X X	
	Х	
	Х	
	X	
	X X X	
	X	
	Х	
		Х

Level of Emphasis				
Low	Med.	High		
		Х		
	Х			
		Х		
		Х		
		Х		
	Х			
		Х		
	х			
	Х			
		Х		

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MEM 466—Mine Management <u>Required</u> Meets MONDAYS, 8:00 – 10:50 in MI 320

Catalog Data:

(2-0) 2 Credits – Prerequisites: None. Provide students with an understanding of critical management issues of fundamental importance to the mining industry. Develop students' leadership skills. Emphasize management of human resources, conflict resolution, negotiation skills and project management skills.

Textbook:

None

References:

Mostly class notes and guest speaker notes.

Outcomes:

Students completing this class will be able to demonstrate:

• the ability to use the techniques, skills and modern management tools necessary to function effectively in the mining environment as it related to managing resources, people and projects effectively.

Course Requirements:

<u>Course Evaluation</u>: The final grade in this class will be based upon:

- ➢ Attendance & class participation (80%)
- Exams & homework assignments (10%)
- ➢ Projects & accompanying reports (10%)

Topics:

- o Background of modern management & functions in the management process
- Legal forms of management
- o Planning, Organizational structures, Upper management
- Professionalism and ethics
- Project management and operation scheduling
- o Mine safety management, equipment maintenance management
- Training and development of human resources
- Bargaining process, Risk management
- Computerized databases as a management tool

Prepared By:	Shashi Kanth	Date:	January 2009
	MI 327C		
	Ph: 394-1973		
	E-mail: shashi.kanth@sdsmt.edu		

Contribution of Course to Meeting the Requirements of:	

Criterion 5. Curriculum

(a) one year of a combination of college level mathematics and basic sciences (some with experimental

MEM 466-Mine Management

- experience) appropriate to the discipline:
 - College level mathematics

Basic sciences

(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.

Engineering Topics:

- Engineering Sciences
- Engineering Design

Criterion 9. Program Criteria

- (1) the ability to apply mathematics through differential equations
- (2) calculus-based physics
- (3) general chemistry
- probability and statistics as applied to mining engineering problems applications (4)
- (5) fundamental knowledge in the geological sciences including
 - (5a) characterization of mineral deposits
 - physical geology (5b
 - structural or engineering geology (5c)
 - mineral and rock identification and properties (5d)
- (6) proficiency in
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 - (6d) fluid mechanics (6e) thermodynamics
 - (6f) electrical circuits
- (7) proficiency in engineering topics related to both surface and underground mining, including:
 - (7a) mining methods
 - planning and design (7b)
 - (7c) ground control and rock mechanics
 - (7d) health and safety (7e) environmental issues
 - (7f) ventilation
- (8) proficiency in additional engineering topics such as.....as appropriate to the program objectives.
 - (8a) rock fragmentation,
 - (8b) materials handling
 - mineral or coal processing (8c)
 - (8d) mine surveying
- valuation and resource/reserve estimation (8e) (9) The laboratory experience must lead to proficiency in
- - (9a) geologic concepts
 - (9b) rock mechanics (9c)
 - mine ventilation
 - other topics appropriate to the program objectives (9d)

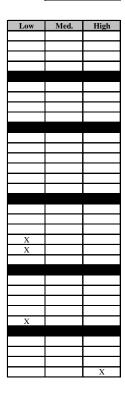
Relationship of Course to ABET Criterion 3 Program Outcomes:

- Ability to apply knowledge of mathematics, science and engineering a.
- b. Ability to design and conduct experiments
- с Ability to design a system, component, or process to meet desired needs
- d. Ability to function on multi-disciplinary teams
- e. Ability to identify, formulate, and solve engineering problems
- Understanding of professional and ethical responsibility f.
- Ability to communicate effectively g.
- Broad education necessary to understand the impact of engineering solutions in a global and sociatal h.
- context
- Recognition of the need for, and ability to engage in life-long learning i.
- Knowledge of contemporary issues j.
- k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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Credits Attributed
1



Level of Emphasis				
Low	Med.	High		
	Х			
		Х		
		Х		
		Х		
		Х		