

Centurion University of Technology and Management Odisha

CHOICE BASED CREDIT SYSTEM

(With effect from 2018 Admitted Batch)

COURSE STRUCTURE & SYLLABIS

BASKET - IV



School of Engineering & Technology

Course Structure
Mining

Course Code	Course Title	Type of-course	T-P-Pr (Credit)	Prerequisite
CCMN0112	Drilling and Blasting	Theory	3	Nil
CCMN0102	Geology for Mining Engineers	Theory	3	Nil
CCMN0103	Mine Environmental Engineering	Theory	3	Nil
CCMN0110	Mine Legislation and Safety –ii	Theory	3	Nil
<i>CCMN0107</i>	Mine Machinery i	Theory	3	Nil
CCMN0101	Mineralogy Petrology and Stratigraphy	Theory	3	Nil
CCMN0113	Rock Mechanics	Theory	3	Nil
CCMN0109	Mine Legislation and Safety- i	Theory	3	Nil
CCMN0108	Mining Machinery – ii	Theory	3	Nil
CCMN0111	Mine System Engineering	Theory	3	Nil
CCMN0104	Surface Mining	Theory	3	Nil
CCMN0105	Underground Coal Mining	Theory	3	Nil
CCMN0106	Underground Metal Mining	Theory	3	Nil
CCMN0203	Rock Mechanics lab	Practice	2	Nil
CCMN0202	Geology for Mining Engineers lab	Practical	2	Nil
CCMN0201	Mineralogy and Petrology lab	Practical	2	Nil

Syllabus

Drilling and Blasting

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Drilling and Blasting	CCMN0112	Theory	3-0-0(3)	Nil

1. Objective

<p>To make the students have understanding on:</p> <ul style="list-style-type: none"> • Exploration drilling • Explosives and Initiating Systems • Drilling & Blasting in Surface Mines • Drilling & Blasting in Underground Mines
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2. Learning outcome

<ul style="list-style-type: none"> • Students will be able to have knowledge on concepts of drilling and blasting in surface mines. • Students will be able to have knowledge on concepts of drilling and blasting in underground mines.
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3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Module I

Exploration Drilling: Boring for exploration; Various types of exploratory drills and their applicability Auger, Cable tool, Odex, Core Drills; Core recovery: single and double tube core barrels, wire line core barrel; Storage of cores; Interpretation of borehole data.

Module II

Explosives and Initiating Systems:

Types of explosives, their composition and properties, classification; Selection of explosives; Manufacture, transport, storage and handling of explosives; Testing of explosives;

Module III

Types of initiating systems, Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders.

Module IV

Drilling & Blasting in Surface Mines:

Drilling: Blasthole drills types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, compressed air requirement for hole cleaning; Selection of drilling systems, drilling errors, organization of drilling.

Module V

Blasting: Mechanics of rock fragmentation; Livingstone theory of crater formation; Factors affecting blasting, Blast design estimation of burden and spacing, estimation of charge requirement; Initiation patterns; Secondary blasting pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure, Blast instrumentation

Module VI**Drilling & Blasting in Underground Mines:**

Coal mines: Drilling systems and their applicability, blasting off solid, different blasting cuts, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns.

Module VII

Metal mines: Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, long hole blasting, vertical crater retreat blasting

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Boring for exploration; Various types of exploratory drills and their applicability Auger, Cable tool, Odex, Core Drills;	4	Lecture, field studies	assignment	Book, Video, Online source
Core recovery: single and double tube core barrels, wire line core barrel; Storage of cores; Interpretation of borehole data.	3	lecture	Assignment field studies,	Book, Video, Online source
Types of explosives, their composition and properties, classification; Selection of explosives; Manufacture, transport, storage and handling of explosives; Testing of explosives	5	lecture	Assignment, field studies	Book, Video, Online source
Types of initiating systems, Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders.	5	lecture	Assignment, field studies	Book, Video, Online source

Drilling: Blasthole drills types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, compressed air requirement for hole cleaning; Selection of drilling systems, drilling errors, organization of drilling.	7	lecture	Assignment, field studies	Book, Video, Online source
Blasting: Mechanics of rock fragmentation; Livingstone theory of crater formation; Factors affecting blasting, Blast design estimation of burden and spacing, estimation of charge requirement; Initiation patterns; Secondary blasting pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure, Blast instrumentation	7	lecture	Assignment, field studies	Book, Video, Online source
Coal mines: Drilling systems and their applicability, blasting off solid, different blasting cuts, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns.	6	lecture	Assignment, field studies	Book, Video, Online source
Metal mines: Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, long hole blasting, vertical crater retreat blasting	4	lecture	Assignment field studies,	Book, Video, Online source
Total Hrs	41			

Geology for Mining Engineers

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Geology for Mining Engineers	CCMN0102	Theory	3-0-0(3)	Nil

1. Objective

To make the students have a clear knowledge on:

- Structural Geology
- Economic Geology
- Exploration Geology
- Coal Geology
- Petroleum Geology

2. Learning outcome

- Students will be able to understand topographic maps, planar and linear structures, unconformities, folds, faults and joints, and stereographic projections.
- Students will be able to have knowledge on economic geology, major mineral deposits, and mineral exploration.
- Students will be able to understand coal and petroleum geology.
- A clear understanding of economic, structural, exploration, coal and petroleum geology as a prerequisite for mining engineering.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

4. Course outline

Module I

Structural Geology

Study of topographic maps; Attitude of planar and linear structures; Effects of topography on outcrops.

Module II

Unconformities, folds, faults and joints - their nomenclature, classification and recognition. Effects of folds and fractures on strata/orebodies and their importance in mining operations. Forms of igneous intrusions - dyke, sill and batholith.

Module III

Principles of stereographic projections of linear and planar features of rocks.

Module IV

Economic Geology and Exploration Geology

Introduction and scope of economic geology;

Ore and gangue; Processes of ore formation; Major Indian mineral deposits (Iron, Manganese, Copper, Lead, Zinc) distribution and mode of occurrence.

Module V

Mineral Exploration

Concepts and methods viz. surface and subsurface; Exploration strategy and design; Stages of exploration; Resources and reserves.

Module VI

Coal and Petroleum Geology

Rank, characteristics and important constituents of coal; Classification and origin of coal; Chief characteristics of Indian coals; Geology of the principal coalfields of India.

Module VII

Concept of organic constituents of petroleum origin, migration, accumulation, concept of traps and important petroliferous basins of India.

5. Recommended Books:

1. M.P.Billings – Structural Geology
2. Economic Geology – U. Prasad
3. Exploration Geology – Exploration and mining geology – W.C.Peters
4. Coal and petroleum geology – elements of petroleum geology – R.C.Shelly and S.A.Sonnenberg

6. Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Study of topographic maps; Attitude of planar and linear structures; Effects of topography on outcrops.	4	lecture	assignment	book
Unconformities, folds, faults and joints - their nomenclature,	5	lecture	assignment	book

classification and recognition.				
Forms of igneous intrusions - dyke, sill and batholith.	1	lecture	assignment	book
Effects of folds and fractures on strata/orebodies and their importance in mining operations.	2	lecture	assignment	book
Principles of stereographic projections of linear and planar features of rocks.	2	lecture	assignment	book
Introduction and scope of economic geology; Ore and gangue; Processes of ore formation;	2	lecture	assignment	book
Major Indian mineral deposits (Iron, Manganese, Copper, Lead, Zinc) distribution and mode of occurrence.	5	lecture	assignment	book
Mineral Exploration – concepts and methods viz. surface and subsurface;	2	lecture	assignment	book
Exploration strategy and design; Stages of exploration; Resources and reserves.	2	lecture	assignment	book
Rank, characteristics and important constituents of coal;	1	lecture	assignment	book
Classification and origin of coal;	1	lecture	assignment	book
Chief characteristics of Indian coals; Geology of the principal coalfields of India.	1	lecture	assignment	book
Concept of organic constituents of	1	lecture	assignment	book

petroleum origin				
migration, accumulation, concept of traps	1	lecture	assignment	book
Important petroliferous basins of India.	1	lecture	assignment	book
Total (hrs)	31			

Mine Environmental Engineering

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Mine Environmental Engineering	CCMN0103	Theory	3-0-0(3)	Nil

1. Objective

<p>To make the students have understanding on:</p> <ul style="list-style-type: none"> • Mine fires • Mine explosions • Inundation • Rescue and recovery • Airborne respirable dust • Illumination

2. Learning outcome

<ul style="list-style-type: none"> • Students will be able to understand the environmental factors that concerns with the mines. • Students will have an understanding on mine fires, explosions, inundation, rescue and recovery during the mines hazards, airborne respirable dust and illumination survey.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Module I

Mine fires:

Causes and classification of mine fires; Spontaneous combustion mechanism, stages of spontaneous combustion, susceptibility indices, factors affecting spontaneous combustion;

Module II

Detection and prevention of spontaneous heating and accidental fires; Dealing with mine fires, direct and indirect methods, fire stoppings. Re-opening of sealed-off areas; Fires in quarries, Coal stacks and waste dumps.

Module III

Mine explosions:

Firedamp and coal dust explosions causes and prevention, explosive limits; Stone-dust and water barriers; Explosion in quarries over developed pillars; Investigation after an explosion

Module IV

Inundation:

Causes and prevention; Precautions and techniques of approaching old workings; Dewatering of waterlogged working, safety boring apparatus, pattern of holes; Design and construction of water dams.

Module V

Rescue and recovery:

Rescue equipment and their uses, classification of rescue apparatus; Resuscitation; Rescue stations and rescue rooms; Organization of rescue work; Emergency preparedness and response system.

Module VI

Airborne respirable dust:

Generation, dispersion, measurement and control; Physiological effects of dust, dust-related diseases.

Module VII

Illumination:

Cap lamps; Layout and organization of lamp rooms; Standards of illumination; Photometry and illumination survey.

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Mine fires: Causes and classification of mine fires; Spontaneous combustion mechanism stages of spontaneous combustion, susceptibility indices, factors affecting spontaneous combustion	5	lecture	assignment	Book, Video, Online source
Detection and prevention of spontaneous heating and accidental fires; Dealing with mine fires, direct and indirect methods, fire stoppings.	3	lecture	assignment	Book, Video, Online source
Re-opening of sealed-off areas; Fires in quarries, Coal stacks and waste dumps.	2	lecture	assignment	Book, Video, Online source

Mine explosions: Firedamp and coal dust explosions causes and prevention, explosive limits; Stone-dust and water barriers; Explosion in quarries over developed pillars; Investigation after an explosion.	4	lecture	assignment	Book, Video, Online source
Inundation: Causes and prevention; Precautions and techniques of approaching old workings; Dewatering of waterlogged working, safety boring apparatus, pattern of holes; Design and construction of water dams.	5	lecture	assignment	Book, Video, Online source
Rescue and recovery: Rescue equipment and their uses, classification of rescue Apparatus; Resuscitation; Rescue stations and rescue rooms; Organisation of rescue work; Emergency preparedness and response system.	6	Lecture, lab practice	assignment	Book, Video, Online source
Airborne respirable dust: Generation, dispersion, measurement and control; Physiological effects of dust, dust-related diseases.	3	lecture	assignment	Book, Video, Online source
Illumination: Cap lamps; Layout and organisation of lamp rooms; Standards of Illumination; Photometry and illumination survey.	3	Lecture, lab practice	assignment	Book, Video, Online source
Total Hrs	31			

Mine Legislation and Safety –II

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Mine Legislation and Safety –II	CCMN0110	Theory	3-0-0(3)	Nil

1. Objective

<p>To make the students have understanding on:</p> <ul style="list-style-type: none"> • Various mines rules • Safety measures – investigation and management
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2. Learning outcome

- Students will be able to have knowledge on mines legislation
- Students will be able to have knowledge on safety measures in mines.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Module I

Mine Legislation

The Mine Rules, 1955;

Module II

The Mines Rescue Rules, 1985;

Module III

Provisions of Electricity Rules, 1961 relevant to Mining.

Module IV

Salient provisions of the Mines and Minerals (Development & Regulation) Act, 1957,

Module V

Mineral Concession Rules, 1960, and Mineral conservation and Development Rules.

Module VI

Mine Safety

Investigations into mine accidents and accident reports;

Module VII

Mine Emergency Management System

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
The Mine Rules, 1955; The Mines Rescue Rules, 1985; Provisions of Electricity Rules, 1961 relevant to	15	lecture	assignment	Book

Mining				
Salient provisions of the Mines and Minerals (Development & Regulation) Act, 1957, Mineral Concession Rules, 1960, and Mineral conservation and Development Rules.	14	lecture	assignment	Book
Investigations into mine accidents and accident reports; Mine Emergency Management System	8	lecture	assignment	Book
Total Hrs	37			

Mine Machinery i

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Mine Machinery i	CCMN0107	Theory	3-0-0(3)	Nil

1. Objective

<p>To make the students have a clear knowledge on:</p> <ul style="list-style-type: none"> • Drilling machine • Coal cutters • Shearer • Plough • Continuous miner • Road header and dint header • Loading and transport equipment • Man riding systems • Free steered vehicles • Shuttle car, ram car • Different types of winders • Mechanics of winding, • Power calculation • Rope selection, inspection and maintenance • Safety features and automatic contrivances • Mine pumps and compressors

2. Learning outcome

<ul style="list-style-type: none"> • Students will be able to understand about different types of machineries used in u/g mines and classification and constructional features of drilling machine used in mines.
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3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Course outline

Module I

Drilling machine:

Classification, application, constructional features

Module II

Different types of machinery used in u/g mines:

coal cutters, shearer, plough, continuous miner, road header and dint header,

Module III

Loading and transport equipment, man riding systems, free steered vehicles, shuttle car, ram car.

Module IV

Winding system:

Classification and constructional difference of different types of winders,

Module V

Mechanics of winding, power calculation.

Module VI

Wire ropes:

rope selection, inspection and maintenance. Safety features and automatic contrivances.

Module VII

Mine pump:

Classification, construction, and selection of mine pumps and compressors.

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Drilling machine	1	lecture	Assignment, <i>field study</i>	book
Classification of drilling machines	1	lecture	assignment	book

Application of drilling machines	1	lecture	assignment	book
Constructional feature of drilling machines	1	lecture	assignment	book
coal cutters, shearer	2	lecture	Assignment, <i>field study</i>	book
plough, continuous miner	2	lecture	Assignment, <i>field study</i>	book
road header and dint header, loading and transport equipment	2	lecture	Assignment, <i>field study</i>	book
man riding systems, free steered vehicles	1	lecture	Assignment, <i>field study</i>	book
Classification and constructional difference of different types of winders,	2	lecture	Assignment, <i>field study</i>	book
mechanics of winding, power calculation	1	lecture	Assignment	book
rope selection, inspection and maintenance	2	lecture	Assignment, <i>field study</i>	book
Classification, of mine pumps and compressors	2	lecture	Assignment, <i>field study</i>	book
construction and selection of mine pumps and compressors	2	lecture	Assignment	book

Total Hrs 20

Mineralogy Petrology and Stratigraphy

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Mineralogy Petrology and Stratigraphy	CCMN0101	Theory	3-0-0(3)	Nil

1. Objective

To make the students have a clear knowledge on:

- Mineralogy
- Petrology
- Stratigraphy
- Palaeontology

2. Learning outcome

- *Students will be able to understand the physical and chemical properties of minerals, crystal classes and systems, classification of minerals and properties of common silicate minerals, sulphides and oxides.*
- *Students will be able to have knowledge on igneous rocks, its forms, textures and classification. Sedimentary rocks, its processes and its classification. Metamorphic rocks, its processes, textures and structures of metamorphic rocks and its classification.*
- *Students will be able to understand the concept of paleontology, fossils, concept of stratigraphy, ore provinces, coal belts and oil fields of India.*
- *A clear understanding of mineralogy, petrology, stratigraphy and palaeontology as a prerequisite for mining engineering.*

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

4. Course outline

Module I

Mineralogy

Minerals: Physical and chemical properties; Crystal, crystal classes and systems; Classification of minerals and properties of common silicate minerals (Quartz, Feldspar, Pyroxene, Amphibole, Garnet, Olivine, Mica),

Module II

Sulphides (Pyrite, Chalcopyrite, Galena, Sphalerite) and Oxides (Haematite, Magnetite, Chromite, Pyrolusite, Psilomelane).

Module III

Petrology

Igneous Rocks:

Magma and lava, extrusive and intrusive forms, textures; Classification and description of some common igneous rocks (Granite, Dolerite, gabbro, Basalt, Rhyolite, Pegmatite).

Module IV

Sedimentary rocks:

Sedimentation processes; Classification and description of some common sedimentary rocks (Conglomerate, Sandstone, Shale, Limestone).

Module V

Metamorphic rocks:

Processes of metamorphism, textures and structures of metamorphic rocks; Classification and description of some common metamorphic rocks (Slate, Phyllite, Schist, Gneiss, Quartzite, and Marble).

Module VI

Paleontology and Stratigraphy

Concepts of palaeontology:

Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils.

Module VII

Principles of stratigraphy:

Broad stratigraphic subdivisions and associated rock types of important ore provinces, coal belts and oil fields of India.

5. Recommended Books:

- Rutley's elements of mineralogy
- Petrology – Tyrrell
- Stratigraphy – P.K. Mukherjee
- Textbook of palaeontology – M.S. Chatwal

6. Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)

		etc.)		
Minerals: Physical and chemical properties	2	lecture	assignment	book
Crystal, crystal classes and systems;	3	lecture	assignment	book
Classification of minerals and properties of common silicate minerals	1	lecture	assignment	book
Quartz, Feldspar, Pyroxene, Amphibole, Garnet, Olivine, Mica	3	lecture	assignment	book
sulphides (Pyrite, Chalcopyrite, Galena, Sphalerite)	2	lecture	assignment	book
Oxides (Haematite, Magnetite, Chromite, Pyrolusite, Psilomelane).	2	lecture	assignment	book
Igneous Rocks, Magma and lava, extrusive and intrusive forms,	2	lecture	assignment	book
textures	1	lecture	assignment	book
Classification and description of some common igneous rocks (Granite, Dolerite, gabbro, Basalt, Rhyolite, Pegmatite)	2	lecture	assignment	book
Sedimentary rocks: Sedimentation processes	1	lecture	assignment	book
Classification and description of some common sedimentary rocks (Conglomerate, Sandstone, Shale, Limestone)	2	lecture	assignment	book
Metamorphic rocks: Processes of	1	lecture	assignment	book

metamorphism,				
textures and structures of metamorphic rocks	2	lecture	assignment	book
Classification and description of some common metamorphic rocks (Slate, Phyllite, Schist, Gneiss, Quartzite, Marble).	3	lecture	assignment	book
Concepts of palaeontology;	1	lecture	assignment	book
Fossils, their mode of preservation and significance as indices of age and climate	2	lecture	assignment	book
Concept of index fossils. Principles of stratigraphy	1	lecture	assignment	book
Broad stratigraphic subdivisions and associated rock types of important ore provinces	3	lecture	assignment	book
coal belts and oil fields of India.	2	lecture	assignment	book
Total (hrs)	36			

Rock Mechanics

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Rock Mechanics	CCMN0113	Theory	3-0-0(3)	Nil

1. Objective

To make the students have understanding on:

- Physico-mechanical properties of rock
- Dynamic properties of rock and rockmass
- Time dependent properties of rock
- Failure criteria for rock and rockmass
- Pre-mining state of stress
- Physico-mechanical properties of soil
- Ground water

2. Learning outcome

- Students will be able to have knowledge on various properties of rockmasses.
- Students will be able to have knowledge on failure criteria for rocks
- Students will be able to have knowledge on groundwater

Course outline

Module I

Rock Mechanics:

Definition, history, inherent complexities, source of information and field of application of rock mechanics. Concept of stress and strain in rock Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks.

Module II

Physico-mechanical properties of rock:

Determination of physical properties, strengths, strength indices and static elastic constants; Parameters influencing strength; Abrasivity of rock and its determination.

Module III

Dynamic properties of rock and rockmass

Propagation of elastic wave in rock media; Determination of dynamic strength and elastic constants of rock.

Module IV

Time dependent properties of rock:

Creep deformation and strength behaviour; Creep test and rheological models. Strength and Deformability of Rock Mass: In situ shear tests; Evaluation of shear strength; In situ bearing strength test; In situ deformability tests-Plate Loading Test, Plate Jacking Test and Borehole Jack Tests

Module V

Failure criteria for rock and rockmass

Theories of rock failure; Coulomb, Mohr and Griffith criteria; Empirical criteria.

Pre-mining state of stress:

Sources, methods of determination including over coring, hydro-fracturing methods and other methods.

Module VI

Physico-mechanical properties of soil

Origin of soils; Basic relationships; Index properties including consistency and gradation; Clay mineralogy; Classification of engineering soils; Engineering properties of soils compressibility, consolidation, compaction and strength

Module VII

Ground water:

Free and confined groundwater; Exploration and engineering importance of groundwater; Influence of water on rock and soil behaviour; Permeability of rocks; Measurement of permeability; Ground water flow in rockmass; Groundwater pressure in rockmass and its measurement

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Definition, history, inherent complexities, source of information and field of application of rock mechanics	2	lecture	field study	Book, Online source
Concept of stress and strain in rock Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks.	3	lecture	assignment	Book, Online source
Determination of physical properties, strengths, strength indices and static elastic constants; Parameters influencing strength; Abrasivity of rock and its determination.	4	lecture	assignment	Book, Online source
Propagation of elastic wave in rock media Determination of dynamic strength and elastic constants of rock.	2	lecture	assignment	Book, Online source
Creep deformation and strength behaviour; Creep test and rheological models.Strength and Deformability of Rock Mass: In situ shear tests; Evaluation of shear strength; In situ	7	lecture	assignment	Book, Online source

bearing strength test; In situ deformability tests-Plate Loading Test, Plate Jacking Test and Borehole Jack Tests				
Theories of rock failure; Coulomb, Mohr and Griffith criteria; Empirical criteria.	2	lecture	assignment	Book, Online source
Pre-mining state of stress: Sources, methods of determination including over coring, hydro-fracturing methods and other methods.	4	lecture	assignment	Book, Online source
Origin of soils; Basic relationships; Index properties including consistency and gradation; Clay mineralogy; Classification of engineering soils; Engineering properties of soils compressibility, consolidation, compaction and strength	5	lecture	assignment	Book, Online source
Free and confined groundwater; Exploration and engineering importance of groundwater; Influence of water on rock and soil behaviour; Permeability of rocks; Measurement of permeability; Ground water flow in rockmass; Groundwater pressure in rockmass and its measurement	6	lecture	assignment	Book, Online source
Total Hrs	35			

Mine Legislation and Safety- I

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Mine Legislation and Safety- i	CCMN0109	Theory	3-0-0(3)	Nil

1. Objective

To make the students have understanding on:

- Various mines Acts
- Safety measures that are adopted in mines.

2. Learning outcome

- Students will be able to have knowledge on mines legislation and various acts that are enacted.
- Students will be able to have knowledge on various safety measures that needs to be adopted for avoiding mine accidents.

Course outline

Module I

Legislation

The Mines Act, 1952;

Module II

The Coal Mines Regulations, 1957

Module III

The Metalliferous Mines Regulations, 1961

Module IV

Mine Safety

Occupational hazards of mining;

Module V

Accidents and their classification; Frequency and severity rates of accidents; Basic causes of accident occurrence; Place wise and Cause wise analysis;

Module VI

Measures for improving safety in mines; Cost of accidents.

Module VII

Introduction to risk based safety and health management system; Methods of Risk assessment.

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
The Mine Rules, 1955; The Mines Rescue Rules, 1985; Provisions of Electricity Rules, 1961 relevant to	15	lecture	assignment	Book

Mining.				
Salient provisions of the Mines and Minerals (Development & Regulation) Act, 1957, Mineral Concession Rules, 1960, and Mineral conservation and Development Rules.	14	lecture	assignment	Book
Investigations into mine accidents and accident reports; Mine Emergency Management System	8	lecture	assignment	Book
Total Hrs	37			

Mining Machinery – II

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Mining Machinery – II	CCMN0108	Theory	3-0-0(3)	Nil

1. Objective

To make the students have understanding on: <ul style="list-style-type: none"> Different machineries that are used in mines for carrying out heavy operations.

2. Learning outcome

<ul style="list-style-type: none"> Students will be able to have knowledge on the design construction and operation applications of different machineries that are used in mines.
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3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Course outline

Module I

Design, construction and operation of:

blast hole drills, rippers, shovels, hydraulic excavators,

Module II

scraper, dragline, dumpers, wheel loaders,

Module III

dozers, graders, surface miners, BWE,

Module IV

Spreader, stacker & reclaimer.

Module V**High capacity belt conveyors**

Constructional detail and selection procedures.

Module VI

Aerial rope ways – classification, layout and constructional features.

Module VII**Classification, application and constructional features of:**

Crushers, breakers and feeders.

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Design, construction and operation of blast hole drills, rippers, shovels, hydraulic excavators, scraper, dragline, dumpers, wheel loaders, dozers, graders, surface miners, BWE, spreader, stacker & reclaimer.	16	Lecture, field-trip	assignment	Book, Video, Online source
High capacity belt conveyors – constructional detail and selection procedures. Aerial rope ways – classification, layout and constructional features. Classification, application and constructional features of crushers, breakers and feeders.	9	Lecture, field-trip	assignment	Book, Video, Online source
Total Hrs	25			

Mine System Engineering

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Mine System Engineering	CCMN0111	Theory	3-0-0(3)	Nil

1. Objective

To make the students have understanding on:

- Creative aspects of mine planning and design.
- Linear programming
- Transportation and assignment problem
- Project management and network models
- Concept of simulation and inventory management

2. Learning outcome

- Students will be able to have knowledge on mine planning and design.
- Students will be able to have knowledge on linear programming, transportation and assignment problem
- Students will be able to work on project management and network models
- Students will have knowledge on simulation and inventory management.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Course outline

Module I

Introduction to systems engineering:

Concept of system, sub system and system environment; Classification of systems; Systems analysis;

Module II

Creative aspects of planning and design; Factors influencing creativity, techniques and alternative ideas/solutions.

Module III

Linear Programming:

Linear Programming models; Assumption of linear programming, Graphical and Simple method of solving Linear Programming Problems; Basic and Basic feasible solution, optimal solution, interpretation of SIMPLEX table. Primal and Dual Problem. Application of Linear Programming for solution of mining related problems of production planning, scheduling and blending.

Module IV

Transportation and Assignment Problem:

Transportation models, Variations on Classical Transportation models, Solution. Algorithm for Transportation problem. Assignment model, Variations on Classical Assignment model; solution algorithm for Assignment problems. Application to mining problems.

Module V

Project Management with PERT & CPM:

Assumption of PERT and CPM; Methods of drawing network; Redundancy and identification of redundant jobs; Critical path calculation, Criticality index; Statistics related to PERT; Probability of completing a project by a due date, Lowest cost schedule: Case studies.

Module VI

Network Models:

Introduction and concept; shortest route and minimal spanial tree problems, application to mining problems.

Simulation: Introduction and concept; Scope and limitation; System type versus simulation technique; Generating input data; Monte Carlo simulation; Simulation of equipment maintenance and inventory systems in mines.

Module VII

Inventory management:

Introduction, components and nature of inventory problems,; Classical E.O.Q model; EOQ model with quantity discount; Static and dynamic inventory problems.

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Concept of system, sub system and system environment; Classification of systems; Systems analysis; Creative aspects of planning and design; Factors influencing creativity, techniques and alternative ideas/solutions.	4	lecture	assignment	Book, Online source
Linear Programming models; Assumption of linear programming, Graphical and Simple method of solving	3	lecture	assignment	Book, Online source

Linear Programming Problems				
Basic and Basic feasible solution, optimal solution, interpretation of SIMPLEX table. Primal and Dual Problem. Application of Linear Programming for solution of mining related problems of production planning, scheduling and blending.	4	lecture	assignment	Book, Online source
Transportation models, Variations on Classical Transportation models, Solution. Algorithm for Transportation problem.	2	lecture	assignment	Book, Online source
Assignment model, Variations on Classical Assignment model; solution algorithm for Assignment problems. Application to mining problems.	3	lecture	assignment	Book, Online source
Assumption of PERT and CPM; Methods of drawing network; Redundancy and identification of redundant jobs;	2	lecture	assignment	Book, Online source
Introduction and concept; shortest route and minimal spanial tree problems, application to mining problems.	2	lecture	assignment	Book, Online source
Introduction and concept; Scope and limitation; System type versus simulation technique; Generating input data; Monte Carlo simulation; Simulation of equipment maintenance and inventory systems in mines.	5	lecture	assignment	Book, Online source
Introduction, components and nature of inventory problems,; Classical E.O.Q model; EOQ model with	4	lecture	assignment	Book, Online source

quantity discount; Static and dynamic inventory problems.				
Total Hrs	29			

Surface Mining

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Surface Mining	CCMN0104	Theory	3-0-0(3)	Nil

1. Objective

<p>To make the students have understanding on:</p> <ul style="list-style-type: none"> • Basic concepts on surface mining • Concept on opening up of deposits • Concept on preparation for excavation • Discontinuous methods of excavation and transport • Continuous methods of excavation and transport • Conveyors • Semi continuous methods of excavation and transport • Mining of developed coal seams and dimensional stones • Slopes in surface mines
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2. Learning outcome

<ul style="list-style-type: none"> • Students will be able to understand the concept of surface mining and all other operations that are concerned with the open cast or surface mining.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Course outline

Module I

Introduction

Surface mining

basic concepts, applicability, advantages and disadvantages; Role of surface mining in total mineral production; Deposits amenable to surface mining vis-à-vis excavation characteristics; Surface mining unit operations; Surface mining systems vis-à-vis equipment systems – classification, applicability, advantages and disadvantages.

Module II

Opening up of deposits Box cut

Objective, types, parameters, methods; Factors affecting selection of box cut site; Production benches – formation, parameters and factors affecting their selection.

Module III

Preparation for excavation Ripper:

Types, classification, applicability and limitations; Method and cycle of operation; Estimation of output; Concept of rippability. Estimation of number of drills required for a given mine production.

Module IV

Discontinuous/cyclic methods of excavation and transport Shovel-dumper operation:

Applicability and limitations of electric shovel, hydraulic excavators and dumpers; Cycle time and productivity calculation for shovel and dumper; Estimation for equipment (shovel, dumper and other heavy earth moving machines) required for a given mine production; Method of work for sub-surface bedded and massive deposits and for hilly massive deposits by shovel – dumper combination. Dragline operation: Applicability and limitations, different modes of operation; Side cast diagram and calculation of reach; Cycle time and productivity calculation; Calculation of required bucket capacity for a given handling requirement; Maximum usefulness factor and its significance in selection of dragline for a given situation; Method of work by simple side casting. Scrapers: Applicability and limitations, various types; Method and cycle of operation; Pusher dozer and push-pull operation. Dozers: Applicability and limitations; Types and classification; Types of blade and corresponding merits and demerits; Method and cycle of operation. Front-end-loaders: Applicability and limitations; Method and cycle of operation; Minimum tipping- load – concept, estimation and significance; Calculation of maximum working load and selection of bucket capacity of a front-endloader for a given job condition.

Module V

Continuous methods of excavation and transport Bucket wheel excavators:

Applicability and limitations; Types and principle of operation; Operational methods – lateral block / half block method, full block methods and their corresponding merits and demerits; Calculation of productivity. Continuous surface miners: Types, classification, applicability and limitations; Principles of operation; Operational methods – classification; Wide / full bench method, block mining method and stepped cut method; Empty travel back method, turn back method and continuous mining method; Conveyor / truck loading method, side casting method and windrowing method, Respective merits & demerits and applicability & limitations of these methods.

Module IV

Conveyors:

Shiftable and high angle conveyors; Mode of operation, applicability and limitations; Merits and demerits of conveyor as a system of transportation.

Module V

Semi-continuous methods of excavation and transport Continuous excavation and partly/fully cyclic transport system:

Different methods and applicability & limitations.

Module VI

Cyclic excavation and partly/fully continuous transport system:

Different in-pit crushing and conveying methods and their respective applicability & limitations. Mining of developed coal seams and dimensional stones mining of developed coal seams: Problems associated;

Methods of working. Dimensional stones: Types, occurrences and uses; Methods vis-à-vis equipment for extraction of primary blocks in granite and marble quarries.

Module VII

Slopes in surface mines

Types of mine slope – highwall and waste dumps; Common modes of slope failure; Factors influencing stability of slopes; Slope stability assessment techniques; Waste dumps - types and formation methods; Slope protection, stabilization and monitoring.

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Surface mining - basic concepts, applicability, advantages and disadvantages; Role of surface mining in total mineral production; Deposits amenable to surface mining vis-à-vis excavation characteristics; Surface mining unit operations; Surface mining systems vis-à-vis equipment systems – classification, applicability, advantages and disadvantages.	5	Lecture, field studies	assignment	Book, online source
Opening up of deposits Box cut – objective, types, parameters, methods; Factors affecting selection of box cut site; Production benches – formation, parameters and factors affecting their selection.	2	lecture	assignment	Book, online source
Preparation for excavation Ripper: Types, classification, applicability and limitations; Method and cycle of operation;	3	lecture	assignment	Book, online source

Estimation of output; Concept of rippability. Estimation of number of drills required for a given mine production.				
Discontinuous/cyclic methods of excavation and transport Shovel-dumper operation: Applicability and limitations of electric shovel, hydraulic excavators and dumpers; Cycle time and productivity calculation for shovel and dumper; Estimation for equipment (shovel, dumper and other heavy earth moving machines) required for a given mine production;	4	Lecture, field studies	assignment	Book, online source
Method of work for sub-surface bedded and massive deposits and for hilly massive deposits by shovel – dumper combination. Dragline operation: Applicability and limitations, different modes of operation; Side cast diagram and calculation of reach; Cycle time and productivity calculation; Calculation of required bucket capacity for a given handling requirement; Maximum usefulness factor and its significance in selection of dragline for a given situation; Method of work by simple side casting.	5	lecture	assignment	Book, online source
Scrapers: Applicability and limitations, various types; Method and cycle of operation; Pusher dozer and push-pull operation. Dozers: Applicability and limitations; Types and classification; Types of blade and corresponding merits and demerits; Method and cycle of operation. Front-end-loaders: Applicability and limitations; Method and	5	Lecture, field studies	assignment	Book, online source

cycle of operation; Minimum tipping- load – concept, estimation and significance; Calculation of maximum working load and selection of bucket capacity of a front-endloader for a given job condition.				
Continuous methods of excavation and transport Bucket wheel excavators: Applicability and limitations; Types and principle of operation; Operational methods – lateral block / half block method, full block methods and their corresponding merits and demerits; Calculation of productivity.	4	lecture	assignment	Book, online source
Continuous surface miners: Types, classification, applicability and limitations; Principles of operation; Operational methods – classification; Wide / full bench method, block mining method and stepped cut method; Empty travel back method, turn back method and continuous mining method; Conveyor / truck loading method, side casting method and windrowing method, Respective merits & demerits and applicability & limitations of these methods.	5	Lecture, field studies	assignment	Book, online source
Conveyors: Shiftable and high angle conveyors; Mode of operation, applicability and limitations; Merits and demerits of conveyor as a system of transportation.	2	lecture	assignment	Book, online source
Semi-continuous methods of excavation and transport Continuous excavation and partly/fully cyclic transport system: Different methods and applicability & limitations. Cyclic	4	lecture	assignment	Book, online source

excavation and partly/fully continuous transport system: Different in-pit crushing and conveying methods and their respective applicability & limitations.				
Mining of developed coal seams: Problems associated; Methods of working. Dimensional stones: Types, occurrences and uses; Methods vis-à-vis equipment for extraction of primary blocks in granite and marble quarries.	3	lecture	assignment	Book, online source
Types of mine slope – highwall and waste dumps; Common modes of slope failure; Factors influencing stability of slopes; Slope stability assessment techniques; Waste dumps - types and formation methods; Slope protection, stabilization and monitoring	4	Lecture, field studies	assignment	Book, online source
Total (hrs)	46			

Underground Coal Mining

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Underground Coal Mining	CCMN0105	Theory	3-0-0(3)	Nil

1. Objective

To make the students have understanding on:

- Concept on underground coal mining
- Bord and Pillar Mining
- Pillar extraction
- Longwall mining
- Roof support

2. Learning outcome

- Students will be able to understand the concept of underground coal mining and all other operations that are concerned with the underground coal mining.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation
	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Course outline

Module I

Introduction:

History of coal mining;

coal resource and their geographical distributions; Coalification and factors affecting coalification process, modes of accumulation of coal, evidences in support of in-situ and drift theories;

Module II

Geological time scale vis-à-vis formation of coal, occurrence and distribution of coal in various stratigraphic horizons; Coal seam structure and abnormalities, geological and other features of Indian coalfields.

Module III

Bord and Pillar Mining:

Choice of methods of mining coal seams; factors affecting choice of mining methods.

Module IV

General principles of Bord and Pillar (B&P) development, different schemes of development and associated merits/demerits; Design of B&P workings, statutory provisions related to B&P workings, Semi-mechanised and mechanized schemes of B&P development; Mechanised face loading. Conditions suitable for mechanical loaders and continuous miners.

Module V

Pillar Extraction: Preparatory arrangement for depillaring operation, statutory provisions on depillaring; principles of designing pillar extraction, factors affecting choice of pillar extraction; partial and full extraction; depillaring with caving and stowing; mechanization in depillaring operation. Local and main fall, indications of roof weighting, measures to bring down roof at regular interval; air blast and measures to minimize its effects; precautions during depillaring operation against fire and inundation; multi-section and contiguous workings. Extraction of pillars in seams prone to bumps.

Module VI

Longwall Mining:

Factors affecting longwall mining, longwall face layouts, advancing and retreating faces, single versus double unit longwall faces, orientation of longwall faces; single versus multiple heading gate roads, factors affecting length and width of longwall panel. Extraction of Longwall panel, working with shearer

and plough, support system of longwall face and gate roads, monolithic packing in longwall advancing gate roads; case studies of longwall faces in India.

Module VII

Roof Supports: Timber props and cogs; friction/hydraulic props and chocks; other steel supports; types of roof bolts; function, applicability and advantage of roof bolting and cable bolting; powered supports; systematic support rules; supporting scheme of development gallery, B&P and L/W faces, depillaring district; withdrawal of support. Conditions requiring stowing in mines; types of stowing; suitable materials for hydraulic stowing; stowing plant and stowing range; hydraulic gradient and hydraulic profile.

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Introduction: History of coal mining; coal resource and their geographical distributions; Coalification and factors affecting coalification process, modes of accumulation of coal, evidences in support of in-situ and drift theories; Geological time scale vis-à-vis formation of coal, occurrence and distribution of coal in various stratigraphic horizons; Coal seam structure and abnormalities, geological and other features of Indian coalfields.	5	lecture	assignment	Book, Video, Online source,
Bord and Pillar Mining: Choice of methods of mining coal seams; factors affecting choice of mining methods. General principles of Bord	5	lecture	assignment, field study	Book, Video, Online source,

and Pillar (B&P) development, different schemes of development and associated merits/demerits; Design of B&P workings, statutory provisions related to B&P workings, Semi-mechanised and mechanized schemes of B&P development; Mechanised face loading. Conditions suitable for mechanical loaders and continuous miners.				
Pillar Extraction: Preparatory arrangement for depillaring operation, statutory provisions on depillaring; principles of designing pillar extraction, factors affecting choice of pillar extraction; partial and full extraction; depillaring with caving and stowing; mechanization in depillaring operation. Local and main fall, indications of roof weighting, measures to bring down roof at regular interval; air blast and measures to minimize its effects; precautions during depillaring operation against fire and inundation; multi-section and contiguous workings. Extraction of pillars in seams prone to bumps.	7	lecture	assignment, field study	Book, Video, Online source,
Longwall Mining: Factors affecting longwall mining, longwall face layouts, advancing and retreating faces, single versus double unit longwall faces, orientation of longwall faces; single versus multiple heading gate roads, factors affecting length and width of longwall panel. Extraction of Longwall panel, working with shearer and plough, support system of longwall	6	lecture	assignment, field study	Book, Video, Online source,

face and gate roads monolithic packing in longwall advancing gate roads; case studies of longwall faces in India.				
Roof Supports: Timber props and cogs; friction/hydraulic props and chocks; other steel supports; types of roof bolts; function, applicability and advantage of roof bolting and cable bolting; powered supports; systematic support rules; supporting scheme of development gallery, B&P and L/W faces, depillaring district; withdrawal of support. Conditions requiring stowing in mines; types of stowing; suitable materials for hydraulic stowing; stowing plant and stowing range; hydraulic gradient and hydraulic profile.	7	lecture	assignment, field study	Book, Video, Online source,
Total Hrs	30			

Underground Metal Mining

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Underground Metal Mining	CCMN0106	Theory	3-0-0(3)	Nil

1. Objective

To make the students have understanding on:

- Concept on underground metal mining
- Concept on development
- Stopping
- Mine support

2. Learning outcome

- Students will be able to understand the concept of underground metal mining and all other operations that are concerned with the underground metal mining.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	30	Written examination
	Assignment	5	Report and Presentation
	Learning record	5	Report and presentation

	Quiz		Surprise/preannounced ones
External Examination		60	Written examination
Total		100	

Course outline

Module I

Introduction:

Present status of Indian metal mining industry; Scope and limitations of underground mining.

Development:

Choice of level interval and back/block length; Shape, size, position, excavation and equipping of shaft station/plat, grizzly, ore/waste bin, main ore pass system, underground crushing and loading stations, underground chambers, sump and other subsidiary excavations; Arrangements for dumping into main ore pass; Underground crushing, loading and hoisting.

Module II

Cross cuts and drifts, their shape, size and position, review of excavation process, ground breaking, mucking, ventilation and support, track extension and car switching, Use of modern drilling and loading equipment in drifting, raises and winzes, their shape, size and position, excavation process, ground breaking, mucking, ventilation and support; Modern methods of raising – Alimak and Jora-lift raising, longhole method including vertical crater retreat method of raising; raise boring, systems and their details, modern methods of winzing, secondary breaking at grizzley, conventional and mechanized methods, waste handling systems in underground workings.

Module III

Stoping:

Selection of stoping methods; Classification of stoping methods; Stoping of narrow ore bodies by underhand, overhand, breast, longhole and raise mining methods; Resuing; Mining of parallel veins; Room & pillar, sublevel, large diameter blast hole/DTH, cascade, shrinkage and vertical crater retreat methods, their applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting; Haulage and dumping; Supported methods – horizontal overhand and underhand cutand-fill methods, square-set method and its variations, details of stope layouts, ground breaking, supporting, mucking, ventilation, haulage and dumping.

Module IV

Mine supports:

Timber support: Post, drift-set of various types, square-set, crib-set, cog, stull and chock/chockmat supports; forepoling/piling; load bearing capacity of timber supports; bulkheads, steel support: steel set, rigid and yielding types, tubing, wire mesh, steel lining, screw jacks and ratchet jacks; improvised steel props, friction props, hydraulic props; link bars and chocks, powered supports;

. Module V

Cement support:

Poured monolithic and reinforced concrete lining; monolithic pump packing, concrete blocks, concrete slabs, guniting and shotcreting. Rock support: Pillars of ore and waste, pack walls, masonry, walls and arches, building materials and construction, fill support : materials of backfill and their procurement; theoretical aspects of slurry transportation; preparation, transport and placement of hydraulic backfill with and without cement; Paste fills; rock and concrete fills; surface arrangement for storage and mixing; pneumatic and mechanical methods of backfilling.

Module VI

Reinforcement systems:

Materials and techniques; rock bolts and dowels – different types and uses; mechanics of bolting; point anchored rockbolts – Slot and wedge type, expansion shell type, grouted point anchor type;

Module VII

full column anchors

Wooden and fibreglass dowels, mechanical full column anchors, split sets/friction rock, stabilizers, swelllex, full column grouted rockbolts; installation and testing of rock bolts, cable bolting, its installation and applications, innovations in support and reinforcement systems for hard rock mines.

Sesion Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Introduction: Present status of Indian metal mining industry; Scope and limitations of underground mining. Development: Choice of level interval and back/block length; Shape, size, position, excavation and equipping of shaft station/plat, grizzly, ore/waste bin, main ore pass system, underground crushing and loading stations, underground chambers, sump and other subsidiary excavations; Arrangements for dumping into main ore pass; Underground crushing, loading and hoisting.	8	lecture	assignment	Book, Video, Online source
Cross cuts and drifts, their shape, size and position, review of excavation process, ground breaking, mucking, ventilation and support, track extension and car switching,	7	lecture	assignment	Book, Video, Online source

Use of modern drilling and loading equipment in drifting, raises and winzes, their shape, size and position, excavation process, ground breaking, mucking, ventilation and support;				
Modern methods of raising – Alimak and Jora-lift raising, longhole method including vertical crater retreat method of raising; raise boring, systems and their details, modern methods of winzing, secondary breaking at grizzley, conventional and mechanized methods, waste handling systems in underground workings.	6	lecture	assignment	Book, Video, Online source
Stoping: Selection of stoping methods; Classification of stoping methods; Stopping of narrow ore bodies by underhand, overhand, breast, longhole and raise mining methods; Resuing; Mining of parallel veins; Room & pillar, sublevel, large diameter blast hole/DTH, cascade, shrinkage and vertical crater retreat methods, their applicability	7	lecture	assignment	Book, Video, Online source
stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting; Haulage and dumping; Supported methods – horizontal overhand and underhand cutand-fill methods, square-set method and its variations, details of stope layouts, ground breaking, supporting, mucking, ventilation, haulage and dumping.	4	lecture	assignment	Book, Video, Online source
Mine supports: Timber support: Post, drift-set of various types, square-set, crib-set, cog, stull and chock/chockmat supports;	8	lecture	assignment	Book, Video, Online source

forepoling/piling; load bearing capacity of timber supports; bulkheads, steel support: steel set, rigid and yielding types, tubbing, wire mesh, steel lining, screw jacks and ratchet jacks; improvised steel props, friction props, hydraulic props; link bars and chocks, powered supports; . Cement support: Poured monolithic and reinforced concrete lining; monolithic pump packing, concrete blocks, concrete slabs, guniting and shotcreting				
Rock support: Pillars of ore and waste, pack walls, masonry, walls and arches, building materials and construction, fill support : materials of backfill and their procurement; theoretical aspects of slurry transportation; preparation, transport and placement of hydraulic backfill with and without cement; Paste fills; rock and concrete fills; surface arrangement for storage and mixing; pneumatic and mechanical methods of backfilling.)	5	lecture	assignment	Book, Video, Online source
Reinforcement systems: Materials and techniques; rock bolts and dowels – different types and uses; mechanics of bolting; point anchored rockbolts – Slot and wedge type, expansion shell type, grouted point anchor type; full column anchors - Wooden and fibreglass dowels, mechanical full column anchors, split sets/friction rock, stablizers, swellex, full column grouted	7	lecture	assignment	Book, Video, Online source

rockbolts; installation and testing of rock bolts, cable bolting, its installation and applications, innovations in support and reinforcement systems for hard rock mines.				
Total Hrs	44			

Rock Mechanics lab

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Rock Mechanics lab	CCMN0203	Practice	0-2-0(2)	Nil

1. Objective

<p>To make the students have practical knowledge on:</p> <ul style="list-style-type: none"> • Preparation of rock sample • determination of compressive strength, tensile strength, shear strength and triaxial strength of rock • Consolidation and compaction of soil • Stresses in rock.

2. Learning outcome

<ul style="list-style-type: none"> • Students will be able to have knowledge on rock samples for testing in laboratory • Students will be able to have knowledge on compressive strength, tensile strength, shear strength and triaxial strength of rock; Porosity of rock; Abrasivity of rock; Strength indices of rock • Students will be able to have knowledge on modulus of elasticity and Poisson's ratio; slake durability of rock; shear strength, consistency, consolidation and compaction of soil; determination of in situ stresses in rock.

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Experiments	40	Lab work
	Learning record	10	Lab report
External Examination		50	
Total		100	

Course outline

Module I

Preparation of rock sample for testing in laboratory; Methods for determination of compressive strength, tensile strength, shear strength and triaxial strength of rock; Porosity of rock; Abrasivity of rock

Module II

Strength indices of rock; Modulus of elasticity and Poisson's ratio; Slake durability of rock; Shear strength, consistency, consolidation and compaction of soil; Determination of in situ stresses in rock.

Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Preparation of rock sample for testing in laboratory	3	Workshop, lab practice		Book, Online source
Methods for determination of compressive strength, tensile strength, shear strength and triaxial strength of rock	9	lab practice		Book ,Online source
Porosity of rock; Abrasivity of rock; Strength indices of rock; Modulus of elasticity and Poisson's ratio	6	Workshop, lab practice, field studies		Book, Online source
Slake durability of rock; Shear strength, consistency, consolidation and compaction of soil; Determination of in situ stresses in rock.	12	Workshop, lab practice, field studies		Book, Online source
Total Hrs	30			

Geology for Mining Engineers lab

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Geology for Mining Engineers lab	CCMN0202	Practical	0-2-0(2)	Nil

1. Objective

To make the students have practical knowledge on:

- Topographic maps
- Calculating attitude, thickness and depth of ore bodies.
- Structural maps
- Stereographic projection

2. Learning outcome

- *Students will be able to study the topographic maps.*
- *Students will be able to calculate the attitude, thickness and depth of ore bodies.*
- *Students will be able to illustrate structural features.*
- *Students will be able to do stereographic projection.*

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Experiments	40	Lab work
	Learning record	10	Lab report
External Examination		50	
Total		100	

4. Course outline

Module I

Study of topographic maps; Completion of outcrops : 1 – and 3 – point problems; Map illustrating ‘V’ rules; Calculation of attitude, thickness and depth of ore bodies; Fracture patterns in rose diagram; Maps illustrating fold, fault and unconformity; Stereographic projection

5. Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)

Study of topographic maps; Completion of outcrops : 1 – and 3 – point problems;	9	Lab practice		
Map illustrating ‘V’ rules	6	Lab practice		
Calculation of attitude, thickness and depth of orebodies	6	Lab practice		
Fracture patterns in rose diagram; Maps illustrating fold, fault and unconformity;	9	Lab practice		
Stereographic projection	6	Lab practice		
Total (hrs)	36			

Mineralogy and Petrology lab

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
Mineralogy and Petrology lab	CCMN0201	Practical	0-2-0(2)	Nil

1. Objective

To make the students have practical knowledge on:

- Identification of certain rock forming and ore forming minerals.
- Identification of certain igneous, sedimentary and metamorphic rocks.

2. Learning outcome

- *Students will be able to identify certain rock forming and ore forming minerals by studying their physical properties.*
- *Students will be able to identify certain igneous, sedimentary and metamorphic rocks by studying their mineral composition*

3. Evaluation System

Internal Examination	Component	% of Marks	Method of Assessment
	Experiments	40	Lab work
	Learning record	10	Lab report
External Examination		50	
Total		100	

4. Course outline

Module I

Mineralogy

Study of physical properties of:

- (a) **Rock forming minerals:** Talc, Gypsum, Calcite, Fluorite, Feldspar (Orthoclase, Microcline, Plagioclase), Muscovite, Biotite, Quartz, Beryl, Tourmaline, Corundum, Kyanite, Serpentine, Garnet and Sillimanite
- (b) **Ore minerals:** Haematite, Magnetite, Chalcopyrite, Malachite, Azurite, Chromite, Bauxite, Pyrolusite, Psilomelane, Sphalerite, Galena

Module II

Petrology

Study of common rocks with reference to their structures, mineral composition and uses.

- (a) **Igneous Rocks:** Granite, Syenite, Gabbro, Basalt, Dolerite, Lamprophyre, Aplite, Pegmatite.
- (b) **Metamorphic Rocks:** Slate, Schists, Gneisses, Quartzite, Marble, Amphibolite, Charnockite.
- (c) **Sedimentary Rocks:** Conglomerate, Sandstone, Shale, Carbonaceous Shale, Coal, Limestone

5. Session Plan

Topic coverage and Internal Test	No. of Sessions (in hrs.)	Activity (lecture, tutorial, lab practice, field studies/field-trip, Workshop etc.)	Assignment (project, assignment, field study, seminar, etc.)	Suggested Reading (Book, Video, Online source, etc.)
Study of physical properties of: (A) Rock forming minerals: Talc, Gypsum, Calcite, Fluorite, Feldspar (Orthoclase, Microcline, Plagioclase), Muscovite, Biotite, Quartz, Beryl, Tourmaline, Corundum, Kyanite, Serpentine, Garnet and Sillimanite	9	Lab practice		
B). Ore minerals: Haematite, Magnetite.	6	Lab practice		

Chalcopyrite, Malachite, Azurite, Chromite, Bauxite, Pyrolusite, Psilomelane, Sphalerite, Galena				
Petrology Study of common rocks with reference to their structures, mineral composition and uses. (A) Igneous Rocks: Granite, Syenite, Gabbro, Basalt, Dolerite, Lamprophyre, Aplite, Pegmatite.	6	Lab practice		
(B) Metamorphic Rocks: Slate, Schists, Gneisses, Quartzite, Marble, Amphibolite, Charnockite.	6	Lab practice		
(C) Sedimentary Rocks: Conglomerate, Sandstone, Shale, Carbonaceous Shale, Coal, Limestone	6	Lab practice		
Total (hrs)	33			