SURFACE MINING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Sub Code	**15MN61**	**IA Marks**	**20**
Number of Lecture Hours/week	**04(L)**	**Exam Hours**	**03**
Total Number of Lecture Hours	**50**	**Exam Marks**	**80**

Credit = 04

Course objectives:

This course will enable students to:

1. Understand the basic concept of surface mining and associated methods.
2. Learn various aspects of drilling and blasting practices in open cast mines.
3. Learn application of various heavy earth moving machinery and their selection criteria.

Modules	**Teaching Hours**
MODULE- 1: Introduction	
General consideration for the applicability of opencast mining, limits of open cast mining and its advantages and disadvantages. Method of opening box cut, selection of site for box cut.	**10 Hours**
MODULE- 2: Open Pit Layout and Design	
Planning the layout and open pit mine with special reference to large mechanized mines. Optimum dimensions of open pit mines. Removal of over burden and disposal, open cast bench- number, height, width and slope angle of the bench. Factors affecting the stability of the slope. Various types of slope failures, problems on slope failures. Ground water control.	**10 Hours**
MODULE- 3: Drilling and Blasting	
Major types of drilling machines- DTH, Rotary drilling machines with tri-cone roller bits with their construction, applications, advantages and limitations. Mechanics of blasting, principles of fragmentation. Design of blasting: with special reference to heavy blasting, air blasting, ground vibration, fly rocks novel methods of drilling, smooth blasting and pre-splitting. Initiation systems: various patterns.	**10 Hours**
MODULE- 4: Surface Mining Methods and Machinery	
Casting, strip, quarrying and Placer Mining. Excavation and loading: Shovels: different types like rope shovel, hydraulic shovel, dragline, Front-end loader, Stackers, Graders. Non-Cyclic Surface Mining: Bucket Wheel Excavators and Continuous surface miners. Selection criteria of equipment their advantages and limitations.	**10 Hours**
MODULE- 5: Transport Equipment	
Dumpers, Shovel – dumper combination, high angle conveyor and in-pit crusher.	**10 Hours**

Selection criteria of equipment, advantages and limitations.	

Course outcomes:

1. An understanding of various design parameters associated with different methods of surface mining.
2. Ability to design blasting round to have desired productivity with minimum damaging effect.
3. Ability to select appropriate equipment for excavating, loading and transporting material in opencast mines.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Surface Mining Technology by S.K.Das, Lovely Prakashan, Dhanbad, 1994.
2. Surface Mining by G.B.Mishra, Dhanbad Publishers, 1978.

REFERENCE BOOKS:

1. Elements of Mining Technology, Vol. – I, D.J.Deshmukh, 6th Edition, Central Techno Publications, Nagpur, 1998.
2. Opencast Mining – R.T. Deshmukh, M. Publications, Nagpur, 1996.
3. Latest Development of Heavy Earth Moving Machinery Amithosh De, Annapurna Publishers, Dhanbad, 1995.
4. Rock Slope Engineering, Hock and Bray, The Institution of Mining and Metallurgy, 1981.
5. Introductory Mining Engineering, Hartman, John Wiley and Sons, 1987.
6. Surface Mining: The American Institute of Mining Metallurgical And Petroleum Engineers In. 1968.

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MINERAL PROCESSING & FUEL TECHNOLOGY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Sub Code	**15MN62**	**IA Marks**	**20**
Number of Lecture Hours/week	**04(L)**	**Exam Hours**	**03**
Total Number of Lecture Hours	**50**	**Exam Marks**	**80**

Credit = 04

Course objectives:

This course will enable students to:

1. To review all unit operations in mineral processing and fuel technology.
2. To understand the importance and principles of materials handling in the mineral processing plant.
3. To explain the methods of analysis of comminution theory, selection criteria for crushing, grinding and screening equipment, selection principles for mineral concentration techniques, criteria for mineral concentration equipment selection.
4. To analyze mineral beneficiation flow sheets for coal, copper, lead, iron, chromite and uranium.

Modules	**Teaching Hours**
Module 1: Fuel Technology	
Solid fuels: Wood, peat, lignite, coal, anthracite; proximate and ultimate analyses; coal characteristics for different industrial uses; characteristics of Indian coals; caking and coking properties; Liquid fuels: Petroleum - its products and testing methods. Geseous fuels: Natural gas, producer gas and water gas. **Combustion of Coal:** Mechanism of coal combustion, combustion systems (combustion stoichiometry), carbonization of coal: Low temperature carbonization, high temperature carbonization.	**10 Hours**
Module 2: Introduction to Mineral Processing, and Comminution	
Introduction: Scope, objectives and limitations of mineral processing; Liberation and beneficiation characteristics of minerals and coal. Laboratory sampling. **Comminution:** Definition, objectives and principles of comminution, theories of comminution, stages of comminution,	**10 Hours**
Module 3: Crushing, Grinding and Size Separation	
Crushing & Grinding: Different types of crushing and grinding equipment - their application and limitations; numerical Problems. **Size separation:** Laboratory size analysis and interpretation; Settling of solids in fluids; Industrial screens; Mechanical classifiers and hydro-cyclones: Numerical problems.	**10 Hours**

Module 4: Concentration Process	
Gravity concentration methods: Jigging, heavy media separation, flowing film concentration - theory, application and limitations. **Froth flotation:** Physico-chemical principles; Reagents; Machines; Flotation of sulphides, oxides and coal. **Electrical and magnetic methods of concentration**: Principles, fields of application and limitations.	**10 Hours**
Module 5: Float & Sink Test, Dewatering and Flow Sheets	
Float and sink test: procedure for float and sink test, construction of washability curves and their use/application **Dewatering**: Principles and techniques: thickening, filtration, and drying techniques. **Simplified processing/ beneficiation flow sheets**: coal, copper, lead, zinc, gold, iron, manganese ores and lime stone.	**10 Hours**

Course outcomes:

At the end of the course students will be able to:

1. Ability to understand the importance and principles of materials handling in the mineral processing plant.
2. Ability to explain the methods of analysis of comminution theories, selection criteria for crushing, grinding and screening equipment, selection principles for mineral concentration techniques, criteria for mineral concentration equipment selection.
3. Ability to analysis the mineral beneficiation flow sheets for coal, copper, lead, iron, chromite and uranium.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Fuels and Combustion, Dr. Samir Sarkar, Published by Orient Longman Ltd., 1990.
2. Mineral Processing Technology, B.A.Wills, 5th Edition, Pergamon Press.
3. Ore Processing, S.K.Jain, @nd Edition, Oxford IBH, 1990.
4. Coal Its Beneficiation, D.V. Subba Rao, M.K. Publications, 2003.

REFERENCE BOOKS:

1. Hand Book of Mineral Processing taggart, John willy & Sons, 1945.

2.Introduction to Mineral Processing Errol G.Kelly and David J. Spottiswood, John Wiley and Sons, 1982.
3. Principles of Mineral Dressing, A.K. Gaudin, TMH Edition, Tata Mc. Graw Hill, 1971.
4. Coal Conversion Technology, Edited by C.Y.Wen, Addison Wesley Publishing Company, 1979.
5. Coal Carbonisation, T.K.Basu et al., Allied Publishers, 1996.
6. The Chemistry and Technology of coal, James G. Speight, Mercel Dekker, Inc. 1994.
7. Text Book of Metallurgical Analysis, B.G.Agarwal and S.P.Jain, Khanna Publications, New Delhi, 1984. 8. Coal Preparation Practice, G.G.Sarkar, Oxford and IBH Publishing Co. 1986.
9. Coal Mining Practice – I.C.F. Statham Vol. IV, the Caxton Publishing company Ltd. Inc. 1958.

UNDERGROUND METAL MINING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Sub Code	**15MN63**	**IA Marks**	**20**
Number of Lecture Hours/week	**04(L)**	**Exam Hours**	**03**
Total Number of Lecture Hours	**50**	**Exam Marks**	**80**

Credit = 04

Course objectives:

This course will enable students to:

1. Understand the construction of the mine developments to the deposit.
2. Understand the different methods of extraction of ore blocks in metal mine.
3. Understand the modern methods of extraction of ore blocks in metal mine.
4. Understand the problems, method of extraction in deep mining and machineries used.

Modules	**Teaching Hours**
MODULE- 1: Introduction to Metal Mining and Mine Development	
Present status of Indian metal mining industry, scope and limitations of underground metal mining, Methods of developments, Choice of level interval and block length- shape, size, position; excavation and equipping of shaft station, grizzly, ore/waste bin, main ore pass system, underground crushing and loading stations, arrangements for dumping into main ore pass, Cross-cuts, drifts, and declines: their shape, size and position.	**10 Hours**
MODULE- 2:Stope and Stoping methods: Open and Unsupported	
Classification of stoping methods, factors affecting the choice of stoping methods like depth, dip, width, grade of ore, physio mechanical characteristics of ore and wall rock.Factors affecting the stope design. Open stoping/Unsupported stoping – room and pillar, sublevel, large diameter blast hole/DTH, shrinkage and vertical crater retreat methods - their applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting, haulage and dumping. Case studies.	**10 Hours**
MODULE- 3: Stoping Methods: Supported Methods	
Supported stoping – post and pillar, square set, longwall, cut and fill- their applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting, haulage and dumping. Case studies	**10 Hours**
MODULE- 4: Caving Methods:	
Stoping by Caving method – top slicing, sublevel caving, and block caving; their applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting, haulage and dumping. Case studies.	**10 Hours**
MODULE- 5: Special methods and Design of Stopes	
Solution mining, in-situ leaching, borehole mining, underground retorting, Problems of deep mining and their remedial measures. Case studies.	

Mining of parallel and superimposed veins, Pillar recovery Dilution, loss and recovery in stoping.Design of stopes: Stope design and production planning, scheduling.	**10Hours**

Course outcomes:

At the end of the course students will be able to:

1. Ability to construct the mine developments to the deposit
2. Ability to extract the ore block by different methods.
3. Ability to extract the ore block by modern methods.
4. Ability to identify the machineries used, methods of extraction and to analyse the problems in deep underground mine.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Elements of Mining Technology Vol. II – D.J.Deshmukh, 6th edition Central Techno Publication, Nagpur, 1998.
2. Introductory Mining Engg - by H.L.Hartman

REFERENCE BOOKS:

1. Underground mining methods handbook - by Hustrulid SME publication

2. Metalliferrious mining of ores - by Borosov et.al.

3. SME Mining Engineering Handbook, Edited - by H.L.Hartman SME publication

4. Techniques in Underground Mining Selection - Richard E. Gertsch et al, SME 1998

ROCK MECHANICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Sub Code	**15MN64**	**IA Marks**	**20**
Number of Lecture Hours/week	**04(L)**	**Exam Hours**	**03**
Total Number of Lecture Hours	**50**	**Exam Marks**	**80**

Credit = 04

Course objectives:

This course will enable students to:

1. To describe the importance of Rock Mechanics in the field of mining and identify of the physical and mechanical properties of rocks.
2. To understand stress and strain in rocks and the physical and mechanical properties of rocks, and failure criteria for rock and rockmass.
3. To understand the methods of in-situ strengths of rock mass, rheological models and elastic constants of rocks.

Modules	**Teaching Hours**
MODULE- 1:Introduction to Rock Mechanics:	
Definition, Scope and importance, development and application of rock mechanics in mining. Discontinuities; Description of discontinuities, Introduction to mapping and hemispherical projection of discontinuities, Barton's shear strength of joints.	**10 Hours**
MODULE- 2:Analysis of Stress and Strain	
Analysis of Stress: Introduction, definition and basic concepts, stress in a plane, (two dimensional stress), Mohr's Circle of stress, Secondary principal stress, equations of equilibrium, plane stress equations. Simple numerical problems. **Analysis of Strain**: Introduction, definition and basic concepts, strain in a plane, (two dimensional strain), Mohr's Circle of strain, equations of compatibility, stress-strain relationship, plain strain equations, elasto plastic behaviour of rocks.	**10 Hours**
MODULE- 3: Physico-Mechanical Properties of Rocks	
Definition and explanation - Specific gravity, hardness, porosity, moisture content, permeability, thermal conductivity. Compressive, tensile and shear strengths. Modulus of elasticity, Poisson's ratio and triaxial strength.Swell index, slake durability, point load index, Protodyakonov index and RQD. Creep behavior.	**10 Hours**
MODULE- 4: In-situ Strength and failure criteria of rocks	
In-situ Strength Properties of Rocks: Necessity and requirement, methods of in-situ stress measurements - Plate load test, cable jack test, borehole test, dilatometer test, flatjack test, hydraulic fracture and velocity propagation. **Failure criteria for rock**: Theories of rock failure; Coulomb, Mohr Griffith and Empirical criteria.	**10 Hours**
MODULE- 5: Rheological and Elastic Constants of Rocks	
Rheological models: Introduction, simple and complex rheological models. **Elastic constants:** Introduction and determination of static and dynamic elastic constant.	**10 Hours**

Course outcomes:

At the end of the course students will be able to:

1. Ability to describe the importance of Rock Mechanics in the field of mining and identify

of the physical and mechanical properties of rocks.
2. Ability to calculate the stress and strain in rocks and rockmass.
3. Ability to understand the time dependent behaviour by rheological models and determination of elastic constants of rocks.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Strata Mechanics in Coal Mining, Jeremic, K.L. Jeremic, Rotterdam, Balkema, 1985.
2. Fundamentals of Rock Mechanics – Jager & Cook, Methuen andco. London, 1969.

REFERENCE BOOKS:

1. Continuum Theory of rock Mechanics CsabaAsszonyi, Transtech Publications, 1979.
2. Hand Book on Mechanical Properties of rocks R.D. Lama, V.S.Vutukuri, Vol. I to IV, Transtech Publications, 1978.
3. Mechanics and Engineering, Charles Jaeger, Cambridge University Press, 1979.
4. Rock Mechanics for Underground Mining, 2nd edition, Brady and Brown, Kluwer Academic Publlishers, 1993.
5. Ground Mechanics in Hard rock Mining, M.L. Jeremic, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

Professional Elective-II

MINE DISASTERS AND RESCUE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Sub Code	**15MN651**	**IA Marks**	**20**
Number of Lecture Hours/week	**03(L) + 01(T)**	**Exam Hours**	**03**
Total Number of Lecture Hours	**40**	**Exam Marks**	**80**

Credit = 03

Course objectives:

This course will enable students to:

1. To understand the causes of mine fire and spontaneous heating.
2. To know how to tackle the mine disasters like mine fire and inundation.
3. To understand the lighting in underground and open cast mine.
4. To understand the rescue and recovery operation in a mine.

Modules	**Teaching Hours**
MODULE- 1: Mine Fires	
Mine Fires: Classification, surface and underground fires, prevention and control of underground fires, firefighting, study of atmosphere behind sealed-off area, re-opening of sealed off area.	**08 Hours**
MODULE- 2: Spontaneous Heating	
Spontaneous Heating: Mechanism, factors governing spontaneous heating, stages of spontaneous heating, symptoms of spontaneous heating in underground mines, detection and prevention of spontaneous heating, interpretation of mine air samples, Graham's Index, Problems.	**08 Hours**
MODULE- 3: Disasters	
Disasters: Types of Disasters, mechanism, ignition temperature, lag on ignition, causes and coal dust and fire damp explosions. Stone dusting, stone dust barriers and water barriers, investigation after the explosion, explosibility Limit, Problems on explosibility limit, Inundation: Causes, measures against inundation. Dewatering water logged workings, precautions to be taken when approaching old water logged workings, safety boring apparatus. Simple problems.	**08 Hours**
MODULE- 4: Mine Illumination	
Mine Illumination: Technical terms in lighting and photometry, Underground lighting, electric safety lamp, different types of portable lamps, Layout of lamp room. Methods of illumination in underground mines- fixed system, mobile system. Mine Lighting in Opencast mines: Standards of mine lighting in opencast mines, Illumination survey, Luminance calculations. Simple problem	**08 Hours**
MODULE- 5: Mine Rescue and Recovery	

Mine Rescue: Mine Rescue and equipment, short distance apparatus, self-contained breathing apparatus (not specific to any equipment), Principle of operation, advantages, self-rescuers, organization of rescue. Mine Recovery: recovery work in connection with fires, explosions and inundations.	**08 Hours**

Course outcomes:

At the end of the course students will be able to:

1. An ability to know the causes of mine fire and spontaneous heating.
2. An ability to tackle the mine disasters like mine fire and inundation.
3. An ability to design the lighting in underground and open cast mine.
4. An ability to carry out the rescue and recovery operation in a mine.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Mine Disasters and Mine Rescue, M.A. Ramulu, Oxford & IBH Publishing Co. Ltd., 1991.
2. Elements of Mine Technology Vol. II by D.J.Deshmukh, 6 th Edition, Central Techno Publications, Nagpur.

REFERENCE BOOKS:

1. Fires in Coal Mines L.C. Kaku, 2 nd Edition Oriental Publishers, 1985.
2. Mine Ventilation, S. Ghatak, Vol. I, Coal Field Publishers, Asansol, 1983. 3. Underground Mine Lighting – Torter, Vol. II, Trans Tech Publication, Frg, 1982. 4. Environmental Engineering in Mines, V.S. Vutukuri& R.D. Lama, Cambridge University Press, 1992.

Professional Elective-II

MINE SAFETY ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Sub Code	**15MN652**	**IA Marks**	**20**
Number of Lecture Hours/week	**03(L) + 01(T)**	**Exam Hours**	**03**
Total Number of Lecture Hours	**40**	**Exam Marks**	**80**

Credit = 03

Course objectives:

This course will enable students to:

1. Describing safety management system and risk management in Indian mining industries.
2. Formation of safety audits and control in mining industries.
3. Producing of risk analysis using statistical methods and analysis of mine accidents.

Modules	**Teaching Hours**
MODULE- 1: Introduction	
Need for safety management system in mining industry; Safety policy, Internal Safety Organization (ISO); structure and its functions; publicity campaign; safety competition and its awards; safety weeks.	**08 Hours**
MODULE- 2: Risk Management	
Risk Management related terms and definitions; Basic concept of risk; Difference between hazard and risk; Components and types of risks, Risk management objectives and its process; Risk analysis objectives in hazardous system life cycle; Functions of a risk manager; Hazards Identification and Risk Assessment (HIRA).	**08 Hours**
MODULE- 3: Statistical methods of Risk analysis	
Fault tree analysis, Failure Mode and Effect Analysis (FMEA); Failure Mode Effect and Critical Analysis (FMECA) - Definitions, descriptions, applications, benefits, similarities and differences between FMEA & FMECA	**08 Hours**
MODULE- 4: Mine Accident Analysis	
Accidents due to various causes and preventive measures; and Human Behavioral Approach in mine safety; accident enquiry: procedure and preparation of report.	**08 Hours**
MODULE- 5: Safety Audits and Training	
Safety audit - Objectives, Frequency, and methods; Safety Audit Process Flowchart; Baseline Data for Safety Audit;Safety management, Mine	**08 Hours**

Vocational Training Rules, 1966. Recent trends of development of safety engineering approaches.	

Course outcomes:

At the end of the course students will be able to:

1. Gain insights of safety management system and risk management in Indian mining industries.
2. Formulate safety audits and control in mining industries.
3. Produce risk analysis using statistical methods and analysis of mine accidents.

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Mine Safety by Prof. Kejriwal
2. Occupational Safety and Health in Industries and Mines by C.P.Singh
3. Indian Mining Legislation – A Critical Appraisal by Rakesh& Prasad.
4. Safety in Mines: A survey of accidents, their causes & prevention (1901 to 2000)

REFERENCE BOOKS:

1. Safety in Mines, by Prof. B. K. Khejriwal.
2. System Safety engineering and risk assessment: A practical approach, by N. J. Bahr Publisher: Taylor and Francis
3. System Safety engineering and management, by H. E. Roland and B. Moriarty Publisher: Wiley Interscience

Open Elective-II
TUNNELING ENGINEERING
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VI (Mining Engineering)

Sub Code	**15MN661**	**IA Marks**	**20**
Number of Lecture Hours/week	**03(T)**	**Exam Hours**	**03**
Total Number of Lecture Hours	**40**	**Exam Marks**	**80**

Credit = 03

Course objectives:

This course will enable students to:

1. Design tunnels, rock support and grouting and evaluate the most important issues in the procedure
2. Evaluate tunnel excavation method from technical and production aspects
3. Analyze cost and time for ordinary tunnels based on risks and construction management principles
4. Carry out a basic design of tunnel ventilation

Modules	**Teaching Hours**
MODULE- 1:	
Introduction: Scope and application, historical developments, art of tunneling, tunnel engineering, future tunneling considerations. Types of Underground Excavations: tunnel, adit, decline, shaft; parameters influencing location, shape and size; geological aspects; planning and site investigations for a tunnel.	**08 Hours**
MODULE- 2:	
Tunnelling Methods: Types and purpose of tunnels; factors affecting choice of excavation technique; Methods - soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered in tunneling and remedial measures.	**08 Hours**
MODULE- 3:	
Tunneling by Drilling and Blasting: Unit operations in conventional tunneling; Drilling - drilling principles, drilling equipment, drilling tools, drill selection, rock drillability factors; Blasting - explosives, initiators, blasting mechanics, blast hole nomenclature; types of cuts- fan, wedge and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.	**08 Hours**
MODULE- 4:	
Tunneling by Road headers and Impact Hammers: Cutting principles, method of excavation, selection, performance, limitations and problems.	**08 Hours**

Tunnelling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications.	
MODULE- 5:	
Supports in Tunnels: Different types of supports in tunneling and their applicability, NATM. Ground Treatment in Tunnelling: Adverse ground conditions and its effect on tunneling; introduction to ground control. Tunnel Services: Ventilation, drainage and pumping Tunnelling Hazards: Explosion, flooding, chimney formation, squeezing ground.	**08 Hours**

Course outcomes:

At the end of the course students will be able to:

1. Design tunnels, rock support and grouting and evaluate the most important issues in the procedure
2. Evaluate tunnel excavation method from technical and production aspects
3. Analyze cost and time for ordinary tunnels based on risks and construction management principles
4. Carry out a basic design of tunnel ventilation

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Driving Horizontal Workings and Tunnel, by Pokorovski, Mir Publishers, 1980.
2. Harbour, Dock and Tunneling Engineering by R. Srinivasan Published by R. C. Pattii, Chal'otar Book Stall, Station Road TulsiSada, Arland (W. Rly), India.

REFERENCE BOOKS:

1. Rock Mechanics and Design in Mining and Tunneling, by Bieniawski, Z.T., Rotterdam A.A. Balkema, 1984.
2. Drilling and Blasting of Rocks, by Carlos L Jimeno, A.A. Balkema/Rotterdam/Brookfield 1995.
3. Hoek, E., Brown, E. Underground excavations in Rock, CRC Press, 1980.
4. Hoek, E. and Brady, J. D. Rock Slope Engineering, Taylor and Francis, 1981
5. Nick Barton, Tunnel Boring Machines, 2000

Open Elective-II

UNDERGROUND SPACE TECHNOLOGY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Sub Code	**15MN662**	**IA Marks**	**20**
Number of Lecture Hours/week	**03(T)**	**Exam Hours**	**03**
Total Number of Lecture Hours	**40**	**Exam Marks**	**80**

Credit = 03

Course objectives:

This course will enable students to:

1. Excavation methods for construction of underground structures
2. Requirement of different machinery for excavation purposes
3. Facility design in under structures
4. Hazards associated with underground construction works

Modules	**Teaching Hours**
MODULE- 1:	
Historical: Natural caves, archeological caves and their construction, tunnels for road, rail and hydropower. Need for Underground Space: Congestion driven needs for development of infrastructure for transport, water, power supply, vehicle movement in cities, storage of materials	**08 Hours**
MODULE- 2:	
Engineering Utilities: Hydropower tunnels and caverns, underground storage for LPG, LNG, Crude and its products – basic principles. Nuclear Waste Disposal: Conditions for waste disposal, effect of radioactivity and heat on surrounding rock, conceptual design of a nuclear waste disposal facility.	**08 Hours**
MODULE- 3:	
Strategic Utilities: Defense facilities, civil shelters, navy bases, air force hangers, safety and risk assessment systems. Other Storage: Grain storage, their advantages, disadvantages, underground cold storage and cellar for foods and beverages.	**08 Hours**
MODULE- 4:	
Modern Developments: Underground ring roads in mega cities, submerged and floating tunnels, underground libraries, museums, dwelling units, resorts.	**08 Hours**
MODULE- 5:	
Traffic surveillance and control system (TSCS) in tunnels: Traffic control	**08 Hours**

signs, signals, lights, cameras. Assignment: Preparation of different underground space application plans.	

Course Outcomes:

At the end of the course students will be able to:

1. excavation methods for construction of underground structures
2. requirement of different machinery for excavation purposes
3. facility design in under structures
4. hazards associated with underground construction works

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module. Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Underground Space Design: A Guide to Subsurface Utilization and Design for People in Underground Spaces: John Carmody, Raymond Sterling:

REFERENCE BOOKS:

1. Rock Mechanics and Design in Mining and Tunneling, by Bieniawski, Z.T., Rotterdam A.A. Balkema, 1984.
2. Driving Horizontal Workings and Tunnel, by Pokorovski, Mir Publishers, 1980.
3. Harbour, Dock and Tunneling Engineering by R. Srinivasan Published by R. C. Pattii, Chal'otar Book Stall, Station Road TulsiSada, Arland (W. Rly), India.
4. Drilling and Blasting of Rocks, by Carlos L Jimeno, A.A. Balkema/Rotterdam/Brookfield 1995.
5. Hoek, E., Brown, E. Underground excavations in Rock, CRC Press, 1980.
6. Hoek, E. and Brady, J. D. Rock Slope Engineering, Taylor and Francis, 1981
7. Nick Barton,Tunnel Boring Machines, 2000

ROCK MECHANICS LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Laboratory Code	**15MNL67**	**IA Marks**	**20**
Number of Lecture Hours/week	**01 Hour Tutorial (Instructions)+02 Laboratory**	**Exam Hours**	**03**
Total Hours	**42**	**Exam Marks**	**80**

Credit = 02

Course Objectives:

This course will enable students to:

1. Prepare rock specimen for lab tests.
2. Select suitable lab testing method to determine strength of rock specimen.
3. Analyze discontinuities using hemispherical projection.

Part-A (Any one question 35 marks)

1. Plotting of Stereographic Hemispherical projections of Discontinuities
2. Determination of Rock Quality Designation of rock.
3. Preparation of rock specimens for laboratory tests.
4. Determination of uniaxial compressive strength of rocks.
5. Determination of tensile strength of rock by Brazilian test.

Part-B (Any one question 35 marks)

6. Determination of compressive strength index of rocks by using point load tester.
7. Determination of slake durability index of rocks.
8. Determination of Protodyakanov index of the given rock specimen.
9. Schmidt hammer test.
10. Determination of shear strength by direct and indirect test

Part – C: Viva Voce 10 Marks

Course Outcomes:

On the completion of this laboratory course, the students will be:

1. Ability to prepare suitable rock specimen for lab tests.
2. Ability to select suitable testing methods to determine strength.
3. Ability to plot Stereographic Hemispherical projections of Discontinuities.

Conduction of Practical Examination:

- All laboratory experiments (Part - A & Part - B) are to be included for practical examination.
- Students are allowed to pick one experiment from each of the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks
- PART –A: Procedure + Conduction + Viva: 10 + 25 +05 (40)
- PART –B: Procedure + Conduction + Viva: 10 + 25 +05 (40)
- Change of experiment is allowed only once and marks allotted to the procedure part to be made zero

MINE ENVIRONMENT AND VENTILATION LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI (Mining Engineering)

Laboratory Code	**15MNL68**	**IA Marks**	**20**
Number of Lecture Hours/week	**01 Hour Tutorial(Instructions)+02 Laboratory**	**Exam Hours**	**03**
Total Hours	**42**	**Exam Marks**	**80**

Credit = 02

Course objectives:

This course will enable students to:

1. To study the measure and monitor different types of gases in mines
2. To study ventilation survey
3. To study the handling of rescue apparatus
4. To study the dust sampling in mines

Part-A (Any one question 35 marks)

1. Assembling and dismantling of flame safety lamp
2. Assess the percentage of methane and oxygen using flame safety lamp
3. Determine the relative humidity of the atmosphere
4. Determine the quantity of air flow in a mine
5. Determine the cooling efficiency of the atmosphere

Part-B (Any one question 35 marks)

6. Determination of characteristic curves of a fan with respect mine characteristics
7. Demonstration of fire extinguishers to quench the fire
8. To determine the quantity of particulate matter using dust samplers
9. Study of gas sampling equipment and determination of CO (MSA CO detector and other equipment).
10. Demonstration of self-contained breathing apparatus, self-rescuers, and short distance apparatus.

Part – C: Viva Voce 10 Marks

Course outcomes:

On the completion of this laboratory course, the students will be:

1. An ability to measure and monitor different types of gases in mines.
2. An ability to do ventilation survey.
3. An ability to handling of rescue apparatus.
4. An ability to dust sampling in mines.

Conduction of Practical Examination:

- All laboratory experiments (Part - A & Part - B) are to be included for practical examination.
- Students are allowed to pick one experiment from each of the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks
- PART –A: Procedure + Conduction + Viva: 10 + 25 +05 (40)
- PART –B: Procedure + Conduction + Viva: 10 + 25 +05 (40)
- Change of experiment is allowed only once and marks allotted to the procedure part to be made zero