UNDERGROUND MINE PLANNING AND DESIGN
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VII (Mining Engineering)

Sub Code	15MN71	IA Marks	20
Number of LectureHours/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 principles of mining law in India and role and influence of government on mining industries. To identify software for mine planning and designing.
2. Explain the process of strategic mine planning and its impact on decision-making during project development and the factors considered in underground coal mine planning. Explain novel mining methods.
3. Illustrate surface layouts, pit bottom and pit top layouts for different transport systems.
4. Analyze and select suitable mine development and working methods.

Modules	Teaching Hours
MODULE- 1:Government Role in Mining andMine Development	
Introduction, Social-Legal-Political-Economic impacts, Environmental consequences: air, water and land pollution; causes and preventive measures. General principles of mine development, Land Acquisition, Plant silting and construction, environmental Protection and Permission, impoundments and dams.	**10 Hours**
MODULE- 2: Planning of Coal Mines	
Principles of mine planning, stages of planning of new mines: pre-feasibility report, feasibility report and DPR, selection of mine sites, geological aspects, and division of a coal field into mining areas.Surface layouts, pit bottom layout, transport system. Application of computers in mine planning.	**10 Hours**
MODULE- 3: Underground Coal Mine Design	
Mining Area, Term of life and mine capacity, division of mining property into parts, length, number and position of productive Longwall faces, dimensions of development workings.	**10 Hours**
MODULE- 4: Planning of Metal Mines	
Stope planning: Cut-off grade, evaluate stope boundaries, selection criteria for stoping methods, application of computers in stope design, economics of each stope. **Production planning**: Stope reserve, development, manpower, ore/wastehandling, equipment, essential services, production scheduling, time	

and work study for improvement of production, Optimization ofmine size (mine production capacity) based on techno-economic considerations.	
MODULE- 5: Miscellaneous	
Planning of mine closure: factors to be considered for mine closure; mine closure plan; rehabilitation.Novel and Innovative Mining Methods.	**10 Hours**

Course outcomes:
1. Knowledge of Mining laws in India and role and influence of government on mining industries and software for mine planning and designing.
2. Ability to explain Process of strategic mine planning, Factors considered in underground coal mine planning and Novel mining methods.
3. Ability to apply Surface layouts, pit bottom and pit top layouts for different transport systems.
4. Ability to analyze and select suitable mine development and working methods.

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. Advanced Coal Mining – B.M. Vorobjev&R.T.Deshmukh, Asia Publishing House, Bombay 1966.
2. Introductory Mining Engineering – Hartman, John Wiley and Sons Inc. 1987.

REFERENCE BOOKS:
1. S.M.E. Mining Engineering Handbook, Vol. I & II. Hartman, Society for Mining metallurgy and Exploration Inc. 1992. (Sections 3, 6, 7,8, 22 and 23).
2. Underground Winning of Coal – T.N. Singh, Oxford IBH, 1992.
3. Modern Coal Mining Technology – S.K.Das, Lovely Prakashan, Dhanbad, 1996.
4. Principles & Practices of Modern Coal Mining – R.D. Singh, New Age International (P) Ltd. Publishers, 1997, Section 16.
5. Mine Planning for Coal S.P.Mathur, MG Consultants Bilaspur, 1993. Mining B. Boky Mir Publishers, 1967.

<table>
<tr><td colspan="5" align="center">GROUND CONTROL
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VII (Mining Engineering)</td></tr>
</table>

GROUND CONTROL [As per Choice Based Credit System (CBCS) scheme] **SEMESTER – VII (Mining Engineering)**				
Sub Code	15MN72	**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. Knowledge of underground excavation ; stability around the excavation, subsidence and stress around the excavation
2. To comprehend the rock mass classification and support system for underground excavation
3. To monitor and predict subsidence and underground disasters
4. To design single and multiple opening and support system for underground excavations

Modules	Teaching Hours
MODULE- 1: Design and stability of structures in rock	
Definition, types of underground excavation, excavation design and constraints. Methods for design and stability analysis of underground excavations; Energy released by making an underground excavation; Design of single and multiple openings in massive, stratified and jointed rock mass. Numerical problems.	**10 Hours**
MODULE- 2: Design of mine pillars	
Mine pillars and their classification; pillar mechanics; Design of mine pillars and shaft pillar: stresses acting on pillars; stress distribution in pillars; mechanics of pillar failure; interaction of pillar, floor and roof; design of rooms and pillars; design of barrier and yield pillars, Numerical Problems.	**10 Hours**
MODULE- 3: Subsidence	
Causes and impacts of subsidence; Mechanics of surface subsidence, discontinuous and continuous subsidence; Monitoring, prediction, control and management of subsidence, prediction of subsidence using graphical and analytical method, monitoring and determination. Numerical Problems.	**10 Hours**
MODULE- 4: Caving of rock mass	
Rock caving in mining; Mechanics of rock caving; Assessment of cavability;	**10 Hours**

caving prediction and control.

Rockburst and coal bump: Phenomenology of rockbursts and coal bump; causes, prediction, monitoring and control of rockbursts; gas outbursts.

MODULE- 5: Classification of Rock Masses	
Introduction, methods and approaches: Terzaghi, RQD, Rock structure Rating, Rock Slope Rating(RSR), RMR, Q, NATM, ISRM, Paul committee Report, CMRI Classification, Limitations, Suggestion of various support system based on the classification.	**10 Hours**

Course outcomes:

1. To be familiar with the types of underground excavation and to stabilize the excavation.
2. Support the rock mass based on different properties of rock.
3. Ability to estimate the subsidence and monitor the disasters.
4. To design an opening and support system for underground.

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. Rock Mechanics and the Design of Structures in Rocks, L.Obert and W.I.Duvall, John Wiley and Sons, 1966.
2. Coal Mine Ground Control, S.Peng, John Wiley and Sons, Inc. 1978.
3. Strata Mechanics in Coal Mining, M. Jeremic, CRC Press, 1985

REFERENCE BOOKS:

1. S.M.E. Mining Engineering Hand Book, Volume I and II, Society for Mining, Metallurgy & Exploration. Inc. 1992.
2. Underground Mining Methods Hand Book, W.A. Hustralid, Society for Mining, Metallurgy & Exploration Inc. 1982.
3. Ground Mechanics in Hard Rock Mining, M.L.Jeremic, Oxford & IBH Publishing Co. New Delhi, 1986.
4. Design of Supports in Mines, C.Biron& E. Arioglu, John Wiley & Sons, New York, 1983.
5. Underground Mining Methods and Technology, Proceedings of the International Symposium, Nottingham, Elsevier 1986. Coal Mining Technology Theory and Practice Robert Stefanko SME 1983.
6. Underground Excavations in rock E. Hoek and E.T. Brown IMM, 1980. Support of Underground Excavation in Hard Rock E. Hoeket. al., Oxford and IBH 1995.

COMPUTER APPLICATION IN MINING			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – VII (Mining Engineering)			
Sub Code	15MN73	**IA Marks**	20
Number of Lecture Hours/week	04(L)	**Exam Hours**	03
Total Number of Lecture Hours	50	**Exam Marks**	80
Credit = 04			
Modules			**Teaching Hours**
MODULE- 1:Computer Aided Design			
Fundamentals of CAD, Introduction, The Design Process, The application of Computers for Design, Creating the Manufacturing Data Base, Benefits of Computer – Aided Design. **Hardware in Computer – Aided Design**: Introduction, The design Workstation, the Graphics Terminal, Operator Input Devices, Plotters and Other Output Devices, The Central Processing Unit, Secondary Storage.			**10 Hours**
MODULE- 2: Computer Graphics software and Database			
Introduction, The Software Configuration of a Graphics System, Functions of a Graphics Package, Constructing the Geometry, Transformations, Data base Structure and Content, Wire-frame Versus Solid Modeling, Other CAD Features, Application of Computers in Mining Industries.			**10 Hours**
MODULE- 3: Algorithms			
Development of algorithms in Ore Reserve Estimation, Equipment Selection, Material Handling System, Pit Configuration, Blast Design, Pillar Design, Subsidence Protection, Ventilation Network Analysis, Ground Vibration Prediction from Blasting.			**10 Hours**
MODULE- 4: Data Base Management System			
Introduction: Database Approach versus traditional file processing Approach, DBMS Administrators, Designers users, Developers, and maintenance, uses of DBMS, Data mine Package. Database System Concepts and Architecture: Architecture, Data Models, Schemes and Instances, Architecture and Data Independences, Database languages and Interfaces, Classification of Management Systems. Entity Relationship Model: Entities, Attributes, Key Attributes, relationships, Roles. Structural Constants, Weak Entity Types, E-R Diagram.			**10 Hours**
MODULE- 5: Relational Data Models and Relational Algebra and SQL - A Relational Database Language			

Relational Models concept, the relational Algebra, Additional Relational Operators, Queries in the Relational Algebra Data Definition in SQL, Views in SQL, Queries in SQL. Queries. Database Design: Normal forms based of primary keys, First, Second, Third normal forms, BCNF.	**10 Hours**

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. Fundamentals of Database Systems, Elmarsi and Navathe, 3rd edition, Wesley 2000.
2. CAD/CAM : Computer Aided Design and Manufacturing, Mikell P. Groover, Emory W. Zimmers, Jr. PHI Inida, 1989.

REFERENCE BOOKS:

1. Mine Ventilation and Air – Conditioning, Hartman, Wiley International, 1961.
2. Mine Environmental Engineering, V.S. Vutukuri& Lama, Cambridge University Press, 1986.
3. Database System Concepts, Korth, McGraw Hill, 1986.
4. CAD/CAM Theory and Practice by Zeid, Tat Mc. Graw Hill.

Professional Elective-III **OPEN PIT SLOPE ANALYSIS AND DESIGN** [As per Choice Based Credit System (CBCS) scheme] **SEMESTER – VII (Mining Engineering)**			
Sub Code	**15MN741**	**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			
Modules			**Teaching Hours**
MODULE- 1: Introduction			
Types and formation of slopes in surface mines, pit slope vis-à-vis mine economics, mechanism of common modes of slope failure, factors influencing stability of slopes, and planning of slope stability investigations.			**08 Hours**
MODULE- 2: Geotechnical Information			
Geotechnical data required for highwall slope stability studies. Collection of Geological Data and their interpretation for stability studies of highwall slopes.			**08 Hours**
MODULE- 3: Shear Strength			
Shear strength of intact rock, discontinuity surfaces, filled discontinuities and rock-mass - estimation and determination; Surface roughness, joint roughness coefficient – estimation and determination.			**08 Hours**
MODULE- 4: Water Flow			
Concepts of water flow through a material and its permeability; water flow through rock-mass, water flow through soil type material and broken spoil material; Estimation and measurement of permeability and water pressure; Graphical solution of seepage problems (flow nets), seepage forces and seepage patterns under different conditions.			**08 Hours**
MODULE- 5: Analysis and Design of Pit Slopes and Waste Dumps			
Slope stability assessment methods and techniques; Analysis and design criteria and methodology for highwall slopes and backfill and waste dumps; Probabilistic approaches of slope analysis and design.			**08 Hours**
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. Derek Martin, Peter Stacey, "Guidelines for Open Pit Slope Design in Weak Rocks", by CRCPress, ISBN 9781138298095 - CAT# K35659.

REFERENCE BOOKS:

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

Professional Elective - III			
OCCUPATIONAL HEALTH & GENERAL SAFETY			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – VII (Mining Engineering)			
Sub Code	**15MN742**	**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			
Modules			**Teaching Hours**
MODULE- 1: Introduction			
Introduction: Safety conference and their impact, Safety Education and training; Pit Safety committee, health and safety program, Feedback on safety.			**08 Hours**
MODULE- 2: Occupational Health			
Occupational Health: Safety and occupational health survey, notified and general miners diseases and their preventive measures. Permissible standard of dustiness. The Mines Rescue Rules, 1985.			**08 Hours**
MODULE- 3: Safety Rules and Regulations and Bye-Laws			
Safety Rules and Regulations: Standing order in event fire, inundation and failure of main mechanical ventilator. **Bye-Laws:** ANFO Explosive, A.C. mains firing, Bulk transportation of explosives, Diesel Locomotives.			**08 Hours**
MODULE- 4: Accidents			
Accidents: Classification of accidents, statistics, causes and preventive measures of various accidents; Accident enquiry report for accidents due to roof fall, blasting, machinery failure etc.			**08 Hours**
MODULE- 5: Accidental Planning			
Accidental Planning: Collection and presentation of accidental records, zero accidental planning (ZAP) and minimum accidental planning (MAP). Inspection for safety. Accident Compensation, Job safety Analysis.			**08 Hours**
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. Legislation in Indian Mines a Critical Appraisal, Vol. I & II, Rakesh & Prasad, Tara Book Agency, Varanasi, 1999.
2. Mine Management Legislation and General Safety, Ghatak, Coal Field Publishers, Asansol, 1998.

REFERENCE BOOKS:

1. DGMS Classified Circulars, Lovely Prakashan, 1998.
2. V.T. Rules 1966, Bare Act Publishers, 1999.
3. Indian Electrical rules 1956, Bare Act Publsihers, 1999.
4. Mine Rescue Rules 1985, Bare Act Publishers, 1999.

Professional Elective-III				
SURFACE MINE PLANNING & DESIGN				
[As per Choice Based Credit System (CBCS) scheme]				
SEMESTER – VII (Mining Engineering)				
Sub Code		**15MN743**	**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				
Modules				**Teaching Hours**
MODULE- 1: Introduction				
Stages/Phases of mine life; Preliminary evaluation of surface mining projects; Mine planning and its importance; Mining revenues and costs, and their estimation; Mine planning: stages of mine planning and planning inputs.				**08 Hours**
MODULE- 2: Ore reserve estimation and Stripping ratio				
Ore zone and bench/level compositing; Objectives and principles of ore reserve estimation; Estimation of grade at unknown point; Methods of ore reserve estimation - vertical cross section method, horizontal cross section method and 3-D geological block method. Concept of stripping ratio; Types of stripping ratios and their significance.				**08 Hours**
MODULE- 3: Geometrical considerations and Pit Planning				
Basic bench geometry; Ore access; Pit slope geometry; Addition of haul road on pit plan; Pit layouts. Development of economic block model; Pit Cut-off grade and its estimation; Ultimate pit configuration and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm, and computer assisted hand method.				**08 Hours**
MODULE- 4: Production planning and, Analysis and design of highwall slopes and waste dumps				
Determination of optimum mine size and Taylor's mine life rule; Sequencing by nested pits; Cash flow calculations; Mine and mill plant sizing, Lanes algorithm for estimation of optimum mill cut of grade;				**08 Hours**

Introduction to production scheduling. Influence of pit slope on mine economics; Highwall slope stability analysis and design methodology; Stability analysis and design methodology for waste dumps.	
MODULE- 5: Miscellaneous	
Design of haul roads: Design of road cross section; Design of road width, curves and gradient; Haul road safety features and their design. Design of drainage system in surface mines. Selection of mining system vis-à-vis equipment system. Closure of surface mines and rehabilitation.	**08 Hours**

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, S.K.Das, Lovely Prakashan, Dhanbad, 1994.
2. Surface Mining by G.B. Mishra, Dhanbad Publishers, Dhanbad, 1978.
3. Surface Mining: The American Institute of Mining Metallurgical AndPetroleum Engineers In. 1968.

REFERENCE BOOKS:

1. S.M.E. Mining Engineering hand Book Vol. I and II, Hartman, Society for Mining, Metallurgy and Exploration Inc. 1992.
2. Method of Mining, Working Coal and Metal Mines, Vol. I, II and III – Wood ruff S.D., Pergoman Press, 1968.
3. Introductory Mining Engineering – Hartman H.L. John Wiley and Sons Inc. 1987.
4. Opencast Mining – R.T. Deshmukh, M. Publications, Nagpur, 1996.
5. Latest Development of Heavy Earth Moving Machinery Amithosh De, Annapurna Publishers, Dhanbad, 1995.
6. Rock Slope Engineering, Hock and Bray, The Institution of Mining and Metallurgy, 1981.
7. Principles and Practices of Modern Coal Mining – R.D. Singh, New Age International, 1997.

<table>
<tr><td colspan="5" align="center">**Professional Elective-IV**
MINE SYSTEMS ENGINEERING
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VII (Mining Engineering)</td></tr>
<tr><td>**Sub Code**</td><td>**15MN751**</td><td>**IA Marks**</td><td colspan="2">**20**</td></tr>
<tr><td>**Number of Lecture Hours/week**</td><td>**03(L) + 01(T)**</td><td>**Exam Hours**</td><td colspan="2">**03**</td></tr>
<tr><td>**Total Number of Lecture Hours**</td><td>**40**</td><td>**Exam Marks**</td><td colspan="2">**80**</td></tr>
<tr><td colspan="5" align="center">**Credit = 03**</td></tr>
</table>

Course objectives:

This course will enable students to:

1. Identify and develop operational research models from the verbal description of the Real Systems.
2. Enables to create mathematical models that are useful to solve optimization problems.
3. Ability to estimate the optimum cost/distance in transporting the goods.
4. Able to apply the different types of strategies of game theory in decision making.
5. Able to design and develop the analytical models like PERT and CPM for planning, scheduling and controlling projects.

Modules	**Teaching Hours**
MODULE- 1: System Engineering and Linear Programming	
System Engineering: Introduction to systems concept, analysis and systems engineering. Models in systems analysis. Basic concepts of statistical decision theory. **Linear Programming:** Definition, mathematical formulation,standard form, solution space, solution-feasible, basic feasible, optimal,infeasible, multiple, optimal, Redundancy, Degeneracy, Graphical andSimplex methods.	**08 Hours**
MODULE- 2: Variants of Simplex algorithm, Simulation and Inventory Model	
Variants of Simplex algorithm – Artificial basis techniques.Duality, Economic interpretation of Dual, Solution of LPP using dualityconcept, Dual simples method. **Simulation:** Simulation techniques for equipment selection and production scheduling, Significance of management information systems in controlling and managing the mining activities. **Inventory Model**: Definition, deterministic models, probabilistic models and their applications to mining.	**08 Hours**
MODULE- 3: Transportation Problem	
Transportation Problem: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems. **Assignment Problem:** Formulation, unbalanced assignment problem, Traveling salesman problem.	**08 Hours**

MODULE- 4: Project Management Using Network Analysis and PERT CPM	
Project Management Using Network Analysis: Network construction, Network techniques for mining projects, determination of critical path and duration, floats. **PERT** –Estimation of project duration, variance. **CPM** – Elements of crashing, least cost project scheduling. Flow innetworks: Determination of shortest route, Determination of Maximum flowthrough the networks for mining project.	**08 Hours**
MODULE- 5: Queuing Theory and Game Theory	
Queuing Theory: Queuing system and their characteristics. The M/M/I Queuing system, Steady state performance analyzing of M/M/I and M/M/C queuing model. **Game Theory:** Formulation of games, Two Person - Zero sum game, games with and without saddle point, Graphical solution (2xn, mx2game), and dominance property.	**08 Hours**

Course Outcomes:

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

1. Mine Systems Engineering presents the theoretical principals and practical applications for strategic mine planning in surface and underground mining operations.
2. It covers planning and valuation methodologies applicable to metal and coal mining projects.
3. The students will explore and apply basic manual procedures, algorithms, computer applications and mathematical models for strategic mine planning.

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. Cummins .Mining Engineers Handbook, Vol. II SME, AIME, New York, 1979.
2. Sharma J.K. Mathematical Models in Operations Research. Tata Mcgraw-Hill, New Delhi, 1989.
3. Taha H.A. – Operations Research and Introduction, Mc. Millan. ISBN -0-02-418940-5.

REFERENCE BOOKS:

1. Hiller and Liberman, Introduction to Operation Research, Mc. GrawHill V Edition.

2. S.D. Sharma – Operations Research, Kedarnath, Ramnath& Co.

3. Philips, Ravindran and Soleberg – Principles of Operations Research – Theory and Practice, PHI.

4. KanthiSwarup& Others – Operations Research, Sultanch and Sons.

Professional Elective-IV			
NUMERICAL MODELLING AND INSTRUMENTATION IN ROCK MECHANICS			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – VII (Mining Engineering)			
Sub Code	15MN752	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			

Modules	Teaching Hours
MODULE- 1:Basic Concepts and Principles	
Basic Concepts: Sensitivity, range, reproducibility and accuracy, drift, absolute and relative measurements, error, environmental factors and planning for instrumentation. **Principles:** Mechanical, pneumatic, optical, vibrating wire, piezoelectric, electrical and thermal.	**08 Hours**
MODULE- 2: Field and Laboratory Instruments	
Load cells, MPBX, tape extensor meters, convergence recorders. Load, stress, deformation and strain measuring instruments.	**08 Hours**
MODULE- 3: Instrumentation monitoring	
Introduction, purpose, monitoring systems, data collection, interpretation and application in mining engineering.	**08 Hours**
MODULE- 4: Introduction to numerical modelling	
Introduction, need, domain and boundary conditions; discretisation, approach to numerical simulation for excavations in mining. Steps followed in numerical modelling.	**08 Hours**
MODULE- 5: Methods of Numerical modelling	
Methods of numerical modelling: Basic principle, advantages and their limitations of Finite difference method, finite element method, boundary element method and discrete element code.	**08 Hours**
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. Rock mechanics, instrumentation, room and pillar workings, tests: Parker, Jack. 02650.   2. Numerical Methods in Rock Mechanics, by G. N. Pande, Publisher: John Wiley & Sons Inc (June 1, 1990)
REFERENCE BOOKS:
1. Geotechnical observations and instrumentation in tunneling. Vols. 1 & 2, Report No. UILU-ENG ... Proceedings, 8th Symposium on Rock Mechanics, American Institute of Mining, Metallurgy, and Petroleum Engineering, Minneapolis, Minnesota, pp. 237-302.   2. Strata Mechanics in Coal Mining, Jeremic, K.L. Jeremic, Rotterdam, Balkema, 1985.   3. Fundamentals of Rock Mechanics – Jager & Cook, Methuen and co. London, 1969.

MINERAL PROCESSING LABORATORY			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – VII (Mining Engineering)			
Laboratory Code	**15MNL76**	**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 different types of sampling methods
2. To study the laboratory sizing and separation of particles.
3. To study the process of comminution
4. To study the settling of solids in fluids
5. To study the different types of concentration process

Part-A (Any one question 35 marks)
1. Sampling: a) Coning and quartering b) Riffle Sampling
2. Sieve analysis and interpretation of data
3. Determination of actual capacity of a jaw crusher.
4. Determination of actual capacity of a roll crusher.
5. Determination of grindability index of the given ore.
Part-B (Any one question 35 marks)
6. Determination of free settling velocities of quartz particle and comparison of the results with theoretical results.
7. Separation of heavier from the given feed using mineral jig and calculation of ratio of concentration.
8. Study of the particle movement on the deck of an operating table.
9. Separation of ferrous minerals using magnetic separator.
10. Study of the flotation of characteristics of the sulfide and oxide ore and, calculate the ratio of concentration.
Part-C (Viva Voce 10 marks)

Course Outcomes:
On the completion of this laboratory course, the students will be:
1. An ability to identify different types of sampling methods, comminution methods and concentration methods.
2. An ability to explain laboratory sizing, comminution and concentration methods.
3. An ability to interpret laboratory sizing, comminution and concentration methods.

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

COMPUTER APPLICATION IN MINING LABORATORY
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VII (Mining Engineering)

Laboratory Code	15MNL77	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 understand the draw, modify and dimensioning tools in the CAD package
2. To draw the orthographic projections
3. To draw mining Machineries using CAD tools.

Part-A (Any one question 20 marks)

1. Learning of the following commands using a CAD package.

2. Drawing Commands: Line, arc, circle, polygon, Donut, Solid, Spline Pline, Text, M Line, ellipse, dimensioning, object snaps point, Hatch, layers, Units.

3. Editing Commands: Limits, Erase, Array, Copy, Move, Offset, Stretch, Pedit, change properties, Trim, Extend, Fillet, Chamfer, Break, Mirror, Scale, Rotate, Zoom, Pan.

4. Enquiry Commands: Id, list, Dist, Area, DB list, Status Selection sets i.e. window, crossing, fence, W polygon. Plotting.

5. Simple exercises using any of the above commands

Part-B (Any one question 50 marks)

6. 08 (Eight) Exercises (Mining Drawing) using any of the above commands.

Part-C (Viva Voce 10 marks)

CourseOutcomes:

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

1. To use the draw, modify and dimensioning tools in the CAD package.
2. Ability to draw orthographic projections using CAD package.
3. Ability to draw mining Machineries using CAD tools.

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