Shri Rawatpura Sarkar University, Raipur

Examination Scheme & Syllabus

for

M.Tech.(Mining Engineering)

Semester-II

(Effective from the session: 2022-23)

Faculty of Engineering,
Shri Rawatpura Sarkar University, Raipur

M.Tech.(Mining Engineering)
Semester-II
Examination Scheme
(Effective from the session: 2022-23)

S.N	Course Code	Th/ Pr	Subject	Type of Course	Teaching hours per week			TC	Examination Scheme				Total Marks
					L	T	P		Theory		Practical		
									EX	IN	EX	IN	
1	MENMN201	Th	Mine Safety Management	Core	4	-	-	4	70	30	-	-	100
2	MENMN202	Th	Mine Ventilation and Planning	Core	4	-	-	4	70	30	-	-	100
3	MENMN203	Th	Elective –III	Core	4	-	-	4	70	30	-	-	100
	MENMN204	Th	Elective –IV	Core	4	-	-	4	70	30	-	-	100
5	MENMN202P	Pr	Mine Ventilation and Planning Lab	Core	-	-	2	1	-	-	35	15	50
6	MENMN205P	Pr	Geotechnical Engineering Lab	Core	-	-	2	1	-	-	35	15	50
7	MENMN206P	Pr	Mini Project with Seminar	Core	-	-	2	1	-	-	35	15	50
8	MENMN207P	Pr	Value Education	Core	2	-	-	-	-	-	35	15	50
	Total Contact hr per week: 22			**Total Credit: 19**					**Grand Total Marks:**				**600**

L: Lecture T: Tutorial P: Practical

Elective-III

S.NO.	Subject Name	Subject Code
1	Surface Mine Environmental Engineering	MENMN203A
2	Mine System Engineering	MENMN203B
3	Sustainable Mining Industry	MENMN203C

Elective-IV

S.NO.	Subject Name	Subject Code
1	Geo- Statistics	MENMN204A
2	Advance Underground Mine Planning and Design	MENMN204B
3	Numerical Methods in Geotechnical Engineering	MENMN204C

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<table>
<tr><td>Course Title</td><td colspan="5">MINE SAFETY MANAGEMENT</td></tr>
<tr><td>Course Code</td><td colspan="5">MENMN201</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>4</td><td>-</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Mine Safety & Legislation</td></tr>
<tr><td>Course objectives</td><td colspan="5">This course will enable students to:
Represent the problems mathematically.
Optimize the solutions.
Analyze the result numerically and linguistically by fuzzy theory.
EmphasizethemeaningandpurposeofthesetechniquesandtheiruseinsolvingEngineering Problems.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT – I
Mine accidents and their analysis
Accident in mines; - different types, accident investigations; In-depth study of accidents due to various causes; and Human Behavioral Approach in mine safety, accident prevention and corrective action, accident proneness, creating and maintaining safety awareness, ZAP and MAP, job safety analysis, safety meeting and committee.
UNIT - II
Health and mine safety
Definition of health and safety, management’s role – function; evolution of management involvement, management’s training, responsibility, cost of health and safety, role of labour organizations – Union impact and involvement, role of government – statutory controls and directions, spot and regular inspections, enforcement of standards, penalties for violations, collection and distribution of statistical data. Safety audit methods; Safety records management, Training of Miners. Recent trends of development of safety engineering approaches.
UNIT – III
Fault tree analysis
Introduction – methodology, symbols and Boolean techniques, qualitative analysis, computerized methods, statistical analysis, safety information, systems design. Appraisal of advance Techniques - fault tree analysis, Failure−Statistical methods of Risk analysis: Appraisal of advanced techniques Mode and Effect Analysis (FMEA); Failure Mode Effect and Critical Analysis (FMECA)</td></tr>
</table>

	UNIT - IV **Risk assessment and disaster management** Principles, risk and hazard control, risk and hazard evaluation and data collection for identified health risks, exposure assessment and risk characterization, probabilistic risk analysis, risk management, safety culture, human factors, reliability evaluation, safety audit. Identification of causes of mine disasters, preventive action. Concepts of Disaster, Types of Disaster and Dimensions of Natural and Anthropogenic Disasters (landslide, subsidence, fire and earthquake); Principles and Components of Disaster Management. Disaster Management and Mitigation, typical cases of mine disasters in India. **UNIT - V** **Miner's occupational diseases and enquiry committee** Miner's occupational health and diseases, preventive medical examinations, various types of injuries, compensable diseases, medical attention and removable of causative factors in the mines. Recommendations of inquiry committee carried out for safety and health issues in India.
Course Outcomes	**After the completion of course:** • This is the foundation of research and development in the computational domain of engineering and technology. • As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. • This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. Brown DB. System analysis and design for safety. Prentice Hall. 1976. 2. Stranks J. Management systems for safety. Pitman publishing. 1994. 3. DeReamer R. Modern safety practices. John Wiley and Sons. 1959. 4.
Reference Books	1. Ericson CA. Fault tree analysis primer. Create Space Independent Publishing Platform. 2011. 2. Wahab KA. New technology in health and safety. SMME. 1992.

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Course Title	**MINE VENTILATION AND PLANNING**				
Course Code	**MENMN202**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Mine Ventilation & Mine Planning**				
Course objectives	**This course will enable students to:** • Represent the problems mathematically. • Optimize the solutions. • Analyze the result numerically and linguistically by fuzzy theory. • EmphasizethemeaningandpurposeofthesetechniquesandtheiruseinsolvingEngineering Problems.				
Course Contents	**UNIT – I** **Mine Gases** Origin, occurrence, physical, chemical and physiological properties of mine gases, instruments used for spot detection of mine gases. Various damps, methane drainage techniques. Gas chromatography. **UNIT - II** **Mine Climate and Control** Sources of heat and humidity in mines and their effects, instruments used for measurement of temperature, humidity, pressure and velocity. Heat stress indices, Cooling power and method of improving cooling power. **UNIT – III** **Natural Ventilation and Laws of Air flow** Natural ventilation, Factors effecting NVP, Direction of air flow, Derivation of NVP, Motive column, Atkinson law governing airflow in mine openings. **UNIT - IV** **Mechanical Ventilation** Definition of Mechanical ventilation, Different types of fans and their characteristics, Operating point, Fan laws, installation. Ventilation appliances, economic size of roadways, determination of quantity and head requirements. Fan selection and evasee. Ventilation networks: simple and complex, solutions to simple ventilation network.				

	Introduction to Hardy cross method for solving complex network. Introduction to ventilation software's. **UNIT - V** **Ventilation Planning** Standards of ventilation, ascensional ventilation, descensional ventilation, ventilation planning for different mining methods: Bord and pillar, Longwall mining method and cut and fill, sub level caving and shrinkage stoping method.
Course Outcomes	**After the completion of course:** • This is the foundation of research and development in the computational domain of engineering and technology. • As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. • This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. Mishra GB. Mine environment and ventilation. Oxford University Press. 1992. 2. Hartman HL. Mine ventilation and air conditioning. Wiley Interscience publication.1993. 3. Hall CJ. Mine ventilation engineering. Society of mining engineers, New engineers, New York, 2 nd Edition. 1992.
Reference Books	1. Vutukuri VS. Mine environment engineering, Trans tech publishers. 1986. 2. McPherson MJ. Subsurface ventilation and environmental engineering. Chapman and hall publication, London. 1993.

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Course Title	**SURFACE MINE ENVIRONMENTAL ENGINEERING**				
Course Code	**MENMN203A**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Surface mining**				
Course objectives	**This course will enable students to:** • Represent the problems mathematically. • Optimize the solutions. • Analyze the result numerically and linguistically by fuzzy theory. • EmphasizethemeaningandpurposeofthesetechniquesandtheiruseinsolvingEngineering Problems.				
Course Contents	**UNIT – I** **Introduction** Goals, strategies and tools for environmental management – systems approach to environmental management – environmental guideline – National Policies on environment with respects to mining activities – Global and Local environmental issues – resource degradation –desertification – Industrialization, Objectives of Sustainable Development. Structure of the atmosphere – ozone layer depletion – Acid rain – Greenhouse gases and global warming. Ambient Air quality and emission standards, Air quality Sampling and monitoring, Dispersion of air pollutants. **UNIT - II** **Environmental Pollution – I** Environmental Pollutants due to surface – Air, Water, Noise, Sources and Classification of pollutants including dust and their effect on human health, Sources, hazards, sampling and analysis, standards, instrumentation and measurement of pollutants including dust, Air born dust modeling, Control and preventive measures for air pollution including for dust, , Water pollution standards, Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution. Pollution due to blast and equipment vibrations their monitoring, prevention and control. **UNIT – III** **Environmental Pollution – II** Land pollution, land for alternation dealing with mind out land, re-vegetation, tailing management, tailing dams, method and construction, land use plan, Mine closure planning. Textural classification and properties of soil. Impact of pollution on human health, miner's diseases and their social impact.				

	UNIT - IV **Environmental Management** Environmental quality objectives, Emission and ambient standards – Minimum National standards – International environmental standards – ISO 14000 –EIA Notification – Sitting of Industries – Environmental management plans, Environmental impact assessment, Environmental management system audits, Environmental economics –Principles of cost benefit analysis – Valuing the Environment – Environmental Accounting, Environmental administration-training awareness and competence, Mine subsidence, its prediction and control. **UNIT - V** **Environmental Legislations** Environmental laws, the Environmental (Protective) Act, 2004, The Water Act (1974), The Air act (1981), The Forest Act 1927, The forest conservation act 1980, Power and responsibilities of regularity agencies and occupation consent to establish and operate wild life protection act and rules , Environmental clearance procedure for a mining project.
Course Outcomes	**After the completion of course:** 3. This is the foundation of research and development in the computational domain of engineering and technology. 4. As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. 5. This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. Manahan S.E. Environmental Science and Technology. 2. Mackenthun, K.M. Basic Concepts in Environmental Management, Lewis Publications, London, 1998. 3. Noel de Nevers, Air Pollution Control Engg., McGraw Hill, New York, 1995
Reference Books	1. Anjaneyulu, Y. Air Pollution & Control Technologies, Allied Publishers (P) Ltd, India, 2002. 2. Nick Hanley, Jaison F. Shogren and Ben White. Environmental Economics – In Theory and Practice, Macmillan India Ltd, New Delhi, 1999. 3. Roger Perman, Yue Ma and James McGilvray. Natural Resources and Environmental Economics, Second edition, Addision Wesley Longman Ltd, Singapore, 1997.

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Course Title	**MINE SYSTEM ENGINEERING**				
Course Code	**MENMN203B**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Mine Safety & Legislation**				
Course objectives	**This course will enable students to:** • Represent the problems mathematically. • Optimize the solutions. • Analyze the result numerically and linguistically by fuzzy theory. • EmphasizethemeaningandpurposeofthesetechniquesandtheiruseinsolvingEngineering Problems.				
Course Contents	**UNIT – I** **Introduction** Introduction to systems engineering, systems concept and analysis, models in systems analysis, tools and methodology of system analysis. **UNIT - II** **Operations Research** Introduction to operations research, introduction to linear programming, application to mineral industry **UNIT – III** **Simulation Techniques** Introduction to Monto-carlo sampling and deterministic simulation of different mining subsystems and total system, simulation application for equipment selection and production scheduling. **UNIT - IV** **Network Analysis** Network analysis, monitoring and control of developmental activities in mining project by CPM and PERT. **UNIT - V** **Miscellaneous** Inventory of mineral resources, basic models and optimization, introduction to statistical decision theory and its application in mineral industry.				
Course Outcomes	**After the completion of course:** 1. This is the foundation of research and development in the computational				

	domain of engineering and technology. 2. As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. 3. This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. Syal, I.C., and Gupta, B.P., Computer Programming and Engineering Analysis, A.B., Wheeler and Company, Madras 1986. 2. Anon., Management by Network Analysis, The Institution of Engineers (India), 1976.
Reference Books	1. Rao, S.S., Finite Element Methods in Engineering, Pergamon Press, 1982. 2. Cummings, A.B., and Given I.V. SME Mining Engg., Handbook Vol I and II, SME-41 ME, Inc, New York, 1973.Stranks J. Management systems for safety. Pitman publishing. 1994.

Course Title	**SUSTAINABLE MINING INDUSTRY**				
Course Code	**MENMN203C**				
Course Credits	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisites	**Industrial Engineering**				
Course objectives	**This course will enable students to:** • Represent the problems mathematically. • Optimize the solutions. • Analyze the result numerically and linguistically by fuzzy theory. • EmphasizethemeaningandpurposeofthesetechniquesandtheiruseinsolvingEngineering Problems.				
Course Contents	**UNIT – I** **Introduction** Concept of Sustainable development for mining industry-Sustainable development –a perspective of mineral professional community. International sustainability reporting and tools for measurement of sustainability. Milos statement on Sustainable mineral industry. Legislative measures for sustainable development- MMRD Act- star rating of Indian mines (non-coal), Environmental responsibility – Corporate social responsibility. District mineral fund, its collection, utilization etc. **UNIT - II** Current status of mining practices and their impact on sustainability. Mining and environmental frame work, National mineral policies in mineral-based countries. Indian national mineral policy, its historical development with the changing goals and sustainable practices. Issues of leases, auctions for mineral development in India. **UNIT – III** Clean coal technologies, Coal bed methane, abandoned coal mine methane, Underground gasification of coal. Leaching of old dumps and recovery of metals. Recycling of metals. Application of new techniques for sustainable development. **UNIT - IV** Mine water- Water conservation Acts and rules in India. New Initiatives in mines. Underground mine water, Water pollution and control measures, Phyto-remediation, Sewage and effluent treatment plants, their use and benefits. Waste management- processing of overburden material for underground stowing and innovative methods for utilization of waste from				

	mines. Air quality in open pit mines, dust control measures, noise levels-pollution, monitoring and control. Bio-diversity- Land reclamation and plantation. Mine closure plan- Collection and disbursement of Mine closure fund for both open pit and underground mines in India. **UNIT - V** Best mining practices for Sustainable mining. - Case studies. Innovative practices for achievement of sustainability. Benefits of sustainability.
Course Outcomes	**After the completion of course:** 4. This is the foundation of research and development in the computational domain of engineering and technology. 5. As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. 6. This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. MMRD Act 2015 and amendments, Ministry of Mines 2. Mineral concession Rules
Reference Books	3. Rao, S.S., Finite Element Methods in Engineering, Pergamon Press, 1982. 4. Cummings, A.B., and Given I.V. SME Mining Engg., Handbook Vol I and II, SME-41 ME, Inc, New York, 1973.Stranks J. Management systems for safety. Pitman publishing. 1994.

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<table>
<tr><td>Course Title</td><td colspan="5">GEO STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MENMN204A</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>4</td><td>-</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Industrial Engineering</td></tr>
<tr><td>Course objectives</td><td colspan="5">This course will enable students to:
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<tr><td>Course Contents</td><td colspan="5">UNIT – I
Introduction to mineral exploration
Significance and necessity; Prospecting and exploration criteria; Exploration strategy and design - stages of mineral exploration; theory and methods of sampling; resources and reserves - terminology and classification schemes; conventional methods of ore estimation.
UNIT – II
Classical statistical distributions
Normal and lognormal, and their applications in resource evaluation.
Geostatistics: Definition; schools of thought; stationarity assumptions and regionalized variables; what, when and why of Geostatistics.

UNIT – III
Semi-variogram and co-variogram
Definitions, characteristics, and computations in one, two and three dimensions; mathematical models; associated difficulties viz. anisotropy, non-stationarities, regularization, presence of nugget effect and presence of trend. Extension, estimation and dispersion variance; calculation by discretization and auxiliary functions.
Kriging: Definition and derivation of Kriging system of equations. Practice of semi-variogram modeling; practice of Kriging - steps and procedure. An introduction to advanced Geostatistics.
UNIT – IV
Advanced Geostatistics
Practical difficulties associated with semi-variography, viz. anisotropy, non-</td></tr>
</table>

	stationarity, regularization, misclassified tonnage; grade control plan. presence of nugget effect and presence of trend. Extension, Estimation and Dispersion variances: definitions, methods of calculations and applications; Screen Effect. **UNIT – V** **Geostatistical applications** Optimization of exploration drilling; calculation of mineral inventory; establishment of grade-tonnage relations; misclassified tonnage; grade control plan. Geostatistical conditional simulation - theory and approach. Geostatistical case studies of selected mineral deposits.
Course Outcomes	**After the completion of course:** 1. This is the foundation of research and development in the computational domain of engineering and technology. 2. As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. 3. This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. Journel AG and Huijbregts C J. Mining geo statictics. Academic press. 1981. 2. Andereson F. Geo statictics by example approach using R. 2006
Reference Books	1. Sarma DD. Geo statistics with applications in earth sciences. Springer publications. 2009. 2. Cummings, A.B., and Given I.V. SME Mining Engg.

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<table>
<tr><td>Course Title</td><td colspan="5">ADVANCED UNDERGROUND MINE PLANNING AND DESIGN</td></tr>
<tr><td>Course Code</td><td colspan="5">MENMN204B</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>4</td><td>-</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Mine Safety & Legislation</td></tr>
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<tr><td>Course Contents</td><td colspan="5">UNIT – I
Introduction
Exploration, resource, reserve, grade, thickness and size of the deposit, the various reserve estimation techniques. Characteristics of planning process, scope of mining activities, stages of mine planning, feasibility report, detailed project report, mining plan, mine closure plan, mine environmental plan and other plans.
UNIT - II
Underground coal mining methods
Classification of methods of mining coal; factors governing choice of coal mining methods. The various underground coal mining techniques: bord and pillar, blasting gallery, continuous miner, longwall and other special techniques. Criteria for selection of different mining equipment.
UNIT – III
Design of underground coal mining methods
Pillar mining systems: design of panels, rooms and pillars; design and methods of pillar extraction with bord and pillar, blasting gallery and longwall mining: methods and design considerations for exploitation of thick seams by inclined slicing, horizontal slicing and cross-inclined slicing methods; sub-level caving and integrated caving methods. Design and methods of exploitation of contiguous seams, exploitation of seams under water bodies and seams liable to bumps. Design and method of underground hydraulic mining. Underground gassification of coal.
UNIT - IV
Underground metal mining methods</td></tr>
</table>

	Classification of exploitation methods; choice of mining systems - geomechanical, techno-economical, environmental and safety considerations. Factors governing the choice of methods. The different underground stopping methods: breast stopping, under hand and overhand, room and pillar, sublevel, square set, shrinkage, cut and fill methods and other stopping methods. **UNIT - V** **Design of underground metal mining methods** General engineering design; design methods in mining; input parameter for design - geological and other rock mass parameters; empirical, observational and analytical methods of design; design of excavations in massive elastic, stratified and jointed rocks. Design of stoping layouts for mining of different types of ore deposits. Unit operations of stoping. Mining in rockburst prone areas. Novel and innovative mining methods: hydraulic, thermal, hydrochemical and biochemical methods; marine mining and nuclear device mining systems.
Course Outcomes	**After the completion of course:** 1. This is the foundation of research and development in the computational domain of engineering and technology. 2. As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. 3. This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. Syal, I.C., and Gupta, B.P., Computer Programming and Engineering Analysis, A.B., Wheeler and Company, Madras 1986. 2. Anon., Management by Network Analysis, The Institution of Engineers (India), 1976.
Reference Books	3. Rao, S.S., Finite Element Methods in Engineering, Pergamon Press, 1982. 4. Cummings, A.B., and Given I.V. SME Mining Engg., Handbook Vol I and II, SME-41 ME, Inc, New York, 1973.Stranks J. Management systems for safety. Pitman publishing. 1994.

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<table>
<tr><td>Course Title</td><td colspan="5">NUMERICAL METHODS IN GEOTECHNICAL ENGINEERING</td></tr>
<tr><td>Course Code</td><td colspan="5">MENMN204C</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>4</td><td>-</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5"></td></tr>
<tr><td>Course objectives</td><td colspan="5">This course will enable students to:
Represent the problems mathematically.
Optimize the solutions.
Analyze the result numerically and linguistically by fuzzy theory.
EmphasizethemeaningandpurposeofthesetechniquesandtheiruseinsolvingEngineering Problems.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT – I
Introduction
Introduction: Categories of Problems in Geo- technical Engineering, Finite Difference Method, Boundary Corrections for Grids. Accuracy, Convergence and Stability. Idealization of soil behaviour; Linear, Bilinear and multi- linear, Hyperbolic, Spline function, Ramberg – Osgood‟s Model, Polynomials, Higher order elastic models, perfect plasticity, frictional. Elastic models of soil behaviour – The winkler – Filenenko- boroditch – Pasternak – Ressiener models.
UNIT - II
Seepage
Finite Difference Solution to Laplace equation for Homogeneous and Layered Soils.
UNIT – III
Consolidation
Finite Difference Solution for One Dimensional, Two and three dimensional consolidations. Multi layered systems. Consolidation of Ground for Construction Load and Static Load.
UNIT - IV
Shallow Foundations
Beams on Elastic foundations, solution by Finite Difference and – Finite Element Method (Direct Approach) Limit analysis, Lower Bound and Upper bound theories. Method of Finite difference solution of Raft foundations.
UNIT - V
Pile Foundation</td></tr>
</table>

	Pile Stresses – Static loading – Finite Element Method Solution (Direct approach) of the pile static pile capacity- wave equation - - Lateral piles by Finite Element Method (Direct Approach) and Finite Difference method.
Course Outcomes	**After the completion of course:** 1. This is the foundation of research and development in the computational domain of engineering and technology. 2. As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. 3. This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. Numerical methods in Geotechnical Engineering by C.S. Desai and J.T. Christian McGraw 2. Analytical and computer methods in foundation engineering, JE Bowles, McGraw Hill publications. 3. Foundation analysis and design, JE Bowles, McGraw Hill publications 4. Foundation analysis by RF Scott, Printice Hall
Reference Books	1. Hytenyi, Beams on Elastic Foundations – university of Michigan Press.. 2. Elastic Analysis of Soil – Foundation Interaction, APS Selvadurai – Elsevier 3. Pile Foundation Analalysis & Design by Poulos and Davis.

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<table>
<tr><td>Course Title</td><td colspan="5">MINE VENTILATION AND PLANNING LAB</td></tr>
<tr><td>Course Code</td><td colspan="5">MENMN202P</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>-</td><td>-</td><td>4</td><td>2</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Mine Ventilation & Mine Planning</td></tr>
<tr><td>Course objectives</td><td colspan="5">• To choose proper transportation system for mines depending on the geo-mining conditions of the mineral deposit.
• To calculate and analyze basic element of haulage system and winding system.
• To learn the construction and working of various haulage system and winding system.</td></tr>
<tr><td>Course Contents</td><td colspan="5">LIST OF EXPERIMENTS
1. Determination of air quantity.
2. Determination of air-cooling power.
3. Detection of mine gases and construction of mine fans.
4. Performance of evasee.
5. Performance of fans in series and parallel.
6. Determination of weisbach coefficient.
7. Study and analysis of ventilation network.
8. Study of Fire extinguishers, rescue and reviving apparatus.
9. Study of various types of stoppings and re-opening a sealed off area.
10. Konimeter, gravimetric dust sampler and personal dust sampler.</td></tr>
</table>

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<table>
<tr><td>Course Title</td><td colspan="5">GEOTECHNICAL ENGINEERING LAB</td></tr>
<tr><td>Course Code</td><td colspan="5">MENMN205P</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>-</td><td>-</td><td>4</td><td>2</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Mine Planning</td></tr>
<tr><td>Course objectives</td><td colspan="5">• To choose proper transportation system for mines depending on the geo-mining conditions of the mineral deposit.
• To calculate and analyze basic element of haulage system and winding system.
• To learn the construction and working of various haulage system and winding system.</td></tr>
<tr><td>Course Contents</td><td colspan="5">LIST OF EXPERIMENTS
1. Determination of moisture content and specific gravity of soil
2. Grain size distribution analysis and hydrometer analysis
3. Atterberg limits (liquid limit, plastic limit, shrinkage limit)
4. Field identification tests
5. Vibration test for relative density of sand
6. Standard and modified proctor compaction tests
7. Falling head permeability test and constant head permeability test
8. CBR</td></tr>
</table>