RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MINING ENGINEERING
B.TECH (1st) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

1st SEMESTER

COURSE CONTENTS

Mining Engineering

1st semester course structure

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		IA	ESE	Total
Theory										
1	Basic Science Course	BSC101	Physics I	3	1	0	4	30	70	100
2	Basic Science Course	BSC103	Mathematics – I	3	1	0	4	30	70	100
3	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
			Total(A)				**12**	**90**	**210**	**300**
Practical/Drawing/Design										
4	Engineering Science Courses	ESC102	Engineering Graphics & Design	1	0	4	3	25	25	50
5	Basic Science Course	BSC101P	Physics Lab	0	0	3	1.5	25	25	50
6	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engineering Lab / Chemistry Lab	0	0	2	1	25	25	50
			Total(B)				**5.5**	**75**	**75**	**150**
			Grand Total(A+B)				**17.5**	**165**	**285**	**450**

L-Lecture, T-Tutorial, P-Practical

IA- Internal Assessment, ESE-End Semester Examination

Course Code	**BSC101**				
Category	**Basic Science Course**				
Course Title	**Physics-I** (i) Introduction to Electromagnetic Theory – For ME (ii) Introduction to Mechanics – For Civil (iii) Oscillation, Waves and Optics - For EEE (iv) Semiconductor Physics – For CSE				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	Mathematics course with vector calculus, High-school education Mathematics course on differential equations and linear algebra				

PHYSICS-I

Course Code- BSC101 **38hrs**

Objectives:

- Understand the fundamental principles of electrostatics in vacuum, including the calculation of electric fields and potentials for various charge distributions, and solve Laplace's and Poisson's equations.
- Apply the principles of electrostatics in linear dielectric media, including the effects of electric polarization, electric displacement, and solve problems involving dielectrics.
- Analyze magnetostatics, including the application of the Bio-Savart law, calculation of static magnetic fields, and understanding the concept of vector potential.
- Understand Faraday's law of electromagnetic induction, including the calculation of EMF produced by changing magnetic flux, and analyze applications of electromagnetic braking.
- Analyze Maxwell's equations, including the derivation of the differential form of Faraday's law

Contents:

Module I: Electrostatics in vacuum **8hrs**

Electric field and electrostatic potential for a charge distribution; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution. Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and itsexpression in terms of electric field.

Module II: Electrostatics in a linear dielectric medium **4hrs**

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module III: Magneto statics **6hrs**

Bio-Savart law, Static magnetic field; vector potential and calculating it for a given magnetic field; the equation for the vector potential and its solution for given current densities.

Module IV: Magneto statics in a linear magnetic medium **4hrs**

Magnetization and associated bound currents; auxiliary magnetic field; Boundary conditions on **B** and **H**. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussionof magnetic field in presence of magnetic materials.

Module V: Faraday's law and Maxwell's equations **8hrs**

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting.

Module VI: Electromagnetic waves **8hrs**

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium- vacuum interface for normal incidence.

COURSE OUTCOMES:

1. Understand the basics of electrostatics in vacuum.
2. Understand the basics of electrostatics in material medium.
3. Analyse the basics of magneto statics in vacuum.
4. Apply the basics of magneto in magnetic material medium.
5. familiarized with the Faraday's Law and Maxwell's equation leading to the application of EMW in vacuum and in media.
6. Design and development of engineering system

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Book:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn, 1998, Benjamin Cummings.

Reference books:

1. Fundamentals of Physics Electricity and Magnetism, Halliday and Resnick, tenth edition(published 2013).
2. W. Saslow, Electricity, magnetism and light, 1st edition
3. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, TataMcGraw
4. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

Course Code	**BSC103**				
Category	**Basic Science Course**				
Course Title	**Mathematics - I** Calculus and Linear Algebra **(Option 1) for All Branch excluding CSE** Calculus and Linear Algebra **(Option 2) for CSE**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	**Pre-requisites:** High-school education				

MATHEMATICS-I

Course Code- BSC103 **40hrs**

Objectives:

- Understand and apply the concepts of evolutes and involutes, and evaluate definite and improper integrals, including the use of Beta and Gamma functions and their properties.
- Apply calculus techniques such as Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders, and L'Hospital's rule to solve problems related to indeterminate forms and Maxima and minima.
- Analyze sequences and series, including convergence tests, power series, Taylor's series, and Fourier series, and apply them to solve problems involving exponential, trigonometric, and logarithm functions, as well as evaluate surface areas and volumes of revolutions.
- Understand and apply concepts of multivariable calculus, including limit continuity and partial derivatives, directional derivatives, total derivative, tangent planes and normal lines, and solve optimization problems using the method of Lagrange multipliers.
- Analyze matrices, including the calculation of inverse and rank of a matrix, solving systems of linear equations, properties of symmetric, skew symmetric, and orthogonal matrices, determinants, eigenvalues and eigenvectors, diagonalization of matrices, and apply them to solve problems involving orthogonal transformations and the Cayley-Hamilton Theorem.

Contents:

Module I: Calculus-I **6hrs**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module II: Calculus-II **6hrs**

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Module III: Sequences and series **10hrs**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosineseries, Parseval's theorem.

Module IV: Multivariable Calculus (Differentiation) **8hrs**

Limit continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module V: Matrices **10hrs**

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

COURSE OUTCOMES:

1. To Understand the idea of applying differential and integral calculus to notions of curvature and to improper integrals.
2. To apply the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. The student will be able to analyze with functions of several variables that is essential in most branches of Engineering.
5. To develop the essential tool of matrices and linear algebra in a comprehensive manner.
6. To solve various engineering problems

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Textbooks/References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11thReprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Code	ESC101				
Category	Engineering Science Course				
Course Title	Basic Electrical Engineering				
Scheme & Credits	L	T	P	Credit	Semester I
	3	1	0	4	
Pre-requisites	Intermediate level Electricity				

Basic Electrical Engineering
Course Code- ESC101 40hrs

Objectives:

- Understand electrical circuit elements (R, L, and C), voltage and current sources.
- Calculate real power, reactive power, apparent power, and power factor in AC circuits.
- Understand autotransformer and three-phase transformer connections.
- Analyze loss components and efficiency, starting, and speed control of induction motor.
- Describe single-phase and three-phase voltage source inverters, and sinusoidal modulation.
- Describe types of batteries, and important characteristics for batteries.

Contents:

Module I : DC Circuits 7hrs

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module II: AC Circuits 7hrs

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module III: Transformers 6hrs

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module IV: Electrical Machines 8hrs

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque- speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module V: Power Converters 6hrs

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module VI: Electrical Installations 6hrs

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Outcomes:

1. To understand and analyze basic electric and magnetic circuits.
2. To Understand the working principles of electrical machines and power converters.
3. To analyse the components of low voltage electrical installations.
4. Apply electric machine for industrial applications
5. Design power converters
6. Design and implementation of electrical installations

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Suggested Text / Reference Books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Code	ESC102				
Category	Engineering Science Course				
Course Title	Engineering Graphics & Design (Theory & Lab)				
Scheme & Credits	L	T	P	Credit	Semester I
	1	0	4	3	
Pre-requisites	Basic knowledge of Computer and Solid Geometry				

ENGINEERING GRAPHICS & DESIGN

Course Code- ESC102 **Lecture - 10hrs , Lab – 60hrs**

Objectives:

- Understanding of Traditional Engineering and Computer Graphics concepts.
- Explore principles such as orthographic projection, descriptive geometry, and isometric projections.
- Familiarize students with engineering graphics software and its applications.
- Understanding of ISO and ANSI standards for coordinate dimensioning and tolerancing.
- Proficiency in interpreting technical drawings and utilizing CAD software for design and communication purposes.
- Understanding of engineering graphics principles and their relevance in the field of engineering and design.

Contents:

Traditional Engineering and Computer Graphics: **10hrs**
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Lab modules also include concurrent teaching)

Lab Module I: Introduction to Engineering Drawing **5hrs**
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Lab Module II: Orthographic Projections **5hrs**
Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

Lab Module III: Projections of Regular Solids **5hrs**
Those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Lab Module IV: and Sectional Views of Right Angular Solids **5hrs**
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Lab Module V: Isometric Projections **6hrs**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Lab Module VI: Overview of Computer Graphics **8hrs**

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Lab Module VII: Customization & CAD Drawing **8hrs**

consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

Lab Module VIII: Annotations, layering & other functions **9hrs**

applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command;orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non- parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.

Lab Module IX: Demonstration of a simple team design project **9hrs**

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associativemodels at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building.

Course Outcomes:

1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design
3. Exposure to engineering graphics standards
4. Exposure to solid modelling
5. Exposure to computer-aided geometric design
6. Exposure to creating working drawings

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Suggested Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engg Drawing, Charotar Pub House
2. Shah, M.B. & Rana B.C. (2008), Engg Drawing & Comp. Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engg Drawing, Scitech Publishers
5. Corresponding set of CAD Software Theory and User Manuals

PHYSICS LABORATORY

Course Code: BSC101P

List of Experiments:

1. Experiments on electromagnetic induction and electromagnetic breaking.
2. LC circuit and LCR circuit
3. Resonance phenomena in LCR circuits
4. Magnetic field from Helmholtz coil
5. Measurement of Lorentz force in a vacuum tube
6. Coupled oscillators
7. Experiments on an air-track
8. Experiment on moment of inertia measurement
9. Experiments with gyroscope
10. Resonance phenomena in mechanical oscillators
11. Frank-Hertz experiment
12. Photoelectric effect experiment
13. Recording hydrogen atom Spectrum
14. Diffraction and interference experiments (from ordinary light or laser pointers)
15. measurement of speed of light on a table top using modulation
16. minimum deviation from a prism

BASIC ELECTRICAL ENGINEERING LABORATORY

Course Code: ESC101P

List of experiments:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope).Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
9. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Note: 1. At least eight experiments should be performed from the above list.

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MINING ENGINEERING
B.TECH (2nd) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

2nd SEMESTER

COURSE CONTENTS

Mining Engineering

2nd semester course structure

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		IA	ESE	Total
Theory										
1	Basic Science Course	BSC105	Physics -II	3	1	0	4	30	70	100
2	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
3	Basic Science Course	BSC104	Mathematics –II	3	1	0	4	30	70	100
4	Engineering Science Courses	ESC103	Programming for Problem Solving	3	1	0	4	30	70	100
5	Humanities and Social Sciences including Management Courses	HSMC101	English	2	0	2	3	30	70	100
Total(A)							**19**	150	350	500
Practical/Drawing/Design										
6	Engineering Science Courses	ESC104	Workshop/ Manufacturing Practices	1	0	4	3	25	25	50
7	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engg. Lab / Chemistry Lab	0	0	2	1	25	25	50
8	Engineering Science Courses	ESC103P	Programming for Problem Solving	0	0	2	1	25	25	50
Total(B)							**5**	**75**	**75**	**150**
Grand Total(A+B)							**24**	**225**	**425**	**650**

L-Lecture, T-Tutorial, P-Practical

IA- Internal Assessment, ESE-End Semester Examination

Course Code	BSC105				
Category	Basic Science Course				
Course Title	Course contents in Physics-II (i) Introduction to Quantum Mechanics for Engineers – For EEE, CSE (ii) Mechanics of Solid – For Civil, ME				
Scheme & Credits	L	T	P	Credit	Semester II
	2	1	0	3	
Pre-requisites	Mathematics course on differential equations and linear algebra Introduction to Electromagnetic Theory Semiconductor Physics				

PHYSICS-II
Course Code - BSC105 40hrs

Objectives:

- Understand and apply free body diagrams for typical supports and joints.
- Understand stress transformation and principal stresses using Mohr's circle.
- Describe one-dimensional material behavior, including concepts of elasticity, plasticity, strain hardening, and failure
- Calculate bending stress, shear stress, and analyze cases of combined stresses.
- Analyze deflection due to bending and integrate the moment-curvature relationship for simple boundary conditions.

Contents:

Module I: Statics 10hrs

Free body diagrams on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions; Friction: limiting and non-limiting cases; Force displacement relationship; Geometric compatibility for small deformations.

Module II: Stress and Strain at a point 6hrs

Concept of stress at a point; Planet stress: transformation of stresses at a point, principal stressesand Mohr's circle; Displacement field; Concept of strain at a point; Planet strain:transformation of strain at a point, principal strains and Mohr's circle.

Module III: Material behavior 7hrs

One- dimensional material behaviour; Concepts of elasticity, plasticity, strain hardening, failure (fracture / yielding); Idealization of one-dimensional stress-strain curve; Generalized Hooke's law with and without thermal strains for isotropic materials.

Module IV: Force analysis 8hrs

Force analysis — axial force, shear force, bending moment and twisting moment diagrams of slender members (without using singularity functions); Moment curvature relationship for pure bending of beams with symmetric cross-section; Bending stress; Shear stress; Cases of combined stresses.

Module V: Strain energy 9hrs

Concept of strain energy; Yield criteria; Deflection due to bending; Integration of the moment-curvature relationship for simple boundary conditions; Method of superposition (without using singularity functions); Strain energy and complementary strain energy for simple structural elements (i.e. those under axial load, shear force, bending moment and torsion).

Course Outcomes:

1. To familiarize students of civil and mechanical Engineering with the understanding of the elasticand plastic behavior of solids.
2. To understand the importance of stress and strain at a point on solid.
3. To be able to do force analysis and understand strain energy of solid.
4. Apply force analysis for engineering applications
5. Design sustainable engineering system
6. Implementation of engineering physics into complex system design for industrial applications

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Reference books:

1. An Introduction to the Mechanics of Solids, 2nd ed. with SI Units - SH Crandall, NC Dahl & TJ Lardner
2. Engineering Mechanics: Statics, 7th ed. — JL Meriam
3. Engineering Mechanics of Solids — EP Popov

Course Code	BSC102				
Category	Basic Science Course				
Course Title	Chemistry-I Contents (i) Chemistry-I (Concepts in chemistry for engineering) (ii) Chemistry Laboratory				
Scheme & Credits	L	T	P	Credit	Semester I
	3	1	0	4	
Pre-requisites	Knowledge of intermediate level chemistry				

CHEMISTRY-I
Course Code- BSC102 42hrs

Objectives:

- Describe the forms of hydrogen atom wave functions and their spatial variations.
- Analyze electronic spectroscopy, fluorescence, and their applications in medicine.
- Explain equations of state of real gases and critical phenomena.
- Estimate entropy and free energies, and their applications in chemical equilibria.
- Describe effective nuclear charge, penetration of orbitals, and variations of s, p, d, and f orbital energies in the periodic table.
- Introduce reactions involving substitution, addition, elimination, oxidation, reduction, cyclization, and ring openings.

Contents:

Module I: Atomic and molecular structure 12hrs

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions toexplore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module II: Spectroscopic techniques and applications 8hrs

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

Module III: Intermolecular forces and potential energy surfaces 4hrs

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module IV: Use of free energy in chemical equilibria 6hrs

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties and Stereochemistry **8hrs**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurationsand symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Module 6: Organic reactions and synthesis of a drug molecule **4hrs**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Outcomes:

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalise bulk properties and processes using thermodynamic considerations.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5. List major chemical reactions that are used in the synthesis of molecules.
6. Apply chemical reactions in industry applications

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	2	1	2	2	2	2	1	2	-	-	-	-	-	-
CO2	L3	3	3	2	2	2	2	2	2	2	-	-	-	2	-	-
CO3	L2	2	2	1	2	2	2	3	2	-	-	-	2	-	-	2
CO4	L3	2	1	1	3	3	1	3	-	1	-	-	-	-	-	-
CO5	L1	3	2	3	1	3	3	1	-	2	-	-	-	2	-	-
CO6	L2	3	3	-	-	3	-	1	-	-	-	-	2	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Textbooks:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engg Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6 Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5thEdition

Course Code	BSC104				
Category	Basic Science Course				
Course Title	**Mathematics – II** **Contents** Calculus, Ordinary Differential Equations and Complex Variable **(Option 1) for All branches excluding CSE** Probability and Statistics **(Option II) for CSE**				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester**
	3	**1**	**0**	**0**	**II**
Pre-requisites	**Elementary Knowledge of calculus, Probability and Statistics**				

Mathematics – II
Course Code- BSC104 **40hrs**

Objectives:

- Understand multiple integration, including double integrals in Cartesian coordinates, change of order of integration, and change of variables to polar coordinates.
- Solve exact, linear, and Bernoulli's equations, as well as Euler's equations.
- Solve Cauchy-Euler equations.
- Understand elementary analytic functions such as exponential, trigonometric, and logarithmic functions and their properties.
- Understand Taylor's series, zeros of analytic functions, singularities, and Laurent's series.

Contents:

Module I: **Multivariable Calculus (Integration):** **10hrs**

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities);Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module II: First order ordinary differential equations: **06hrs**

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module III: Ordinary differential equations of higher orders: **08hrs**

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module IV: Complex Variable - Differentiation: **08hrs**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable - Integration: **08 hrs**

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Outcomes:

1. To familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables.
2. To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.
3. Analyze high order ordinary differential equation
4. Apply complex variables for differentiation
5. Apply Integration of complex variables for different problems.
6. Design and implementation of mathematical analysis for problem solving in engineering.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L2	3	2	2	3	2	-	2	-	-	-	-	-	-	-	-
CO2	L3	2	2	3	1	2	1	3	2	-	-	-	-	1	-	-
CO3	L4	1	3	1	2	3	2	2	1	-	-	-	-	-	-	2
CO4	L3	1	3	2	2	3	2	-	2	1		-	-		2	
CO5	L3	3	2	2	2	1	3	-	2	-	1	-	-	1	-	-
CO6	L5	3	1	1	3	1	-	-	-	-		-	-		-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Textbooks/References:

1. G.B. Thomas & R.L. Finney, Calculus & Analytic geometry, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, An Introduction to Ordinary Differential Equations, PHI, 1995.
6. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
7. J. W. Brown & R. V. Churchill, Complex Variables & Appln, Mc-Graw Hill, 2004.
8. N.P. Bali and Manish Goyal, Engineering Mathematics, Laxmi Pub, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Code	ESC103				
Category	Engineering Science Course				
Course Title	Programming for Problem Solving				
Scheme & Credits	L	T	P	Credit	Semester II
	3	0	0	3	
Pre-requisites	Basic Knowledge of Computer and Mathematics				

PROGRAMMING FOR PROBLEM SOLVING

Course Code- ESC103 **40hrs**

Objective:

- Define an algorithm and its representation using flowcharts or pseudo code.
- Understand conditional branching and loops.
- Define and utilize arrays, including 1-D and 2-D arrays.
- Implement basic sorting algorithms such as Bubble, Insertion, and Selection sort.
- Understand parameter passing in functions, including call by value.
- Define structures and arrays of structures.

Contents:

Module I: Introduction to Programming **6hrs**

Introduction to components of a computer system (disks, memory, processor, where a program isstored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Module II: Arithmetic expressions and precedence **12hrs**

Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching**,** Iteration and loops

Module III: Arrays **3hrs**

Arrays (1-D, 2-D), Character arrays and Strings

Module IV: Basic Algorithms, Searching, Basic Sorting Algorithms **4hrs**

(Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Module V: Function and Pointers **6hrs**

Functions (including using built in libraries), Parameter passing in functions, call by value,Passing arrays to functions: idea of call by reference, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linkedlist (no implementation).

Module VI: Recursion and Structure **9hrs**

Recursion, as a different way of solving problems. Example programs, such as Finding, Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort. Structures, Defining structures and Array of Structures.

Course Outcomes:

1. Able to formulate simple algorithms for arithmetic and logical problems
2. Able to translate the algorithms to programs (in C language).
3. Able to apply test and execute the programs and correct syntax and logical errors.
4. Able to implement conditional branching, iteration and recursion.
5. To use arrays, pointers and structures to formulate algorithms and programs.
6. To apply programming to solve matrix addition and multiplication problems and searching andsorting problems.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Suggested Text Books

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall of India.

Course Code	HSMC101				
Category	Humanities and Social Sciences including Management Courses				
Course Title	English				
Scheme & Credits	L	T	P	Credit	Semester II
	2	0	2	3	
Pre-requisites	Basic Knowledge of English grammar and composition				

ENGLISH

Course Code- HSMC101 38hrs

Objectives:

- Learn synonyms, antonyms, and standard abbreviations.
- Understand sentence structures and the use of phrases and clauses.
- Identify and correct errors in subject-verb agreement, noun-pronoun agreement, misplaced modifiers, articles, prepositions, redundancies, and clichés.
- Learn techniques for describing, defining, classifying, providing examples or evidence in writing.
- Learn the art of précis writing and essay writing.
- Improve pronunciation, intonation, stress, and rhythm in oral communication.

Contents:

Module 1: Vocabulary Building 6hrs

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms and standard abbreviations.

Module 2: Basic Writing Skills 6hrs

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely.

Module 3: Identifying Common Errors in Writing 7hrs

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés.

Module 4: Nature and Style of sensible Writing 6hrs

Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

Module 5: Writing Practices 6hrs

Comprehension, Précis Writing, Essay Writing,

Module 6: Oral Communication 7hrs

(This unit involves interactive practice sessions in Language Lab)

Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Every day, Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.

COURSE OUTCOMES:

1. The student will acquire basic proficiency in English
2. Apply proficiency in English for enhancing basic writing skills
3. Apply proficiency in English for identify common errors in writing.
4. Analyze different nature and style of writing.
5. Development of writing skill in individuals
6. Enhance communication lead to draft engineering project proposals.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Suggested Textbooks:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Course Code	ESC104				
Category	Engineering Science Course				
Course Title	Workshop/Manufacturing Practices (Theory & Lab)				
Scheme & Credits	L	T	P	Credit	Semester II
	1	0	4	3	
Pre-requisites	Basic Knowledge of Physics, Chemistry and Mathematics				

WORKSHOP/MANUFACTURING PRACTICES

Course Code- ESC104 **Theory-10hrs**

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 hrs)**
2. CNC machining, Additive manufacturing **(1 hrs)**
3. Fitting operations & power tools **(1 hrs)**
4. Electrical & Electronics **(1 hrs)**
5. Carpentry **(1 hrs)**
6. Plastic Moulding, glass cutting **(1 hrs)**
7. Metal casting **(1 hrs)**
8. Welding (arc welding & gas welding), brazing **(1 hrs)**

WORKSHOP PRACTICE

Lab-60hrs

1. Machine shop **(10 hrs)**
2. Fitting shop **(8 hrs)**
3. Carpentry **(6 hrs)**
4. Electrical & Electronics **(8 hrs)**
5. Welding shop **(8 hrs (Arc welding 4 hrs + gas welding 4 hrs))**
6. Casting **(8 hrs)**
7. Smithy **(6 hrs)**
8. Plastic Moulding & Glass Cutting **(6 hrs)**

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan & A. Suresh Babu, "Mfg. Tech- I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, PHl, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I & Vol. II, Tata McGrawHill House, 2017.

CHEMISTRY LABORATORY
Course Code- BSC102P

List of Experiments:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary visco meters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Note: 1. At least eight experiments should be performed from the above list.

PROGRAMMING FOR PROBLEM SOLVING
Course Code: ESC103P

List of Experiments:

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: File operations

Note: 1. At least eight experiments should be performed from the above list.

RADHA GOVIND UNIVERSITY, RAMGARH

MINING ENGINEERING B. Tech,
Semester III (Second year]
Course Structure

3rd Semester Course Structure

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1	BSC301	Mathematics-III	3	1	0	4
2	MN301	Introduction to Mining Technology	3	0	0	3
3	MT301	Materials Engineering	3	0	0	3
4	CE302	Surveying and Geomatics - I	3	0	0	3
5	MN302	Mine Geology	3	0	0	3
6	BSC302	Environmental Science	3	0	0	0
7	MN301P	Introduction to Mining Technology - Lab	0	0	3	1
8	CE302P	Field Surveying Lab	0	0	3	1
9	MN302P	Mining Geology Lab	0	0	3	1
10	EX301	Extra-Curricular Activity – III (NSO/NSS/NCC/YOGA/CA/Mini Project, etc.)	0	0	2	1
11	HS301	Communication Skill Lab	0	0	2	1
	Total Credit					21

MATHEMATICS-III

Course code: BSC301 **40hrs**

Objective:

- Learn the technique of inverse Laplace transformation and the convolution theorem
- Learn numerical differentiation, integration methods such as Newton-Cotes quadrature formula, and numerical techniques for solving differential equations
- Understanding of Z-Transform and Difference Equations
- Learn about the properties of Fourier series, Fourier transformation, and inverse Fourier transformation

Module-I **8hrs**

Laplace Transformation: Laplace Transformation and its properties, Periodic function, Unit step function and impulse function .Inverse Laplace Transformation, Convolution Theorem, Applications of Laplace transforms in solving certain initial value problems & simultaneous differential equations**.**

Module-II **10hrs**

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton-Gregory forward and backward formula, Lagrange's formula, Inverse Interpolation by Lagrange's formula. Numerical Differentiation and Numerical Integration, Newton Cotes Quadrature formula, Trapezoidal rule, Simpson's 1/3"rule, Simpson's3/8"rule.

Module-III **6hrs**

Z-Transform & Inverse Z-Transform- Properties - Initial and Final value theorems, Convolution theorem- Difference equations. Solution of difference equations using Z-Transformation.

Module-IV **8hrs**

Fourier Series &Fourier Transform: Expansion of- Algebraic, Exponential & Trigonometric functions in Fourier series, Change of interval, Even and odd function, half ranges in e and cosine series, Complex form of Fourier series. Fourier Transformation and inverse Fourier Transformation, Fourier sine & cosine transforms. Convolution theorem for Fourier transforms with simple illustrations.

Module-V **8hrs**

Partial Differential Equations: Formation of partial differential equations, Linear partial differential equations of first order, Lagrange's linear equation, Non-linear equations of first order, Charpit's method Solution of one-dimensional Wave equation & Heat equation by the method of separation of variables and its applications.

Course Outcomes:

1. Intuitive meaning and Methods of finding integration definite integration and its properties.
2. Application of Integration in finding Area, volume of irregular shapes.
3. Methods of solving differential equation of first order and first degree.
4. Methods for finding approximate roots by using bisection, Regula -falsi, Newton-Raphson method, Gauss elimination, Jacobi and Gauss-Seidal methods.
5. Use of Binomial, Normal and Poisson distributions for solving different examples.
6. Use of Laplace transform for solving problems of Differential Equations.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	2	--	--	--	--	3	1	--	--	--	1	3	2	2
CO2	L4	3	2	1	1	--	--	1	1	--	--	--	1	3	1	1
CO3	L5	3	2	1	1	--	--	1	1	--	--	--	1	3	1	1
CO4	L4	3	2	1	1	--	--	1	1	--	--	--	1	3	3	2
CO5	L3	3	2	1	--	--	--	1	1	--	--	--	1	3	2	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books

1. Irwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,
2. Ramana R.V, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 2010.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition,

Reference Books

1. R.J. Beerends. H. G. TerMorsche, J. C. Van Den Berg. L. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
2. Sastry S.S. Introductory Methods of Numerical Analysis, PHI

MN301	INTRODUCTION TO MINING TECHNOLOGY	3L:0T:0P	3 Credits

Course Objective

When the students enter the college to pursue a degree in Mining Engineering and as well pursue a career in Mining Engineering after graduation, they need to understand the breadth and depth available in this field for possible engagement. When many alternative disciplines of engineering appear to offer apparently more glamorous avenues for advancement, the Mining Engineering student should realize the potentials available in this engineering discipline. The students should understand the enormous possibilities available for creative and innovative works in this all pervasive field of engineering.

This course is designed to address the following:

- to give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Mining Engineering
- to motivate the student to pursue a career in one of the many areas of Mining Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

Modules

Module 1: Definition and scope of mining:

Mining as a basic industry, definition of mining terms. Economic importance of mining, Social and environmental impact of mining.

Module 2:

Boring:

Principle of boring and purpose of boreholes; methods of boring; rotary and percussive boring methods borehole deflection and deviation.

Module 3:

Explosives and Blasting:

Definition, Classification, Basic ideas about coal and rock drilling, basic ideas about the use of explosives in rock breaking concerning shaft sinking, drifting and drivages of adit.

Module 4:

Opening of mineral deposits:

Types of mine opening, selection, location, shape and size of different types of opening, drivage methods for adits and incline drifts and cycle of operation, support of incline drift and their mouth.

Module 5:

Shaft sinking: Conventional methods of shaft sinking, shaft lining (temporary and permanent), surface arrangements, ventilation, pumping and illumination arrangement during shaft sinking, shaft fittings. Pit top and Pit bottom layouts Opening and development of mineral deposits, method of working, ventilation, transportation, hoisting and dispatch.

Module 6:

Overview of Underground Mining:

Coal: Bord and Pillar method, Longwall method

Metal: Various stopping methods like open stopping, cut and fill stopping, shrinkage stopping, sub level stopping, block caving etc.

Module 7:

Overview of Surface Mining:

Types of surface mine, unit operation, basic bench geometry, applicability and limitation, advantages and disadvantages.

Text/Reference Books:

1. Introductory mining engineering-, Howard L. Hartman, Jan M. Mutmansky/ Wiley India (P) Ltd
2. Elements of mining technology Vol.-I - D.J. Deshmukh /Denett & Company
3. Roy Pijush Pal, Blasting in ground excavations and mines, Oxford and IBH, 1st Ed. 1993
4. C.P. Chugh, Drilling technology handbook, Oxford and IBH, 1sted, 1977.

Goals & Outcomes:

- Introduction to what constitutes Mining Engineering
- Identifying the various areas available to pursue and specialize within the overall field of Mining Engineering
- Exploration of the various possibilities of a career in this field
- Providing inspiration for doing creative and innovative work
- Highlighting possibilities for taking up entrepreneurial activities in this field

Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering

MATERIAL ENGINEERING

Course code -MT 301 **42hrs**

Objectives:

- To increasing demand of the available materials, coupled with new applications and requirements has brought about many changes in the style of their uses.
- To develop the basic knowledge of metals, polymers composites and ceramics other than conventional metals and alloys to apply them to advance engineering applications.

Contents:

Module – I **5hrs**

Introduction – Crystalline and Non crystalline solids, Classification of Engineering materials and their selections, Bonding in solids: Ionic, Covalent and Metallic bonding.

Module – II **12hrs**

Crystal Structure- Space lattices, Bravais lattices, Crystal system, Unit Cell, Metallic crystal structures: SC, BCC, FCC, HCP structures, Miller notations of planes and directions, Imperfections in crystal: Point defects, Line surface defects. Dislocations: Edge and Screw dislocation, Burgers vectors.

Module – III **10hrs**

Metallic Materials – Metals and alloys, ferrous materials- introduction to Iron carbon Diagram, steel and their Heat treatment, Properties and applications. Different types of heat treatment processes. Non-ferrous alloys: - Copper based alloys. Al based alloys, other important nonferrous alloys, properties and applications.

Module – IV **5hrs**

Polymers- Basic concepts of Polymers Science, polymer classifications. Crystallinity of polymers, Copolymers, Thermoplastic and Thermosetting polymers, Elastomers, Properties and Applications.

Module – V **5hrs**

Ceramics- Basic concepts of ceramics science, traditional and new ceramics. Oxide and Non-Oxide ceramics, Ceramics for high temperature applications. Glass, applications of ceramics, and glass.

Module -VI

5hrs

Composite materials- Definition, general characteristics. Particles reinforced and fiber reinforced composite materials, MMC, CMC, PMC, properties and applications.

Course Outcomes:

1. Classify various engineering materials and their selections
2. To learn about various crystal structures.
3. Analyse Iron-Carbon diagram in different structures.
4. To understand different types of heat treatment processes.
5. To understand the basic knowledge of Ceramics and Polymers and their properties & applications.
6. To learn about Composite materials.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L 3	3	3	1	-	-	-	-	-	-	-	-	-	-	2
CO2	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	L 3	2	2	1	-	-	-	-	-	-	-	-	-	-	2
CO4	L 5	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO5	L 5	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO6	L 6	3	2	2	-	-	-	-	-	-	-	-	-	3	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Elements of Material Science by Van Vlack
2. Material Science by O.P. Khanna
3. Material Science and Engineering by V. Raghavan 4. Material Science by R. K. Sharma and
   R.S. Sedha

Reference Books:

1. Material Science and Engineering by Wiliam D. Callister

SURVEYING AND GEOMATICS-I

Course code–CE302

Objectives:

- Establish spatial data collection and analysis skills this may involve traditional surveying techniques using instruments like total stations and GPS, as well as modern.
- **Prepare for construction planning and site layout.**
- **Support project documentation and monitoring** Students will learn how to create maps and plans depicting the existing and proposed conditions of the site, as well as monitor changes

Module I **7Hrs**

Introduction: Importance of Surveying, Types of Surveying, Principle, Scales, Plan and Map, Shrinkage of Maps, Mapping Concepts, Map Projections, Total Station uses and application, Chain Surveying: Purpose, Chaining, accessories, Ranging and its types, Error, Chaining on uneven ground, Tape corrections, Survey stations and lines, Well-conditioned triangle, basic problems, obstacle sin chaining, field book.

Module II **4Hrs**

Compass Surveying: Introduction and Purpose, True Meridian, Magnetic Meridian Geographical Meridian, True Bearing, Magnetic Bearing, Whole circle & Quadrantal Bearing, Prismatic Compass and Surveyors Compass, Magnetic Declination, Isogonic and Agonic Lines, Local Attraction and its adjustments.

Module III **5Hrs**

Plane Table Surveying: Equipment and uses, principle, methods of plane tabling, closing error and its adjustment, two point problem and three point problem.

Module IV **6Hrs**

Levelling: Types of levelling: Temporary Adjustment of Dumpy level, Methods of levelling, Level book and computation, missing data, curvature and refraction corrections, reciprocal leveling. Contouring: - Definition Methods of Contouring and plotting of contour.

Module V **6Hrs**

Theodolite traversing: Scope, Types, temporary adjustment of transit theodolite, measurement of horizontal & Vertical angles, Method of repetition & Direction, errors and its elimination, method of traversing, calculation of latitude and departure, balancing of traverse

Module VI **4Hrs**

Tacheometric Survey: Instruments used, Principle, determination of tacheometric constant, Methods of Tachometry: Stadia Method and Tangential Method.

Module VII **12Hrs**

Classification of Curves: Simple curve, Combined curve, Compound curve, reverse curve, transition curve, Methods of layout, offsets from chord produced, Rankine's Method, Transition Curve, super-elevation, length of transition curve, characteristics, equation, shift, tangent length, and curve length of combined curve, setting out of simple and transition curve.

CO	COURSE OUTCOMES
CO 1	Students are able to understand the surveying with advance instrument like remote sensing, GPS and GIS
CO 2	The students are able to understand the use of different surveying instruments and their use
CO 3	Students are able to calculate compute the area and earthwork for different works by using surveying instruments.
CO 4	Students are able to do the surveying of different civil engineering projects
CO 5	Students are able to do trigonometric and Geodetic Survey
CO 6	Students are able to understand the surveying with advance instrument like remote sensing, GPS and GIS.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes
H-High, M- Moderate, L- Low, '-' for No correlation

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	1	2	3	2	1	1	1	1	-	3	-
CO2	6	3	2	2	2	3	3	3	2	2	2	1	-	3	-
CO3	2	3	1	3	1	2	2	2	3	2	2	1	-	1	1
CO4	4	3	2	1	3	3	3	1	2	2	2	2	2	-	2
CO5	5	3	2	2	3	2	3	3	2	2	2	2	-	2	-
CO6	1	3	3	3	3	3	2	3	3	2	2	2	-	2	-

Text Books:

1. Duggal, S.K. Surveying Vol. I and II, Tata McGraw Hill, 2004.
2. Punmia, B.C. Surveying Vol.I and II, Standard Publishers, 1994.
3. Arora, K. R. Surveying Vol. I and II, Standard Book House, 1996
4. 4 N.N Basak.. Surveying and levelling

ENVIRONMENTAL SCIENCE

Course code –BSC 302 **24hrs**

Objectives:

- To develop basic knowledge of ecological principles and their applications in environment.
- To analyse, how the environment is getting contaminated and probable control mechanisms for them.
- To generate awareness and become a sensitive citizen towards the changing environment.

Contents:

Module-1 **2hrs**

Concept and scope of Environment science, components of environment, environmental segment and their importance.

Module-II **4hrs**

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance.

Module-III **4hrs**

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, greenhouse effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV **4hrs**

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants.

Module-V **4hrs**

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, waste water treatment.

Module-VI **4hrs**

Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods.

Module-VII **2hrs**

Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control.

Course Outcomes:

1. Understanding of issues related to environment and their impact on the human life.
2. Understanding on the solutions related to the environmental problems.
3. Understanding of different component of environment and their function and sustainable development.
4. Able to identify the sources, causes, impacts and control of air pollution.
5. Able to judge the importance of soil.
6. To learn about causes of contamination and need of solid waste management.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L 3	3	3	1	-	-	-	-	-	-	-	-	-	-	2
CO2	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	L 3	2	2	1	-	-	-	-	-	-	-	-	-	-	2
CO4	L 5	3	2	1	-	-	-	-	-	-	-	-	-	2	-
CO5	L 5	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO6	L 6	3	2	2	-	-	-	-	-	-	-	-	-	3	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Books and References:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.
5. Sharma B.K Environmental Chemistry, Krishna Prakashan Media Merrut.
6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International Publication.
7. Menon, S.E. Environmental Chemistry.

MN302	MINE GEOLOGY	3L:0T:0P	3 Credits

Modules:

Module 1: Physical Geology:

Geology in mining engineering, scope and application, earth structure and composition, weathering processes and grade, physiographical division of India, geological work of river, wind and glacier.

Module 2:

Stratigraphy:

Principle of stratigraphy, geological time scale, mineral resource distributions and economic importance of Archean, Cuddapah, Vindhyan, Gondwana, Tertiary deposit of India.

Module 3:

Minerology:

Classification of minerals, physical properties of minerals, properties of silica, feldspar, pyroxene, amphibole, mica, olivine, group of minerals and calcite.

Module 4:

Petrology:

Classification of rocks, igneous rock: composition and diversification of magma, texture and structure of igneous rock, tabular classification of igneous rocks, study of importance igneous rock, sedimentary rock: lithification and diagenesis, texture and structure of sedimentary rock, study of important sedimentary rock, metamorphic rock: metamorphism, agents and types, study of important metamorphic rocks,

Module 5:

Structural Geology:

Introduction to geological structure, faults, folds, joints and unconformities classification, criteria for recognition in the field and significance in mineral exploration, determination of strata thickness, dip and strike calculation,

Module 6: Economic Geology:

Ore, Gauge, tenors of ore, grade, assay value cut – off grade, processes of formation of mineral deposit, magmatic concentration, hydrothermal processes, placer deposit and supergene sulphide enrichment deposit

MN302P	MINE GEOLOGY LAB	0L:0T:3P	1 Credits

SL. NO	NAME OF EXPERIMENT/EXERCISE	
A. Study of Mineral samples (Identification of minerals on the basis of colour, streak, luster, hardness, cleavage, fracture)		
1.	Rock Forming minerals	Quartz, Orthoclase, Biotite, Muscovite, Calcite, Plagioclase,
2.	Economic minerals	Galena, pyrolusite, Hematite, Magnetite, Bauxite, Chromite, Chalcopyrite, Pyrite
B. Megascopic study of hand specimen (Identification of rock on the basis of colour, mineral composition, texture, structure)		
3.	Igneous rocks	Granite, Basalt, Rhyolite, Obsidian, Dolerite, Syenite,
4.	Sedimentary rocks	Sandstone. Shale, Limestone, Conglomerate, Breccia
5.	Metamorphic rocks	Gneiss, Schist, Quartzite, Marble, Slate,
C. Study of external morphology of crystal models (Determination of axial relationship, symmetry elements and forms present in model)		
6.	Isometric System	
7.	Tetragonal System	
8.	Orthorhombic System	
9.	Hexagonal and Trigonal System	
10.	Monoclinic System	
11.	Tetragonal System	

D. Numerical Problems related to Structural Geology	
12.	Three-point problems and its application
13.	Borehole problems and its analysis

MN301P	INTRODUCTION TO MINING LAB	0L:0T:3P	1 CREDITS

NAME OF EXPERIMENT

1. Study and sketch of Boring and various methods of Boring.
2. Study and sketch of Explosive and its types.
3. Study and sketch of Blasting Accessories.
4. Study and sketch of Priming, Charging, Stemming and Shot-firing.
5. Solid Blasting Practices in Underground mines.
6. Study of Blasting Pattern in underground and surface mines.
7. Study and sketch of incline mouth support.
8. Study and sketch of Temporary lining of shaft during sinking.
9. Study and sketch of Concrete lining of Shaft.
10. Study and sketch of special methods of shaft sinking by cementation process.

FIELD SURVEYING LAB

Course code CE 302P

List of Experiments:

1. Study of different Levels and Levelling staff. Practice for temporary adjustment. To find out the reduced levels of given points using Dumpy level. (Reduction by Height of Collimation method)
2. Study of a Tilting (LOP.) Level and to find out the levels of given points (Reduction of data by Rise and Fall method).
3. Visit to Lab, For the study of:-
    (a) Map in the making p Survey of India publication
    (b) Conventional Symbol charts and different types of maps
4. To establish a Benchmark by Check Levelling with a LOP. level and 'closing the work at the staring Bench mark.
5. To perform Fly Levelling with a LO.P. Level.
6. To draw the longitudinal rid cross- sections profiles along a given route.
7. Practice for Temporary adjustments of a Vernier Theodolite and taking Horizontal the work at the starting measurements. By Reiteration method.
8. To plot the coordinates at a given scale on Plane Table and their field checking.
9. To solve two Point and Three Point Problems in Plane Tabling.
10. To carry out Triangulation and Trilateration of a given area (2-3 turns are needed).

COMMUNICATION SKILL LAB

Course code - HS301

This lab paper involves interactive practice sessions in Language Lab along with some class lectures to enable the students to be confident enough in language and professional sphere of life.

Module I: Listening Comprehension

1. To comprehend spoken material in standard Indian English/ British English & American English
2. Current situation in India regarding English American English Vs. British English

Module II: Phonetics & Phonology

1. Introduction to Phonetics & Phonology
2. Organs of Speech/ Speech Mechanism
3. Pronunciation, Intonation, Stress and Rhythm, Syllable Division Consonants/Vowels/Diphthongs/Classification.

Module III: Common Everyday Situations: Conversations and Dialogues

Module IV: Communication at Workplace

Module V: Telephonic Conversation

1. Introduction
2. Listening/Speaking
3. Telephonic Skills Required
4. Problems of Telephonic Conversation
5. Intensive Listening

Module VI: Interviews

1. The Interview Process
2. Purpose/Planning/Two-way Interaction/Informality
3. Pre-interview Preparation Techniques
4. Projecting a Positive Image
5. Answering strategies

Module VII: Formal Presentations

1. Introduction
2. Nature/Importance of Presentation
3. Planning Objective with central idea, main ideas, role of supporting materials Handling Stage Fright

Module VIII: Forms of Technical Communication

Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; C.V./Resume writing; Technical Proposal: Types, Structure & Draft

Module IX: Technical Presentation

Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module X: Technical Communication Skills

Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and nonverbal means.

RADHA GOVIND UNIVERSITY, RAMGARH
MINING ENGINEERING
B. Tech, Semester IV (Second year]
Course Structure

4th Semester Course Structure

Sl No.	Course Code	Course Title	Hours per week			Credit
			L	T	P	
1.	EC404	Electronics and Instrumentation Engg.	3	0	0	3
2.	MN401	Underground Coal Mining Methods	3	0	0	3
3.	MN402	Surface Mining Methods	3	0	0	3
4.	MN403	Drilling and Blasting	3	0	0	3
5.	MN404	Mine Surveying	3	0	0	3
6.	EN401/IT402	Engineering Economics/ cyber Security	3	0	0	0
7.	MN405P	Mine Design – I Lab	0	0	3	1
8.	MN403P	Drilling and Blasting - Lab	0	0	3	1
9.	MN404P	Mine Surveying Lab	0	0	3	1
10.	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
11.	IN401	Internship/Tour&Training/Industrial Training	0	0	0	2
					Total Credit	21

ELECTRONICS AND INSTRUMENTATION ENGINEERING

Course code – EC404 **40hrs**

Objectives:

- To design various instruments for different sectors.
- To ensure that systems and processes work safely and efficiently.
- To create, build, and maintain measuring and control devices and systems found in manufacturing plants and research institutions.

Contents:

Module I: Basic Electronic Components

8hrs

Active and Passive Components, Types of resistors and Color coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.). Measuring Instruments like CRO, Power supply, multi-meters etc.

Module II: Semiconductors, Diode and Transistors

8hrs

Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector, Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier. JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET.

Module III: Digital Electronics Fundamentals

8hrs

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Module IV: Electronic Instruments **8hrs**

Measurement of Temperature, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, Digital Shaft Encoders, Tachometer, Hall effect sensors. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.

Electronic Display Device, Digital Voltmeters, Digital Energy meter, CRO, measurement of voltage and frequency, Lissajous Patterns, Plotting B-H curve of a magnetic material, Wave Analyzers, Harmonic Distortion Analyzer. Digital Energy Meter. Measurements of R, L and C Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers. Digital Storage Oscilloscope.

Module V: Electronic Communication Systems

8hrs

The elements of communication system, IEEE frequency spectrum and Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system, Ultrasonic wave & its application in distance measurement.

Course outcomes:

1. Understanding of the basic concepts of electronics and instrumentation engineering.
2. Knowledge of the different types of electronic devices and their applications.
3. Understanding of the working principle of different types of electronic devices.
4. Ability to analyze the performance of different types of electronic devices.
5. Knowledge of the selection criteria for different types of electronic devices.
6. Ability to design different types of electronic devices.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta, TMH Publications.
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.
3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.
4. Floyd," Electronic Devices" Pearson Education 9th edition, 2012.
5. R.P. Jain, "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.

6. Frenzel, “Communication Electronics: Principles and Applications”, Tata Mc Graw Hill, 3rd Edition, 2001

Reference Books:

1. Integrated Devices & Circuits by Millman & Halkias, TMH Publications.

2. Electronics Devices and Circuit Theory by R. Boylestad & L. Nashelsky, Pearson Publication

3. Electronic Communication System by G. Kennedy, TMH Publications.

4. Basic Electronics by Sanjeev Kumar & Vandana Sachdeva, Paragaon International Publication

MN401	UNERGROUND COAL MINING METHODS	3L:0T:0P	3 Credits

Course Objective:

This course is designed to address the following:

- To give an understanding to the students for opening the underground coal deposit, different mode of opening and their suitability including advantages and disadvantages.
- To give an understanding to the student of various methods of working in underground coal mining and their application.

Proposed Syllabus

Opening of Deposits: Developments of mine for in-seam mining and horizon mining (including shaft pillar), their comparison, advantages and disadvantages, division into levels and districts. General principle of Bord & Pillar Development, their choice, suitability, advantages and disadvantages.

Open and Panel Systems, Layout of Bord & Pillar panel, size of panel and statutory provisions, Concurrent development activities like support, track laying, lighting, transportation of materials and minerals in and out of the mine etc.

Preparatory arrangement for depillaring operation, statutory provision for depillaring, principle and designing of pillar extraction, size of a district, factors affecting choice of pillar extraction, depillaring with caving, stowing, mechanized depillaring operation, organization and safety. Longwall methods of working, their choice, suitability, advantages and disadvantages. Shape & size of development roadways and gate roads and their maintenance, support systems of longwall face and gate roads.

Layout of the workings for the required output, length and orientation of longwall faces. Advancing and retreating longwall faces, longwall face and gate road machineries, mechanized longwall faces with shearers, AFC, power support and gate road machineries.

Modules:

Module 1: Opening of Deposits: Developments of mine for in-seam mining and horizon mining (including shaft pillar), their comparison, advantages and disadvantages, division into levels and districts.

Module 2: Bord and Pillar Development:
General principle of Bord & Pillar Development, their choice, suitability, advantages and disadvantages,

Module 3: Bord and Pillar Panels:
Open and Panel Systems, Layout of Bord & Pillar panel, size of panel and statutory provisions, Concurrent development activities like support, track laying, lighting, transportation of materials and minerals in and out of the mine etc.

Module 4: Pillar Extraction:
Preparatory arrangement for depillaring operation, statutory provision for depillaring, principle and designing of pillar extraction, size of a district, factors affecting choice of pillar extraction, depillaring with caving, stowing, mechanized depillaring operation, organization and safety.

Module 5: Longwall Panel Development:
Longwall methods of working, their choice, suitability, advantages and disadvantages. Shape & size of development roadways and gate roads and their maintenance, support systems of longwall face and gate roads.

Module 6: Longwall Panel Extraction:
Layout of the workings for the required output, length and orientation of longwall faces. Advancing and retreating longwall faces, longwall face and gate road machineries, mechanized longwall faces with shearers, AFC, power support and gate road machineries.

Course Outcomes:
This course qualifies participants to apply basic concepts of Mining in

1. Explain different mining methods and their selection.
2. Describe details working of bord and pillar method and its development & depillaring.
3. Explain longwall working.
4. to give an understanding to the students for basic concept of surface mining including selection between surface mining verses underground mining for a particular project.
5. to give an understanding to the student of various cycle of operation of extraction of deposit including opening of deposit, production of different benches, drilling and blasting, excavation and transportation etc.

Text/Reference Books:

1. Wining and working – R. T. Deshmukh & D. J. Deshmukh
2. Elements of Mining Technology Vol. I, III – D. J. Deshmukh
3. Principle and Practices of Modern Coal Mining – R. D. Singh
4. Modern Coal Mining – S. K. Das
5. Introductory mining engineering-, Howard L. Hartman, Jan M. Mutmansky/ Wiley India (P) Ltd
6. SME Mining Engineers Handbook 3rd Edition - Peter Darling

MN402	SURFACE MINING METHODS	3L:0T:0P	3 CREDITS

Geometrical parameters of the benches, bench height, bench slope, bench width etc. with regard to the geometry of the deposits and overlying rocks. Formation parameters and factors affecting their selection.

Working principles of Excavation machineries, deployment of drills, dozer, shovel - dumper, dragline, hydraulic shovels, Ripper and Scraper, surface miners etc. their cycle of operation, application and limitation.

Drilling principles, types of blast hole drills, estimation of number of drill for a given mine production, blast design, determination of charge weight, factors affecting blast design, calculation of charge required per hole, problems associated with drilling and blasting, secondary blasting. Cyclic methods-- shovel-dumper, pay-loader, dragline and their annual capacity calculation.

Modules:

Module 1: Basic Concept of Surface Mining:
Status of surface mining in India. Selection between surface mining and underground mining. Preliminary evaluation of surface mining prospects; different stripping ratios -- concepts and significance.

le 2: Opening up of Deposits:
Box Cut: Selection of site and machineries, Calculation of rock movement in box cutting for given geometry.

Module 3:

Production benches

Geometrical parameters of the benches, bench height, bench slope, bench width etc. with regard to the geometry of the deposits and overlying rocks. Formation parameters and factors affecting their selection.

Module 4:

Preparation for Excavation:

Working principles of Excavation machineries, deployment of drills, dozer, shovel - dumper, dragline, hydraulic shovels, Ripper and Scraper, surface miners etc. their cycle of operation, application and limitation.

Module 5: Drilling and blasting:
Drilling principles, types of blast hole drills, estimation of number of drill for a given mine production, blast design, determination of charge weight, factors affecting blast design, calculation of charge required per hole, problems associated with drilling and blasting, secondary blasting.

Module 6: Excavation and Transportation:
Cyclic methods-- shovel-dumper, pay-loader, dragline and their annual capacity calculation.

Text/Reference Books:

1. Surface Mining- Misra, G.B.,
2. Surface Mining -B.A. Kennedy
3. Surface Mining Operations -S.K. Das,
4. SME Mining Engineers Handbook 3rd Edition - Peter Darling

Course Learning Outcomes:

1. Provide a detailed description of the proposed surface mining method and related equipment and support infrastructure (including illustrations, sketches, plans, etc.);
2. Design and evaluate materials handling and transport options;
3. Conduct productivity analysis for the selected mining system;
4. Identify and evaluate core risks in each mining method;
5. Appraise mining systems with respect to safe, efficient, economic and environmentally and socially responsible operations; and
6. Demonstrate awareness of major technological trends.

Course Objectives:

This course is designed to address the following:

- to give an understanding to the students for basic concept of drilling and blasting in both surface mining and underground mining.
- to give an understanding to the student of various cycle of operation of drilling and blasting including exploratory drilling, production drilling in both metal as well as coal mines.

MN403	DRILLING AND BLASTING	3L:0T:0P	3 CREDITS

Exploration Drilling Boring for exploration; Various types of exploratory drills and their applicability – Auger, Cable-tool, Odex, Core Drills; Core recovery: single and double tube core barrels, wire line core barrel; Storage of cores; Interpretation of borehole data. Explosives and Initiating Systems Types of explosives, their composition and properties, classification; Selection of explosives; Manufacture, transport, storage and handling of explosives; Testing of explosives; Types of initiating systems – Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders. Drilling & Blasting in Surface Mines Drilling: Blasthole drills – types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, compressed air requirement for hole cleaning; Selection of drilling systems, drilling errors, organization of drilling. Blasting: Mechanics of rock fragmentation; Livingstone theory of crater formation; Factors affecting blasting, Blast design - estimation of burden and spacing, estimation of charge requirement; Initiation patterns; Secondary blasting – pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure, Blast instrumentation Drilling & Blasting in Underground Mines Coal mines: Drilling systems and their applicability, blasting-off-solid, different blasting cuts, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns. Metal mines: Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, long hole blasting, vertical crater retreat blasting.

Modules:

Module 1: Exploration Drilling:

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

Module 2: Explosives and Initiating Systems:

Types of explosives, their composition and properties, classification; Selection of explosives; Manufacture, transport, storage and handling of explosives; Testing of explosives; Types of initiating systems – Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders.

Module 3: Drilling in Surface Mines

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

Module 4: Blasting in Surface Mines

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

Module 5: Drilling & Blasting in Underground Coal Mines:

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

Module 6: Drilling & Blasting in Underground Metal Mines:

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

Text/Reference Books:

1. Rock blasting effects and operations, Lovely Prakashan: P. Pal Roy.
2. Blasting Practices in Surface Mines: S K Das.
3. Explosives and Blasting Technology: G.K.Pradhan.
4. Rock Blasting: Sushil Bhandari.
5. Drilling and Blasting: chapters in SME Mining Engineers Handbook: P Darling.
6. Drilling and blasting of rock, CRC publications: Jimino.
7. Surface and Underground Excavations: R R Tatiya.
8. Blasting principles for open pit mining, SME vol. I & II: W Hustrulid.
9. Surface Blast Design: C.J.Konya.
10. Indian Explosive Act 1884.
11. Legislation in Indian Mines – A Critical Appraisal: Rakesh and Prasad.

Course Learning Outcomes:

After completion of the subject the students will be able to:

1. Identifying and relating various drilling procedures to various rock characteristics.
2. Outline and define various blasting practices, accessories, explosives & their suitability in Indian mines both underground and opencast.
3. Analyse and optimize blast performance and productivity improvements.
4. Formulate and list the documentation for safe blasting practices.
5. To understand and appreciate environmental and social implications of rock/coal blasting.

Course Objectives:

The course is designed where, students can apply knowledge of mathematics in surveying to calculate and analyse different parameters of survey. Students can get the ability to identify, formulate and solve problems in the field of advanced surveying using advanced surveying instruments. Ability to analyse survey data and design mining engineering projects.

This course is designed to address the following:

- To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Mine Surveying.
- To motivate the student to pursue a career in one of the many areas of Mine Surveying with deep interest and keenness.
- To expose the students to the various avenues and Instruments available for doing creative and innovative work in this field by showcasing the applications in many monuments and inspiring projects of public utility.
- To introduce the students to advanced and astronomical surveying.

Proposed Syllabus:

MN404	MINE SURVEYING	3L:0T:P	3 Credits

Surveying Instruments: Mining theodolite, miner's dial, loose and fast needle traversing with miner's dial, EDM & Total Station -- their applications. Introduction to Gyro-theodolite & GPS. Triangulation Survey: Classification; Reconnaissance; Procedures for angles and base-line measurement; Comparison with precise EDM traversing

Correlation Survey: Correlation of underground and surface surveys and different methods of correlation- connection through adit, incline and shafts, method of connection through single or double vertical shafts. Corrections by means of magnetic needle.

In-pit Survey: Setting out a point of known rectangular co-ordinate. Control of directions and gradients for inclined shafts, slopes, levels and tunnels. Maintaining alignments, simple curve laying underground, laying out and fixing of mine boundaries claims, subsidence surveys on surface and underground. Volume calculations.

Stope Surveying: Stope surveying with Hanging Compass and Alignometer, tape triangulation, radiation and other methods.

Mine Plans and Sections: Legal requirements as to mine plans and sections in India, preparation and preservation of plans and sections, representation of geological and other surface and underground features on mine plans and sections.

Astronomy: Astronomical terms and definitions, Introduction to field astronomy, determination of true meridian, latitude, longitude and time including hour angle.

Modules

Module 1: Surveying Instruments:

Mining theodolite, miner's dial, loose and fast needle traversing with miner's dial, EDM & Total Station - their applications. Introduction to Gyro-theodolite & GPS.

Module 2: Triangulation Survey:

Classification; Reconnaissance; Procedures for angles and base-line measurement; Comparison with precise EDM traversing.

Module 3: Correlation Survey:

Correlation of underground and surface surveys and different methods of correlation-connection through adit, incline and shafts. Method of connection through single or double vertical shafts. Corrections by means of magnetic needle

Module 4: In-pit Survey:

Setting out a point of known rectangular co-ordinate. Control of directions and gradients for inclined shafts, slopes, levels and tunnels. Use of Top telescope and side telescope. Maintaining alignments, simple curve laying underground, laying out and fixing of mine boundaries claims, subsidence surveys on surface and underground. Volume calculations.

Module 5: Stope Surveying:

Stope surveying with Hanging Compass and Alignometer, tape triangulation, radiation and other methods.

Module 6: Mine Plans and Sections:

Legal requirements as to mine plans and sections in India, preparation and preservation of plans and sections, representation of geological and other surface and underground features on mine plans and sections.

Module 7: Photogrammetry:

Introduction to photogrammetry, Scale of a vertical photograph, photographs verses maps, application of photogrammetry in mining

Module 8: Astronomy:

Astronomical terms and definitions, Introduction to field astronomy, determination of true meridian, latitude, longitude and time including hour angle.

Application of Computer in surveying and computation.

Text/Reference Books:

1. Surveying (Vol – 1,2 & 3), by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) Ltd., New Delhi.
2. Surveying (Vol 1, 2& 3), Duggal S.K. Tata Mc.Graw Hill Publishing Co. Ltd. New Delhi, 2004

3. Text book of surveying by C. Venkataramaiah, Universities Press.
4. Engineering surveying by Schofield, Wilfred, and Mark Breach.. CRC Press, 2007
5. Surveying (Vol 1, 2 & 3), Arora K R, standard Book House, Delhi, 2004.
6. Plane Surveying, Chandra A M. New age International Pvt. Ltd. Publisher, New Delhi, 2002
7. Higher Surveying, Chandra A M., New Age International Pvt. Ltd. Publisher, New Delhi, 2002
8. Surveying and levelling by R. Subramanian, Oxford University Press, New Delhi.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- Know the various surveying instruments and their purpose;
- Have complete understanding of the significant role of surveying play in mining.
- Understanding the setting out concepts and different kind of techniques.
- Understanding the Legal requirements of mine plans and sections in India
- Understand and remember different Astronomical terms, definition and their significance.
- Can remember different kind of representations of geological, surface and underground features on mine plans and sections (Skills) Use operations of Mine Surveying to:
- Identify and analyse the applications of Surveying Instruments in different kind of Mining scenario.
- Apply and evaluate the techniques used in correlation for correlation survey depending on the type of mine.
- Apply and analyse different setting out procedure in direction and gradient control in Mining Scenario.
- Apply the different techniques of stope surveying in different kind of mining methods.
- Apply different techniques to analyse the volume of mined-out area, heap and etc.
- Identify and evaluate different kind of representations of geological, surface and underground features on mine plans and sections.

CYBER SECURITY

Course code–IT402

Objectives:

- Protect critical infrastructure from cyber attacks**:** Civil engineers design and manage critical infrastructure like bridges, dams, and power grids.
- Safeguard sensitive project data and information**:** Civil engineering projects involve a significant amount of sensitive data, including design plans, construction specifications, and financial information.
- Promote secure communication and collaboration**:** Civil engineering projects often involve collaboration between various stakeholders - engineers, contractors, and government agencies.

Module I: Introduction to Cyber crime: Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, and Cybercrime: The legal Perspectives and Indian Perspective, Cyber crime and the Indian ITA2000, A Global Perspective on Cyber crimes.

Module II: Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cyber crime, Attack Vector, Cloud Computing.

Module III: Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policiesan Measures in Mobile Computing Era, Laptops.

Module–IV: Tools and Methods Used in Cybercrime : Introduction, Proxy Servers and Anony mizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Module V: Cyber Security: Organizational Implications Introduction, Cost of Cyber crimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

CO	COURSE OUTCOMES
CO 1	Protect and defend computer systems and networks from cyber security attacks
CO 2	Diagnose and investigate cyber security events or crimes related to computer systems and digital evidence.
CO 3	Effectively communicate in a professional setting to address information security issues.
CO 4	Apply business principles to analyze and interpret data for planning , decision- making, and problem solving in an information security environment.
CO 5	Propose solution including development, modification and execution of incident response plans.
CO 6	Describe the Modification and execution of incident response plans.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L3	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO2	L5	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO3	L1	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO4	L6	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO5	L4	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO6	L1	3	3	3	3	3	-	-	1	-	-	-	2	3	3

3-High, 2- Moderate, 1- Low, '-' for No correlation

TEXTBOOK:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives,
2. Nina God bole and Sunil Bela pure, Wiley INDIA.

REFERENCEBOOK:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan -Hwa (john) Wu,J. David Irwin. CRC Press T & F Group

ENGINEERING ECONOMICS

Course code–EN401

Objectives:

- **Evaluate the economic feasibility of civil engineering projects:** This objective focuses on equipping civil engineers with the ability to assess the economic viability of proposed infrastructure projects.
- Optimize decision-making for cost-effective infrastructure development**:** Engineering Economics teaches civil engineers to consider the economic implications of their decisions throughout a project's lifecycle

COURSE OUTLINE:

The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to been countered in professional practice.

Module-1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility–its practical application and importance.

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, practical importance & applications of the concept of elasticity of demand.

Module-II

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale. Various concepts of cost–Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module III

Meaning of Market, Types of Market – Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Pricing Policies Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle

Firm as an organization - Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalisation of Indian economy–merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation

CO	COURSE OUTCOMES
CO 1	Describe and determine the effect of financial analysis and its impact on budgeting of projects and their outcomes.
CO 2	The course enable students to acquire the ability to work individually and on multi -disciplinary teams to identify, formulate and analyze financial problems.
CO 3	Use modern computer-based tools such a spread sheets in performing engineering economic analysis.
CO 4	Quantify and include elements of uncertainty and risk into an economic analysis.
CO 5	Identify the characteristics of various methods used for the generation of financial management decisions..
CO 6	Develop and analysis information on investment planning and cost controls, and conduct cost/benefit analysis.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L3	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO2	L5	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO3	L1	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO4	L6	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO5	L4	3	3	3	3	3	-	-	1	-	-	-	2	3	3
CO6	L1	3	3	3	3	3	-	-	1	-	-	-	2	3	3

3-High, 2- Moderate, 1- Low, '-' for No correlation

RECOMMENDED BOOKS:-

1. R. Paneer Seelvan: Engineering Economics, PHI

2. Managerial Economics, D.N. Dwivedi, Vikash Publication
3. Managerial Economics, H.L. Ahuja, S.Chandand Co. Ltd.
4. Managerial Economics, Suma Damodaran, Oxford.

5. R.mol rishnd Ro T.V S 'Theory of firms: Economics and Managerial Aspects'. Affiliated East West Press Pvt. Ltd. New Delhi
6. Managerial Economics, H. Craig Petersen & W. Cris Lewis, Pearson Edu

MN405P	MINE DESIGN - I	0L:0T:3P	1 CREDITS

SL. NO	NAME OF EXPERIMENT
1.	Determination of annual production capacity of a rope shovel with given bucket capacity, dumper capacity and numbers and distance of dumping yard.
2.	Determination of annual excavation capacity of a dragline of given specification including bucket capacity.
3.	Determination of total drilling requirement for an opencast overburden/ coal bench with given geometry and excavation volume/ production requirement per round of blasting.
4.	Determination of matching number of dumpers per shovel for a target output when the shovel and dumper capacities are given.
5.	Determination of volume of rock excavation in box cutting for a given geometry of the entry and depth of first bench.
6.	Determination of haul road dimensions for a given condition.
7.	Study and sketch of an inclined drivage showing support requirements, transport mode, safety features, illumination etc.
8.	Study and sketch of a conventional/ mechanized Bord and Pillar panel being developed.
9.	Study and sketch of a Bord and Pillar panel being depillared with hydraulic sand stowing showing systematic support.

10.	Study and sketch of a Bord and Pillar panel being depillared with caving showing systematic support.
11.	Study and sketch of longwall main gate and tail gate roads with respective gate machineries.
12.	Study and sketch of a mechanized longwall face in a coal seam with given specifications.

MN403P	Drilling and Blasting - Lab	0L:0T:3P	1 Credits
SL. NO	NAME OF EXPERIMENT/ EXERCISE		
1.	Study & sketch of Hand held Coal drill, drill rods and drag bits.		
2.	Study & sketch of air leg mounted compressed air drill, drill rod with bit.		
3.	Study and sketch of rotary drill with Diamond coring bit.		
4.	Study and sketch of Churn/percussive drilling component including water flushing system.		
5.	Study and sketch of Down the Hole (DTH) drill for O/C Mines.		
6.	Study and sketch of P_3 and P_5 explosives with priming and initiation (direct and reverse) methods.		
7.	Study and sketch of copper and aluminium tube delay Detonators with section al views.		

8.	Study and sketch of non – electric delays, detonation chord with sectional views.
9.	Study and sketch of multi shot exploders with internal views.
10.	Exercise for deciding drilling pattern, number of holes, amount and type explosive, of stemming material in respect of a given coal face with desired yield.
11.	Exercise for deciding drilling pattern, number of holes, amount and explosive, type of stemming material in respect of a given stone drift.
12.	Exercise for deciding drilling pattern, number of holes, amount and explosive, type of stemming material in respect of a given coal/ overburden bench.

MN404P	MINE SURVEYING LAB	0L:0T:3P	1 CREDITS

SL. NO	NAME OF EXPERIMENT/ EXERCISE
1.	Study of EDM and total station.
2.	Study of gyro theodolite.
3.	GPS and its applications.
4.	GNSS and its characteristics.
5.	Correlation survey by alignment/ co-planning method.
6.	Correlation survey by weisbach triangle method.
7.	Correlation survey by weiss-quadrilateral method.
8.	Setting out of simple curves.
9.	To determine the most probable value of the included angles of given triangle by method of least squares.
10.	Subsidence monitoring using precise instruments.
11.	Study of photo theodolite.
12.	Measurement of muck pile volume.

RADHA GOVIND UNIVERSITY, RAMGARH

MINING ENGINEERING

B.Tech, Semester V (Third year]

Course Structure

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
Professional Core						
1.	MN501	Mine Ventilation Engineering	3	1	0	4
2.	MN502	Mining Machinery	2	1	0	3
3.	MN503	Underground Metal Mining Methods	2	1	0	3
4.	**Professional Elective – I**					
I.	MNP504	Operation Research	2	1	0	3
II.	MNP505	Mine System Engineering	2	1	0	3
III.	MNP506	Remote Sensing & GIS	2	1	0	3
IV.	MNP507	Numerical Techniques in Geomechanics	2	1	0	3
5.	**Open Elective – I (Any One of the Following)**					
I.	MNO508	Mineral Process Engineering	2	1	0	3
II.	MNO509	Bulk Material Handling	2	1	0	3
III.	MNO510	Clean Coal Technology	2	1	0	3
IV.	MNO511	Internet of Things (IOT)	2	1	0	3
PRACTICALS						
1.	MN501P	Mine Ventilation Engineering Lab	0	0	2	1
2.	MN502P	Mining Machinery Lab	0	0	2	1
3.	MN503P	Internet of Things (IoT) Lab	0	0	2	1
4.	MN504P	Mine Design – II Lab	0	0	2	1
5.	MN505G	General Proficiency/ Seminar	0	0	2	2
					Total Credit	**22**

MINING ENGINEERING
B.Tech, Semester VI (Third year]
Course Structure

Sl. No.	Course Code	Course Title	Hours per week			Credit
			L	T	P	
THEORY						
1.	MN601	Mine Environmental Engineering	3	1	0	4
2.	MN602	Rock Mechanics	2	1	0	3
3.	MN603	Advanced Underground Coal Mining Methods	2	1	0	3
4.	**Professional Elective – II (Any One of the Following)**					
I.	MNP604	Rock Excavation Engineering	2	1	0	3
II.	MNP605	Rock Slope Engineering	2	1	0	3
III.	MNP606	Mine Ventilation Planning	2	1	0	3
IV.	MNP607	Advanced Mine Ventilation Engineering	2	1	0	3
5.	**Open Elective – II (Any One of the Following) ***					
I.	**ELO611**	Electrical Engineering in Mines	2	1	0	3
II.	MNO608	Data Analytics	2	1	0	3
III.	MNO609	Reliability Engineering	2	1	0	3
IV.	MNO610	Geostatistics	2	1	0	3
PRACTICALS						
1.	MN601P	Rock Mechanics Lab	0	0	2	1
2.	MN602P	Mine Environmental Engineering Lab	0	0	2	1
3.	MN603P	Data Analytics Lab	0	0	2	1
4.	MN604P	Electrical Engineering in Mines Lab	0	0	2	1
5.	MN605I	Internship/ Tour & Training/ Industrial Training	0	0	2	2
				Total Credit		**22**

PROFESSIONAL CORE

MN50 1	MINE VENTILATION ENGINEERING	3L:1T:0P	4 Credits

Overview

Excavation in the earth under even normal circumstances can be fraught with environmental problems and hazards. In undergrounds mining, and tunneling too, the most critical aspect of is the environment in the working place. It is in fact the backbone of the miner's life support system.

To the mining engineering, ventilation trends to be the environmental remedy. It is the air – condition process relied upon which accomplish most environmental control underground. Ventilation is the control of air movement, its amount and direction. As the principle means of quantity control, it is one of the constituent processes of total air conditioning, the simultaneous control within prescribed limits of the quality, quantity, and temperature – humidity of the air.

Ventilation, therefore, is not only total-air-conditioning process, nor is it adequate alone to satisfy all mine environmental objectives. That is why this course stress that mine ventilation and air conditioning are complementary and separate processes. Increase, in underground mining as in surface industry, environmental objectives require that condition air to meet quality and temperature –humidity objectives as well as quantity.

In recent years' environmental standards in mines have been raised substantially. Worker productivity and job satisfaction correlate closely with environmental quantity. No mining company today can afford to be negligent in its environmental and air-control practices.

The goal of this course is to instruct the mining engineer in the principles and practices of ventilation and air conditioning applicable to the atmosphere and the unique environmental conditions found in mines.

Course Description

The purpose of this course is to present a modern and comprehensive treatment of mine ventilation system from the viewpoint of the total mine atmosphere environment and its control. Hence, the subject is treated in terms of the theory and practices in the three broad areas of air conditioning-quantity control, quantity control(ventilation), temperature – humidity control.

From the basic physics of gases, the theory is to developed to cover air measurements, the flow of air through ducts, through opening, and through circuits, the design of networks and the design of temperature-humidity control systems. The solution of examples problems and the many references to the technical literature will further assist the reader in grasping this theory.

At the end of this course it is intended that the students will be able to:

- Describe and apply the principles of fluid flow to ventilation systems.

- Describe and apply fan behavior laws to ventilation systems
- Design and develop a ventilation system for a mine.
- Describe environmental hazards found in mines and outline the ventilation control measures that detect, monitor, minimize and/or manage these hazards.

Syllabus:

Atmospheric air- Its composition, mine air -its composition and variation, origin, occurrence, physical, chemical and physiological properties of mine gases, various types of damps. Sampling and analysis of mine air. Methane content and pressure, methane drainage and methane layering. Monitoring of gases. Heat and humidity: Sources of heat in mines, effect of heat and humidity, psychometric, kata thermometer, methods of improving of cooling power of mine air. Air conditioning – basic vapour cycle, representative layout. Air flow through mine openings: Laws of air flow, resistance of airways, equivalent orifice, distribution of air, flow control devices. Natural Ventilation: Calculation of NVP from air density, thermodynamic treatment etc., artificial aids to natural ventilation. Mechanical Ventilation: principal types of mine fan and their suitability, merits, limitation, efficiency and characteristics. Selection of mine fan, fan testing, output control in fans, series and parallel operation of mine fans. Ventilation of advancing heading-auxiliary fan, duct, matching of fan to the duct system. Reversal of air current. Fan drift, evasee, diffuser, booster fans.

Modules:

1. **Introduction and course overview:**composition of mine air, its variation, origin, occurrence, physical, chemical and physiological properties of mine gases.
2. **Classification of various types of damps:**Sampling and analysis of mine air. Methane content and pressure, methane drainage and methane layering. Monitoring of gases.
3. **Heat and humidity:**Sources of heat in mines, effect of heat and humidity, psychometric, kata thermometer,
4. **Methods of improving**: of cooling power of mine air. Air conditioning – basic vapour cycle, representative layout.
5. **Air flow through mine openings:** Laws of air flow, resistance of airways, equivalent orifice, distribution of air, flow control devices
6. **Natural Ventilation**: Calculation of NVP from air density, thermodynamic treatment etc. artificial aids to natural ventilation.
7. **Mechanical Ventilation:** principal types of mine fan and their suitability, merits, limitation, efficiency and characteristics.
8. **Selection of mine fan**: fan testing, output control in fans, series and parallel operation of mine fans.
9. **Ventilation of advancing:** heading-auxiliary fan, duct, matching of fan to the duct system.
10. **Reversal of air current**. Fan drift, evasee, diffuser, booster fans.

Text/Reference Books:

- Banerjee S.P. (2003); "Mine Ventilation"; Lovely Prakashan, Dhanbad, India.
- Panigrahi D.C: Mine Ventilation, CRC Press
- Deshmukh, D. J. (2008); "Elements of Mining Technology,Vol. II"; Denett& Co., Nagpur, India.
- Hartman, H. L., Mutmansky, J. M. & Wang, Y. J. (1982); "Mine Ventilation and Air Conditioning"; John Wiley & Sons, New York.
- Karmakar, N. C. (2001); "Handbook of gas testing"; Lovely Prakashan, Dhanbad, India.
- Le Roux, W. L. (1972); Mine Ventilation Notes for Beginners"; The Mine Ventilation Society of South Africa.
- McPherson, M. J. (1993); Subsurface Ventilation and Environmental Engineering"; Chapman & Hall, London.
- Misra G.B. (1986); "Mine Environment and Ventilation"; Oxford University Press, Calcutta, India.
- Ramlu, M. A. (1991); "Element of Mine Ventilation"; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
- Vutukuri, V. S. & Lama, R. D. (1986); "Environmental Engineering in Mines"; Cambridge University Press, Cambridge.
- Kejriwal,B.K,"ASurvey Of Accidents , Their Causes &Prevention".
- Kaku L.C, "Fire In Coal Mine" ,Lovely Prakashan, Dhanbad, India.
- Ghatak S.,"Mine Ventilation"Vol. 1 & Vol. 2,Lovely Prakashan, Dhanbad, India.
- Banerjee S.P., "Prevention combating Mine Fires",Lovely Prakashan, Dhanbad, India.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:

(Knowledge based)

- Explain the meaning of mine ventilation system.
- Recognise the different types of damps and their causes and prevention techniques.
- Describe the various techniques of fan selection for a particular mine;
- Explain the laws of air flows, resistance of airways, equivalent orifice, distribution of air;
- Have complete understanding of the significant role of different flow control devices.

(Skills)

Use mine ventilation system to:

- Apply the techniques used in fan selection to solve real life problem in mining industry
- Develop skills sets for calculating natural ventilation pressure from air density etc.
- Formulate air quantity required to solve real life problem.
- Deal with fire dams in mine.
- Recognising the physiological properties of dust.
- Develop the prevention and suppression techniques of dust, dust formation sources.
- Develop methods of improving the cooling power of mine air.
- Determine the characteristics of mine airways.
- Maintain and monitor the mine fans.

MN50 2	MINING MACHINERY	2L:1T:0P	3 Credits

Pre-requisite: Engineering Mechanics, Mechanical Technology

Course Objectives:

This course introduces prime movers used for moving of mining machinery, Rails, Joints, Crossings, Plates for track laying, Locomotives used in mines, drills used for drilling in mines, mine winders, winding drums, man riding systems, cutter loaders, pumps, opencast machinery for mining to improve its output.

Syllabus:

Prime Mover for Mining Machinery: O.C. engine, hydraulic power, pneumatic power, elements of mechanical power transmission – gear, belt, chain, coupling, clutch and brake. Rope haulage: Construction of the wire ropes, rope haulages – gravity, direct, balanced direct, main & tail, endless, reversible endless. Suitability of these haulages and their limitations. Dimension of ropes, drums and pulleys, care and maintenance of ropes, changing of haulage ropes, rope splicing, safety appliances in haulage road, signaling, Statutory requirements of haulages. Track Laying: Rail, joints, crossings, plates, turn tables a curve, track extension, Aerial Ropeways: Types, construction, Application and operation. Mine Locomotives: Types, constructional features of compressed air, diesel, battery and electric trolley-wire locomotives, comparison of various locomotive haulages. Comparison of rope and locomotive haulages. Conveyors: Principle types and their operations, installation, shifting, maintenance and applicability, shuttle cars, stage loaders, bridge conveyors, capacity. Drills for Coal and Stone: Various types, their construction and maintenance, Jumbo drills. Mine Winders: Koepe and Drum winders and their applications, head gear, head gear pulley, shaft fitting – Keps, rope guides, shaft sinking and bells, capping and recapping, cage and suspension gear. Winding Drum-types and construction, Safety devices in winders-over speed and over wind preventers, slow breaking, depth indicator, Methods of counter balancing rope. Duty cycle. Mechanical and electrical braking. Winding from different levels in shaft. Man riding system in underground mines. Face Machinery: SDL & LHD – their applications, capacity, operation, fitting, control and maintenance. Cutter loaders – Shearers, Coal plough and Continuous Miners – their constructional features, applications, capacity and maintenance. Layout of faces with Power loader working under varied condition, Shuttle cars. Pumps: Types, Construction, operation, characteristics and application, Calculation of size, efficiencies and capacities. Layout of drainage system. Opencast Machinery: Blast Hole Drill, Ripper, Shovel, Dragline, Dumper, Bucket Wheel Excavator, Continuous Miners – their basic construction, applications and operation.

Modules:

Module 1: Prime Mover for Mining Machinery: O.C. engine, hydraulic power, pneumatic power, elements of mechanical power transmission – gear, belt, chain, coupling, clutch and brake.

Module 2: Rope haulage: Construction of the wire ropes, rope haulages – gravity, direct, balanced direct, main & tail, endless, reversible endless. Suitability of these haulages and their limitations. Dimension of ropes, drums and pulleys, care and maintenance of

ropes, changing of haulage ropes, rope splicing, safety appliances in haulage road, signaling, Statutory requirements of haulages.

Module 3: Track Laying: Rail, joints, crossings, plates, turn tables a curve, track extension, Aerial Ropeways: Types, construction, Application and operation.

Module 4: Mine Locomotives: Types, constructional features of compressed air, diesel, battery and electric trolley-wire locomotives, comparison of various locomotive haulages. Comparison of rope and locomotive haulages. Conveyors: Principle types and their operations, installation, shifting, maintenance and applicability, shuttle cars, stage loaders, bridge conveyors, capacity.

Module 5: Drills for Coal and Stone: Various types, their construction and maintenance, Jumbo drills.

Module 6: Mine Winders: Koepe and Drum winders and their applications, head gear, head gear pulley, shaft fitting – Keps, rope guides, shaft sinking and bells, capping and recapping, cage and suspension gear.

Module 7: Winding Drum-types and construction, Safety devices in winders-over speed and over wind preventers, slow breaking, depth indicator, Methods of counter balancing rope. Duty cycle. Mechanical and electrical braking. Winding from different levels in shaft.

Module 8: Man riding system in underground mines. Face Machinery: SDL & LHD – their applications, capacity, operation, fitting, control and maintenance. Cutter loaders – Shearers, Coal plough and Continuous Miners – their constructional features, applications, capacity and maintenance.

Module 9: Layout of faces with Power loader working under varied condition, Shuttle cars. Pumps: Types, Construction, operation, characteristics and application, Calculation of size, efficiencies and capacities. Layout of drainage system.

Module 10: Opencast Machinery: Blast Hole Drill, Ripper, Shovel, Dragline, Dumper, Bucket Wheel Excavator, Continuous Miners – their basic construction, applications and operation.

Text/Reference Books:

1. Elements of Mining Technology Vol. III, D.J. Deshmukh, Denett & Company,
2. Coal Mining Series Vol. 1 & II, Ernest Mason, Virtue
3. Mine Transport – N.T. Karelin, Orient Longmans
4. Mining and Transport – S. C. Walker, Elsevier
5. Introduction to Mining Engineers – Hartman. H.L, John Wiley & Sons.
6. Pumps Focus Compressors Walkar wending & Transport, Cherkasky B.M.
7. Mine Mechanisation and Automation, Alemgren G, U. Kumar.

Course Outcomes:

Students can understand mechanism involved in heavy machinery, locomotives used in mines, track laying with different techniques. Different types of drills used in mines, winders applications, winding drum construction, face machinery, open cast machinery like blast hole drill, ripper, dumper, bucket wheel excavator, which will enhance the output of mines.

MN503	UNDERGROUND METAL MINING METHODS	2L:1T:0P	3 CREDITS

Syllabus:

Introduction to Metal Mining: Peculiarities of Metalliferous deposit. Scope and limitations of underground mining, Opening up of underground deposits, choice of entry shaft and combination and their applicability, limitations.
Mine Developments: Methods of developments, Factors effecting choice of level interval, Cross cuts, Drive, shape and size of drive, winzes, Raises, block size, shaft station, ore bin, ore pass and their position in relation to ore body and general scheme of its development. Division of mining area into working units and level pattern, dimensions of panels and blocks.
Stoping: Classification of stoping methods, applicability, limitations, merits and demerits, Factors affecting choice of stopping methods like depth, dip, Width grade / value of deposit, physio mechanical characteristics of the ore and wall rocks. Stope design and production planning in various methods of stoping. Production and cycle time estimates. Stope and development support, mining cycles, shift times, estimating equipment's requirements. Stoping Methods: Stoping without supports: Open stopping, overhand, underhand, breast stoping. Stoping with Supports: shrinkage stopping cut and fill stopping, square set stopping. Caving methods: Top Slicing, sublevel caving and block caving.
Special Stoping methods: Sublevel stoping, long-hole stoping, blast hole stoping, raise stoping, V.C.R Stoping, in-situ leaching, bio-mineral engineering, hydraulic mining, blast hole stoping, underground bench blasting, Extraction of remnant pillars, shaft pillars and contiguous reefs, their supporting system and special precautions during extraction.
Deep mining: concept of deep mining, special problems of deep mining, , salt potash and Sulphur mining and their special problems, stoping practices in rock burst prone mines. Under sea mining, novel mining methods, application of tunnel and shaft boring machines and their applications.

Module

01. Introduction to Metal Mining: Peculiarities of Metalliferous deposit. Scope and limitations of underground mining, Opening up of underground deposits, choice of entry shaft and combination and their applicability, limitations.

2. Mine Developments: Methods of developments, Factors effecting choice of level interval, Cross cuts, Drive, shape and size of drive, winzes, Raises, block size, shaft station, ore bin, ore pass and their position in relation to ore body and general scheme of its development. Division of mining area into working units and level pattern, dimensions of panels and blocks.

3. Stoping: Classification of stoping methods, applicability, limitations, merits and demerits, Factors affecting choice of stopping methods like depth, dip, Width grade / value of deposit, physio mechanical characteristics of the ore and wall rocks. Stope design and production planning in various methods of stoping. Production and cycle time estimates. Stope and development support, mining cycles, shift times, estimating equipment's requirements.

4. Stoping Methods: Stoping without supports: Open stopping, overhand, underhand, breast stoping. Stoping with Supports: shrinkage stopping cut and fill stopping, square set stopping. Caving methods: Top Slicing, sublevel caving and block caving.

5. Special Stoping methods: Sublevel stoping, long-hole stoping, blast hole stoping, raise stoping, V.C.R Stoping, in-situ leaching, bio-mineral engineering, hydraulic mining, blast hole stoping, underground bench blasting, Extraction of remnant pillars, shaft pillars and contiguous reefs, their supporting system and special precautions during extraction.

6. Deep mining: concept of deep mining, special problems of deep mining, salt potash and Sulphur mining and their special problems, stoping practices in rock burst prone mines. Under sea mining, novel mining methods, application of tunnel and shaft boring machines and their applications.

Goals and Outcomes:

On completion of the subject, students will be able to:

1. Explain various terminology and development of underground metal mines.
2. Compare between coal and metal mining.
3. Explain various raising methods in stope development.
4. Explain various stopping methods used in metal mines.
5. Describe about face mechanism.
6. Explain about deep mining.
7. Explain design and planning of various stoping methods for effective production.

Suggested Text books:

1. Introductory Mining Engg: Harman, John Wiley and sons;
2. EMT-D.J Deshmukh **Reference Books:**
3. Deep Mining-jack Spalding, mining publications;
4. P. Darling:"SME Mining engineers hand book"Vol.I&II
5. U/G Mining Method-Hustrulid, society for mining, metallurgy & Exploration
6. Shevyalov:"Mining and mineral deposits". MIR Publishers
7. Popov:"Working of mineral deposits". MIR Publishers

PROFESSIONAL ELECTIVE I

MNP504	OPERATION RESEARCH	2L:1T:0P	3 Credits

Overview:

Operation Research (OR) is application of scientific methods, techniques and tools of mathematical science to problems involving the operations of a system. OR provides the control in the system and its component with optimum solutions to the problems. It is a decision taking tool, which searches for the optimum results in coequality with the overall objectives within the constraints of the organization.

Thus, OR is to solve complex problems that involves management of large systems of men, machines, materials, and money in industry, business, government and defence. The distinctive approach is to develop a scientific model of the system incorporating measurement of factors such as chance and risk, to predict and compare the outcome of alternative decisions, strategies or controls.

Its purpose is to give administration, on the basis of predicting most effective quantitative results of an operation, under given set of variable conditions and thereby to provide a sound basis for "decision-making". Though it is very clear that operation research never make decisions for the management, instead the method presents management with a careful scientific and quantitative analysis of problem so that the management will be in a better position to make sounder decisions.

In the more wide sense, operation research does not deal with the everyday problems such as output by the one worker or machine capacity; instead it is concerned with the overall aspect of business operation such as something as the relationship between inventory, sales, production and scheduling. It may also deal with the overall flow of goods and services from plants to consumers.

The team doing operation research may have, psychologists, labour specialists, mathematicians, analysts, statisticians and others depending upon the requirement for the problems.

Course Description:

This course is an introductory and practical course to the study of operations research application in mining projects. It is designed primarily for mining engineering students to replicate what is happening in the mining industry in classroom so as to be able to apply the knowledge and skills gained during and after course of study to real life situations they might face in the industry. It involves demonstration of principles and techniques of operations research using real life projects. Topics to be covered include operation research and model formulation, solution of the operation research model, phases of an 2 operation research study, techniques of operation research or operations research solution tools such as Linear Programming (LP) (Two phase (two variables) LP, Three phase (three variables) LP); Transportation models, Network models, Queuing systems (models) etc.

The objectives of this course are to:

- Introduce students to the techniques of operations research in mining operations

- Provide students with basic skills and knowledge of operations research and its application in mineral industry
- Introduce students to practical application of operations research in big mining projects

Syllabus:

Introduction: Objectives and scope of Quantitative methods; Classification or types of Quantitative methods; A brief history with particular reference to mining industry.

Linear Programming: Concepts, graphical solutions, simplex method, sensitivity analysis, transportation and assignment problems.

Network Analysis: CPM and PERT methods, their relative suitability vis-à-vis specific applications, time cost trading.

Dynamic Programming: Introduction, basic concept, Stage coach problem.

Stochastic Methods: Discrete and continuous probability distributions, Stochastic process and Markov chains.

Basic queuing models with constant arrival and service rates; inventory models. Monte-Carlo method- Introduction.

Modules:

Module 1: **Introduction and course overview:** Definition of Operation Research, Objectives and scope of Quantitative methods.

Module 2: **Classification of Quantitative methods:** Different types of Quantitative methods.

Module 3: **History of OR:** A brief history with particular reference to mining industry.

Module 4: **Linear Programming Solving Techniques:** Concepts, Graphical solutions and Simplex methods.

Module 5: **Linear Programming Application:** Sensitivity analysis, Transportation and assignment problems.

Module 6: **Network analysis methods:** CPM and PERT methods.

Module 7: **Network analysis method's application and suitability:** Relative suitability vis-à-vis specific applications of CPM and PERT methods and Time cost trading.

Module 8: **Dynamic Programming:** Introduction, basic concept, Stage coach problem.

Module 9: **Stochastic approach to OR:** Discrete and continuous probability distributions, stochastic process and Markov chains.

Module 10: **Problems which involves queuing or waiting:** Basic queuing models with constant arrival and service rates.

Module 11: **Inventory models:** Mathematical models in determining optimum level of inventories.

Module 12: **Introduction to statistical simulation:** Introduction to Monte-Carlo method.

Text/Reference Books:

1. Handy A. Taha, An Introduction to Operation Research, University of Arkansas, Fayettiville. 8th Edition. Pearson Education Inc. London (2003). 81p.
2. Hiller, F.S. And L.J. Lieberman: Introduction to operation research, Holden Day, San Francisco (6th Ed.) (1995).
3. S. Kalavathy,Operations Research, 4th Edition, Vikas Publishing House
4. K.A. Stroud: Further Engineering Mathematics. Programmes and problems. 3rd Edition Macmillan Press Ltd (1996). 974p.
5. P. Herrison, Operational Research: Quantitative Decision Analysis; Mike Morris Publication (1983).
6. TaiwoOwoeye: Operation Research; Olugbenga Press Publication (2001). ISBN 987-2430. 60p
7. Wayne L. Winston. Operation Research Application. 415p

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:

(Knowledge based)

- Explain the meaning of operations research
- Know the various techniques of operations research techniques;
- Apply the techniques used in operations research to solve real life problem in mining industry
- Select an optimum solution with profit maximization;
- Have complete understand of the significant role operation research play in mining
- Project completion at every stage of the mines

(Skills)

Use operations research to:

- Identify and develop operational research models from the verbal description of the real system. E.g. Solve transportation problems during the allocation of trucks to excavators
- Formulate operation research models to solve real life problem
- Proficiently allocating scarce resources to optimize and maximize profit
- Eliminate customers / clients waiting period for service delivery
- Turn real life problems into formulation of models to be solve by linear programming etc.
- Determine critical path analysis to solve real life project scheduling time and timely delivery
- Use critical path analysis and programming evaluation production and review techniques for timely project scheduling and completion and
- Conduct literature search on the internet in the use of operation research techniques in mining projects execution and completion.
- Understand the mathematical tools that are needed to solve optimization problems.
- Use mathematical software to solve the proposed models.
- Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decisionmaking processes in Management Engineering.

MNP50 5	MINE SYSTEM ENGINEERING	2L-1T-0P	3 CREDITS

Syllabus

Introduction to system engineering, system concept analysis, models in system analysis.

System approach to mine design, sub-system, engineering design phases of planning. Economic considerations in planning of opencast and underground mining, optimal size, capacity and development parameters.

Tactical and strategic planning, project planning, project appraisal, prepration of project feasibility report.

Introduction to Statistical decision theory and its applications in the mineral industries, Technological forecasting

Introduction to operations research techniques, network analysis, application of PERT and CPM to mining projects.

Modules

1. Introduction to system engineering, system concept analysis, models in system analysis.
2. System approach to mine design, sub-system and engineering design phases of planning.
3. Economic considerations in planning of opencast mining, optimal size, capacity and development parameters.
4. Economic considerations in planning of underground mining, capacity and development parameters.
5. Tactical and strategic planning, project planning, project appraisal, prepration of project feasibility report.
6. Introduction to Statistical decision theory and its applications in the mineral industries, Technological forecasting
7. Introduction to operations research techniques, network analysis, application of PERT and CPM to mining projects.

Text/Reference Books:

1. Handy A. Taha, An Introduction to Operation Research, University of Arkansas, Fayettiville. 8th Edition. Pearson Education Inc. London (2003).
2. D. Biswas, Modern concepts of Surface Mining
3. W.Hustrulid, M.Kuchta and R.Martin, Openpit Mine Planning and Design.
4. S. Kalavathy,Operations Research, 4th Edition, Vikas Publishing House
5. Wayne L. Winston. Operation Research Application.
6. Surface Mining: Methods, Technologies and Systems. Volume-2
7. SME Mining Engineering Handbook, Third Edition
8. Handy A. Taha, An Introduction to Operation Research, University of Arkansas, Fayettiville. 8th Edition. Pearson Education Inc. London (2003).
9. S.K. Das, Surface Mining Operations.

Goals and Outcomes:

This course qualifies participants to apply an advanced body of knowledge in the area of mine system engineering and equips them with highly developed skills for research and enquiry. Students enrolled in this course will be able to apply the body of knowledge to a range of contexts within the mining industry enabling them to undertake professional or highly skilled work within the mining industry and allow them to undertake further study.

Knowledge:

1. Analyse mining systems used in surface operations
2. Identify and develop operational research models from the verbal description of the real system. E.g. Solve transportation problems during the allocation of trucks to excavators
3. Formulate operation research models to solve real life problem
4. Turn real life problems into formulation of models to be solve by linear programming etc.
5. Determine critical path analysis to solve real life project scheduling time and timely delivery **Skills:**

1. Review, analyze, consolidate and synthesizes knowledge to identify and provide solutions to complex surface mining problems
2. Assess and evaluate complex ideas in mine system engineering and selection of the number required and the size of appropriate equipment
3. Apply specialized technical and creative skills using appropriate tools to solve problems in surface mining.

MNP506	REMOTE SENSING & GIS	2L:1T:0P	3 Credits

Course Objectives:

Remote Sensing and GIS is a relatively young scientific discipline and is an area of emerging technology which has witnessed phenomenal growth over last three decades. In the recent past, there has been tremendous development in the field of Remote Sensing data collection, analysis and utilization. The science of Remote Sensing is no more an art of Map making from satellite image. The digital data handling led to the development of GIS (Geographical Information System) followed by another innovation of GPS (Global Positing System). Remote Sensing coupled with GIS and GPS techniques has dramatically enhanced human capability for resources exploration, mapping and monitoring on local and global scale. The application of Remote Sensing techniques and Geographical Information System (GIS) in various activities including resources evaluation, environmental monitoring and Landuse/Landcover mapping etc, have grown considerably during the last three decades and Remote Sensing data products are being increasingly used for plan information at all levels. An essentials pre-requisite to partaking in these opportunities is the building of various indigenous capacities for the development and utilization of space science and technology. This has led to a spurt in the demand for qualified manpower.

This course is designed to address the following:

- Understanding the Geoinformatics approach
- Teach fundamental principles involved in RS and GIS
- Understand the Fundamentals of Remote sensing Products
- Know the Indian Remote Sensing Program
- Role of Remote Sensing for various surveys and information extraction
- Know about different software available in RS and GIS
- Learn fundamental procedures in RS and GIS
- Teach data integration and defining problems in digital format

Syllabus:

Definition & Scope of Remote Sensing: Electromagnetic energy & spectrum, Atmospheric windows. Remote Sensing Systems, Sensors & Scanners, Resolution of sensors, Multispectral, thermal & Radar data. Radiometers, spectral Signatures. Elements of Remote Sensing Systems: Terrestrial, airborne &spaceborne platforms, sunsynchronous & Geostationary satellites. Various earth resources satellites, Indian Remote sensing Programs. Remote Sensing Data products & their types: Analogue & Digital data Formats, errors. Interpretation Techniques: Elements & Methods of interpretation, Relief displacement and vertical exaggeration, Photogrammetric determination of elevation from Remote Sensing Data. Digital Image Processing: Image rectification & restoration, image enhancements, image classification; supervised & unsupervised, accuracy assessments. Geographical Information Systems: Raster & Vector Data, Components of GIS, concepts & basic characteristics of Vectorization, topology generation, attribute data attachment, editing and analysis. Buffer, Overlay and Interpolation techniques. Managing networks in GIS. Global Positioning Systems: Types and method. Applications: Integrated approach of RS & GIS application; Geotechnical investigations (soil studies, dam site studies), water resources management, environmental studies (EIA and Land Use Land cover studies), transportation planning, Urban Planning, E-Governance.

Modules

Module 1: Definition & Scope of Remote Sensing: Electromagnetic energy & spectrum, Atmospheric windows. Remote Sensing Systems, Sensors & Scanners, Resolution of sensors, Multispectral, thermal & Radar data. Radiometers, spectral Signatures.

Module 2: Elements of Remote Sensing Systems: Terrestrial, airborne &spaceborne platforms, sunsynchronous & Geostationary satellites. Various earth resources satellites, Indian Remote sensing Programs.

Module 3: Remote Sensing Data products & their types: Analogue & Digital data Formats, errors.

Module 4: Interpretation Techniques: Elements & Methods of interpretation, Relief displacement and vertical exaggeration, Photogrammetric determination of elevation from Remote Sensing Data.

Module 5: Digital Image Processing: Image rectification & restoration, image enhancements, image classification; supervised & unsupervised, accuracy assessments.

Module 6: Geographical Information Systems: Raster & Vector Data, Components of GIS, concepts & basic characteristics of Vectorization, topology generation, attribute data attachment, editing and analysis. Buffer, Overlay and Interpolation techniques. Managing networks in GIS.

Module 7: Global Positioning Systems: Types and method.

Module 8: Applications: Integrated approach of RS & GIS application; Geotechnical investigations (soil studies, dam site studies), water resources management, environmental studies (EIA and Land Use Land cover studies), transportation planning, Urban Planning, E-Governance.

Text/Reference Books:

1. M. Anji Reddy BS Publications Remote Sensing and Geographical Informatiotn Systems Third Edition.
2. C.P LO Albert KW Yeung, Concepts and techniqes of Geographic Infromation Systems Pritince Hall of India 2002.
3. John R Jensen Remote Sensing of the Environment ..an Earth Resource Perspective Pearson Education 2006.
4. Geographic Informaiton System and Enviornment Modeling Keith C. Clerk, Bradely O Parks, Michel P Crane Pritince Hall of India 2002.
5. Bhatta Remote Sensing and GIS Oxford University press First Edition.Surveying (Vol – 1,2 & 3), by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) Ltd., New Delhi.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- Know Understand the remote sensing process;
- Understand digital data in different and their formats
- Know about National and International RS Programs
- Know about various satellites and images
- Know about changing field practices in Survey
- Know how to generate different types of digital data
- Know about Application areas

(Skills)
Use operations of RS & GIS to:

- Geotechnical investigations (soil studies, dam site studies)
- Water resources management
- Environmental studies (EIA and Land Use Land cover studies) Transportation planning, Urban Planning, E-Governance.

MNP507	NUMERICAL TECHNIQUES IN GEO-MECHANICS	2L:1T:0P	3 credits

Overview:

Numerical Techniques in Geo-Mechanics is the application of Numerical Methods in Geomechanics (i.e. Rock Mechanics and Soil Mechanics). The Course aims to introduce the extended evaluation of safety, regarding collapse or excessive settlement, for slopes, surface, and underground earth works using Numerical Simulation. The perception is to Practice Numerical Techniques in Rock and Geotechnical Engineering. The course is intended for sixth semester students of B. Tech degrees in Civil and Mining Engineering (Geotechnics, Mining Structures). Also, for professionals with an interest in the area of Geomechanics (like Geotechnical Engineers, Structural Foundation Designers and Geology Engineers) and people interested in research in applied numerical methods.

Since the Course is promoted by a Research Group in Computational Mathematics applied to Geomechanics, applications of different Numerical Methods and Techniques are particularly stressed.

Course Description:

This course starts with Principle of continuum mechanics and Numerical Methods. It will elaborate the different numerical methods for Mathematical Modelling and need of Numerical Modelling in designing excavation by analysing stresses around the excavation. The course will also explain different Numerical Techniques such FDM, FEM, BEM and introduction to some software's based on these techniques.

The objectives of this course are to:

- Introduce students to application of Numerical Methods in Mathematical Modelling
- Introduce students to practical application of Numerical Simulation in civil and mining industry
- Introduce students to different Numerical Techniques and software's based on this.

Syllabus:

Introduction: Principle of continuum mechanics, Numerical methods: Numerical Methods in general, Numerical Methods in Linear Algebra; Need for numerical modelling in design of excavation in mines, domain and boundary conditions, discretisation of domain and boundary, principal methods of numerical simulation for excavation in mining (FEM, FDM, & BEM; reference to geomechanics).

Finite Element Method: Basic principle, assembling elements to form a structural stiffness matrix, imposing boundary conditions, solving structural equations using plane truss, elements on assumed displacements, constant strain triangle, iso-parametric formulation. Finite Difference Method: Basic principle, explicit finite difference method, finite difference equation, solution stability.

Boundary Element Method: Basic principle, introductory ideas of its application in mining excavations.

Introduction to numerical modelling packages: ANSYS, PLAXIS, FLAC etc.

Modules:

1. **Introduction:** Principle of continuum mechanics, Numerical Methods in general, Solution of Equations by Iteration, Interpolation.

2. **Numerical Integration and Differentiation:** Numerical Integration and Differentiation
3. **Numerical Methods in Linear Algebra:** Linear systems: Gauss Elimination, Solution by Iteration.
4. **Numerical Modelling:** Need for numerical modelling in design of excavation in mines, domain and boundary conditions and its application in Mathematical Modelling.
5. **Finite Element Method:** Basic principle, assembling elements to form a structural stiffness matrix, imposing boundary conditions, solving structural equations using plane truss, elements on assumed displacements, constant strain triangle, isoparametric formulation.
6. **Finite Difference Method:** Basic principle, explicit finite difference method, finite difference equation, solution stability.
7. **Boundary Element Method:** Basic principle, introductory ideas of its application in mining excavations.

Text/Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th edition; John wiley & sons, Part E (Numerical Methods)
2. Debasis Deb, Finite Element Method: Concept and Applications in Geomechanics; Prentice Hall of India
3. J. B. Martins, Numerical Methods in Geomechanics; Springer
4. G. Swoboda, Numerical Methods in Geomechanics, 6th edition; CRC Press
5. http://vle.du.ac.in/course/view.php?id=562 **Goals & Outcomes:**

Upon successful completion of this course, the student will be able to:

(Knowledge based)

- Understand different Numerical Methods.
- Identify and apply different Numerical Methods in different kind of Modelling
- Understand working of different FEM/ FDM/ BEM based software's

(Skills)

Use Numerical Techniques in Geomechanics to:

- Analyse and evaluate different kind of Numerical Techniques (FEM) for different conditions
- Can use different software's for designing Civil and Mining structures

Able to write some programmes for various applications in Civil and Mining Industry

OPEN ELECTIVE I

MNO508	MINERAL PROCESSING ENGINEEINRG	2L:1T:0P	3 Credits

Course Objectives:

This course introduces objectives of mineral processing, characteristics of minerals and coal, crushing methods, separation methods, methods of concentration, fields of application and limitations. Upon completion of the course, students will possess the knowledge needed to design a mineral processing operation that ensures maximum profitability for a mining company while achieving the required product quality specifications. Students will understand the methodology used to select the appropriate unit operations, determine the optimum operating conditions and select the required size of the unit. A knowledge of product quality assurance programs that includes the monitoring of plant efficiency will be demonstrated.

Syllabus:

Scope, objectives and limitations of mineral processing, liberation and beneficiation. Comminution: Theory and practices of crushing and grinding; different types of crushing and grinding equipment's – their applications and limitations. Laboratory size analysis and interpretation; settling of solids in fluids; industrial screens, mechanical classifiers and hydro cyclones. Gravity Concentration Methods: Jigging, Heavy media separation, flowing film concentrators–theory, applications and limitations. Physico-chemical principles, reagents, Machines, floatation of sulphides and oxides ores and coals. Magnetic methods of concentration Principles, Applications and limitations of magnetic concentration, Electric methods of concentration Principles, High tension and low-tension electric concentration, Ore sorters, Dewatering: Thickeners, filters, thermal drying. Simplified flow sheets for coal, zinc, iron, and manganese ores. Magnetic methods of concentration Principles, Fields of Application and Limitation.

Modules:

Module 1: Introduction: Scope, objectives and limitations of mineral processing, liberation and beneficiation.
Module 2: Comminution: Theory and practices of crushing and grinding; different types of crushing and grinding equipment's – their applications and limitations.
Module 3: Size Separation: Laboratory size analysis and interpretation; settling of solids in fluids; industrial screens, mechanical classifiers and hydro cyclones.
Module 4: Gravity Concentration Methods: Jigging, Heavy media separation, flowing film concentrators–theory, applications and limitations.
Module 5: Froth Floatation: Physico-chemical principles, reagents, Machines, floatation of sulphides, oxides and coal.
Module 6: Electrical and magnetic methods of concentrating technique: Magnetic methods of concentration Principles, Applications and limitations of magnetic concentration, Electric methods of concentration Principles, High tension and low-tension electric concentration, Ore sorters,

Module 7: Dewatering: Thickeners, filters, thermal drying.
Module 8: Flow Sheets: Simplified flow sheets for coal, copper, lead and zinc, gold, uranium, iron, manganese and lime stone ores, Laboratory sampling.

Module 9: Industrial lectures: Case studies of mineral processing plant projects by industry professionals, covering comprehensive planning to commission the same.
Module 10: Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Mineral Processing Technology, Possibilities for creative & innovative working in this field,

Text/Reference Books:

1. Introduction to Mineral Processing – V. Malleswar Rao, Indian Academy of Geoscience
2. Mineral Processing – Barry A Wills, Elsevier.
3.Mineral Processing – S.K. Jain, CBS Publishers & Distributors
4. Mineral beneficiation a concise basic course by D.V. Subba rao
5. J. W. Leonard and B. C. Hardinge, Coal Preparation, Society for Mining, Metallurgy and Exploration, Inc., Littleton, CO, ISBN 0-87335-104-5, 1991.
6. N. L. Weiss, SME Mineral Processing Handbook, Volumes 1 and 2, Society for Mining, Metallurgy and Exploration, Inc., Littleton, CO, ISBN 0-89520-433-6, 1985.

Course goals and outcomes:

At the end of the course, students will be able to learn the following points which are given below:

1. Understand Scope, objectives and limitations of mineral processing and theory of Comminution
2. Understand basic concepts of Size Separation
3. Understand basic concepts Froth Floatation
4. Understand Applications and Limitations of Concentrating techniques
5. Understand various Flow Sheets
6.Develop processing flow sheets for the production of aggregates and mineral concentrates from raw ore material
7. Obtain the knowledge for the typical process circuits used to treat aggregates and ores containing one or more valuable minerals.
8. Conduct mass and water balances throughout the process flow sheet.
9. Predict solid-solid and solid-liquid separation performances based on known physical properties of the raw material and process unit models.
10. Determine the process unit, size and number needed to effectively achieve solid-solid separations and solid liquid separations.

MNO509	BULK MATERIAL HANDLING	2L:1T:0P	3 Credits

Course Objectives:

When the students enter the college to pursue a degree in Mining Engineering and as well pursue a career in Mining Engineering after graduation, they need to understand the breadth and depth available in this field for different bulk material handling system. When many alternative disciplines of engineering appear to offer apparently more glamorous avenues for advancement, the Mining Engineering student should realize the solid foundations available in this mother of all engineering disciplines. The students should understand the enormous possibilities available for creative and innovative works in this all-pervasive field of engineering. This course introduces material handling and transportation concept, Operation and maintenance of different conveying system, Design of transportation system and different storage systems etc.

This course is designed to address the following:

- To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Mining Engineering
- To motivate the student to pursue a career in one of the many areas of Mining Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

Syllabus:

Properties of the bulk material vis-à-vis different bulk handling operations. Classification of bulk material transportation system: Road transport system, Rail transport system, pipe line transport system, conveyor transport system. Design, operation and maintenance: Belt conveyors. High angle conveyors, Cable belt conveyors, Booster belt conveyors - their selection and application in the mining industry. Design and operation of slurry transport of minerals and mining wastes. Operation and maintenance of Stacker, Reclaimer and Spreader. Hydraulic and pneumatic conveying, stacking and blending, reclaiming of bulk materials. Automation and online monitoring of bulk material handling system, Storage systems: Silos, bins and bunkers. Rapid loading system, Merry-go-round system.

Modules:

Module 1: Introduction to Bulk Material Handling: Properties of the bulk material vis-àvis different bulk handling operations

Module 2: Classification of Bulk Material transportation System: Road transport system, Rail transport system, pipe line transport system, conveyor transport system.

Module 3: Design, Operation and Maintenance of different types of Conveyor: Belt conveyors. High angle conveyors, Cable belt conveyors, Booster belt conveyors -their selection and application in the mining industry.

Module 4: Design, Operation and Maintenance of slurry transport system: Design and operation of slurry transport of minerals and mining wastes.

Module 5: Operation and Maintenance of material handling machines: Operation and maintenance of Stacker, Reclaimer and Spreader

Module 6: Hydraulic and pneumatic conveying system: Hydraulic and pneumatic conveying, stacking and blending, reclaiming of bulk materials.

Module 7: Automation and online monitoring: Automation and online monitoring of bulk material handling system,

Module 8: Storage System: Storage systems: Silos, bins and bunkers. Rapid loading system, Merry-go-round system.

Module 9: Industrial lectures: Case studies of large tunneling and shaft sinking engineering projects by industry professionals, covering comprehensive planning to commission the same.

Module 10: Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Tunneling Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in tunnel excavation method.

Text/Reference Books:

1. Design and Selection of Bulk Material Handling Equipment and Systems Vol II, Jayanta Bhattacharya
2. Design and Selection of Bulk Material Handling Equipment and Systems: Mining Mineral Processing Port Plant and Excavation Engineering: Vol. I, Jayanta Bhattacharya
3. Hand Book of Bulk Materials Handling, Fruchtbaum, Jacob
4. Material Handling – Principles and Practices by Allegri (Sr.), T.H CBS Publishers and Distributors, Delhi, 1987.
5. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990.
6. Peng, S.S., and Chiang, H.S., Longwall Mining, John Wiley and Sons, New York, 1984.
7. Hartman, H.L., (Ed.), SME Mining Engg. Handbook Vol. I and II, 8. Society for Mining, Metallurgy, and Exploration, Inc., Colorado, 1992.

Course Goals & Outcomes:

1. Introduction to what constitutes Bulk material handling system.
2. Highlighting the depth of engagement possible within each of these areas.
3. Exploration of the various possibilities of a career in this field.
4. Understanding the vast interfaces this field has with the society at large.
5. Providing inspiration for doing creative and innovative work in bulk material handling system.
6. Highlighting possibilities for taking up entrepreneurial activities in this field.
7. Providing a foundation for the student to launch off upon an inspired academic pursuit into this subject of engineering.
8. Know about material handling system, different material handling methods.
9. Student gets knowledge about design, operation and maintenance of different conveying system i.e. hydraulic, pneumatic, slurry transportation system etc.

MNO510	CLEAN COAL TECHNOLOGY	2L:1T:0P	3 Credits

Course objectives:

The course outlines the current changes and developments in the coal combustion-related processes. The course objectifies with the aim of utilizing the energy from coal and its byproducts efficiently, such that minimal amount of waste generation and disposal takes place. The course aims at stating the physical and chemical process working under the carbon capture, and sequestrations. Clean coal technology works around the foundation to create minimal impact on the environment.

Syllabus:

Definition and objectives. Classification of CCT's. Carbon sequestration and storage of CO_2, coal bed methane recovery and its utilization, underground coal gasification (in-situ and surface gasification), Coal production and utilization trends., Life cycle of coal, Status of coal utilization technology and related operating and environmental problems. coal characterization and qualities and their effect on selection of efficient methods for ecofriendly utilization of coal. classification system of coal, rank and grade of coal. Necessity, scope and limitations of pre-combustion coal cleaning technology. Wash ability characteristics and preparation problems related to coal quality. Principles, operations and selection of processes for coal preparation. Plant performance evaluation and forecasting of cleaning results. Environmental problems and related mitigating measures. Fluidized bed combustion techniques, integrated gasification combined cycle (IGCC) and their co – generation options. Necessity, scope and limitations of combustion and post-combustion clean coal technologies. Developments, basic principles, operating features of clean coal technologies. Selection, performance and related environmental problems and their control. Characterization, impacts, control, treatment and safe disposal of wastes and pollutants released from various stages of clean coal technologies. Utilization of wastes and pollutants.

Modules:

Module 1: Introduction to CCT: Definition and objectives. Classification of CCT's. Carbon sequestration and storage of CO2, coal bed methane recovery and its utilization, underground coal gasification (in-situ and surface gasification),

Module 2: Coal characterization and utilization: Coal production and utilization trends., Life cycle of coal, Status of coal utilization technology and related operating and environmental problems. coal characterization and qualities and their effect on selection of efficient methods for eco-friendly utilization of coal. classification system of coal, rank and grade of coal.

Module 3: Pre-combustion techniques: Necessity, scope and limitations of pre-combustion coal cleaning technology. Wash ability characteristics and preparation problems related to coal quality. Principles, operations and selection of processes for coal preparation. Plant performance evaluation and forecasting of cleaning results. Environmental problems and related mitigating measures.

Module 4: Combustion techniques: Fluidized bed combustion techniques, integrated gasification combined cycle (IGCC) and their co – generation options.

Module 5: Post combustion techniques: Necessity, scope and limitations of combustion and post-combustion clean coal technologies. Developments, basic principles, operating features of

clean coal technologies. Selection, performance and related environmental problems and their control.

Module 6: Waste management and Pollutants: Characterization, impacts, control, treatment and safe disposal of wastes and pollutants released from various stages of clean coal technologies. Utilization of wastes and pollutants.

Module 7: Industrial lectures: Case studies of coal preparation plant projects by industry professionals, covering comprehensive planning to commission the same.

Module 8: Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Clean Coal Technology, Possibilities for creative & innovative working in this field to extend a practicable solution to coal industries.

Reference/text books:

1. Clean Coal Technologies for Power Generation by P Jayrama Reddy.
2. Clean Coal Engineering Technology by Bruce Granville Miller.
3. Clean Coal Technology and Sustainable Development from Proceedings of the 8th International Symposium on Coal Combustion. -**Yue**, Guangxi, **Li**, Shuiqing, (2016).
4. Clean Coal Engineering Technology: Bruce G Miller, Elsevier Publications.
5. Fuels and Combustion: Samir Sarkar, University Press (India) Pvt Limited, India.
6. The Chemistry and Technology of Coal: James G Speight, Marcel Dekker.

Course goals and outcomes:

1. After successful completion of the course the learner will be able to:
2. List the new technologies for coal-fired power generation.
3. Identify policy considerations and outline future aspects for coal use.
4. Examine new technologies for clean coal and analyze commercial viability of new technologies.
5. Assess technologies in clean coal to technologies in energy alternatives.

MNO511	INTERNET OF THINGS (IoT)	2L:1T:0P	3 CREDITS

Course Objective

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defense sectors. This course is designed to address the following: Similarly, for safety critical industry like of mining industry application of IoT has potential to open up the opportunities of enhancement of operational safety and productivity.

Purposes of this course is:

- To get the students acquainted with upcoming trend of using sensor networks in Mining Industry.
- To learn the basic concepts of IoT.
- To learn the different communication schemes and protocols used in IoT To lean the data management techniques in IoT.

Syllabus

Importance of sensor networking in mining and other safety critical industries.

Introduction to IoT: functional layers of IoT, Sensing, Actuation, data warehousing and analytics.

Basics of Networking, Communication Protocols, Networking Hardwares

Sensor Networks: Machine-to-Machine Communications, Interoperability in IoT.

SDN for IoT, Cloud Computing for IoT, Fog Computing in IoT context,

Industrial IoT: Impact in Security, Data Integrity, Ease of industrial operations management.

Modules

1. Importance of sensor networking in mining and other safety critical industries.
2. Introduction to IoT: functional layers of IoT, Sensing, Actuation, data warehousing and analytics.
3. Basics of Networking, Communication Protocols, Networking Hardwares
4. Sensor Networks: Machine-to-Machine Communications, Interoperability in IoT.
5. SDN for IoT, Cloud Computing for IoT, Fog Computing in IoT context,
6. Industrial IoT: Impact in Security, Data Integrity, Ease of industrial operations management.

Text/Reference Books:

1. Related Magazines and Research Articles
2. Online Blogs on IoT
3. NPTEL lecture Notes of Prof. Sudip Mishta

Goals & Outcomes:

- Making students aware of applications of IoT in Mining Industry scenario.
- Getting overall knowledge of IoT ecosystem.
- Making the students aware of different technical perspective of sensor networking.

PRACTICALS

MN 501P	MINE VENTILATION ENGINEERING LAB	0L:0T:2P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Study of whirling and fixed hygrometer and estimation of relative humidity.
2.	Study of whirling and fixed hygrometer and estimation of relative humidity.
3.	Study of kata thermometer and determination of cooling power in mine air.
4.	Determination of air velocity and air quantity measurement by vane anemometer.
5.	Determination of effective temperature using dry and wet bulb temperature.
6.	Study of co and h_2s detectors and determination of their percentage.
7.	Determination of inflammable gas percentage by MSA d6 Methanometer.
8.	Study of various types of flame safety lamps.
9.	Study of various types of fans and their characteristic curves and their use in locating efficient operating point.
10.	Determination of parallel and series operation of fan.
11.	Determination of air pressure by inclined tube manometer.

MN 502P	MINING MACHINERY LAB	0L:0T:2P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Study and sketch of various types of wire ropes construction.
2.	Study of friction props.
3.	Study and sketch of hydraulic props (close and open circuit).
4.	Study and sketch of safety devices in haulage roads.
5.	Study and sketch of coal drill and bits.
6.	Study and sketch of jack hammer drill.
7.	Study and sketch of side discharge loader and load haul dumper.
8.	Study and sketch of chain conveyor & belt conveyor.
9.	Study and sketch of suspension gear arrangements in friction and drum winders.
10.	Study and sketch of various safety hooks in winding.
11.	Study and sketch of safety devices used in winders.
12.	Study and sketch of face pumps and their operations.

MN 503P	INTERNET OF THINGS LAB (IoT LAB)	0L:0T:2P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Setting up a programming environment for Arduino Boards and programming in emulators.
2.	Handling Digital display and LED panels with Arduino
3.	Interfacing methods for digital and analog sensors and logging data with timestamp.
4.	Interfacing Gas Sensors with Arduino controllers.
5.	Serial, I2C and SPI communication.
6.	Wireless communication Modules.
7.	Introduction to IoT development boards with inbuilt wireless capability.
8.	Introduction to Embedded Computer and their programming.
9.	Introduction of designing Device schismatics with KiCad (Open Source)
10.	Introduction to custom PCB Design using KiCad (Open Source)
11.	Localization of Wireless Sensor Devices with RSSI data
12.	Setting up local servers for handling and storage of IoT sensors data.
13.	Use of cloud servers for developing IoT Platforms
14.	Data Analytics with IoT sensors acquitted data.
15.	Designing of user interfaces for IoT data visualization.
16.	Modelling Sensor Networks with Network Emulators.

MN 504P	MINE DESIGN - II LAB	0L:0T:2P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Study of bely conveyor and carrying capacity determination.
2.	Study of direct rope haulage capacity calculation.
3.	Determination of factor of safety of winding rope.
4.	Study of winding pulley and calculation of fleet angle.
5.	Study of torque - time diagram in friction and drum winder.
6.	Determination of load on longwall face and choice of suitable power support.
7.	Production design of mechanized longwall face (AFC & Shearer).
8.	Production design of mechanized B & P using continuous miner technology.
9.	Blast design for given production of an opencast mines.
10.	Design of open pit slope for stability.
11.	Study of bucket wheel excavator in an opencast mine.
12.	Study of Surface Miner in an opencast mine.

MN60 1	MINE ENVIRONMENTAL ENGINEERING	3L:1T:0P	4 CREDITS

Course objective

Assess environmental issues associated with air, land, and water systems and their accompanying human health and ecological impacts due to mining activities. Synthesize technical knowledge of engineering analysis and design to identify, formulate, and solve problems of professional interest and importance. This course streams into more specialised areas including: water quality engineering, air and noise pollution control, solid and hazardous waste management, environmental engineering design, and site remediation related to mining engineering.

Course content

Land environment: visual impacts, landscape analysis, land use, landscape planning, physical reclamation and subsidence management. Land reclamation principles and requirement; Topsoil management inventory, removal, preservation and redistribution; Ecological restoration technology –objectives and guidelines ;Technical reclamation – stability, drainage and erosion control; Factors effecting the development of vegetation cover in mine degraded areas; estimation of sediment load and design of sedimentation pond; Mine closure planning – environmental impacts of mine closure, development of closure plan, closure guidelines, mine closure activity, closure cost.

Water regime: Water quality – physical, chemical, biological, criteria and standards, Waste water management – sources characteristics, techniques of treatment. Acid mine drainage – occurrence, effects and treatment techniques. Groundwater hydrology: Measurement of yield, Laws of groundwater movement: Darcy`s law, Thiems equilibrium formula, Duipuits formula etc. CPCB standards.

Air pollution: sources of gaseous and particulate pollutants , their physical, chemical(special preference to greenhouse gases and ozone)physiological effects Classification of Air Pollutants, Particulates and Gaseous pollutants, Sources of air pollution, Effects of air pollution on Human Beings, Materials, Vegetation, Animals. Major Global and Regional impacts, monitoring and control.control of air borne respirable dust : ventilation , water spray, cyclone dust collector, dust filtration , dust scrubber. Control technologies of motor vehicle emissions and indoor air pollution.CPCB standards for air pollution control.

Noise pollution/ ground vibration: Fundamentals of Noise: Basics of Acoustics: Sound power, Sound intensity and Sound pressure levels; Plane, Point and Line sources, Multiple sources; Outdoor and indoor noise propagation; Effects of noise –noise induced deafness, presbycusis, acoustic trauma, other physiological and psychological effects; Noise standards and indices. Vibration problems in surface mines and control measures. Ground Vibration and Air Blast -Environmental impacts, strategic planning and abatement/ prevention.

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

Learning outcomes:

After successful completion of the course the learner will be able to:

- Identify, formulate, and solve complex mine environmental engineering problems in land degradation ,water and wastewater, air pollution, solid waste, and related areas by selecting and applying appropriate tools and techniques.
- Specify or design unit processes or systems associated with traditional areas of environmental engineering.
- Synthesize advanced technical knowledge in a traditional or emerging specialization area of mine environmental engineering.

References /textbooks

- Environmental Land use planning and Management, John Randolph, Island Press,
- Land Use in Mining Areas of India, Rekha Ghosh, Envis, ISM Dhanbad, ISSN 0972 4656.
- Eco restoration of the coalmine degraded lands- Subodh Kumar Maiti, Springer (2013).
- Air Pollution Control Equipment. H. Brauer and Y. B. G. Verma, Berlin Heidelberg, New York, latest edition.
- Environmental Impact of Mining – Down CG and Stocks J. Applied Science Publishers, London,1978.
- Best Practices Environmental Management in Mining" - EPA (Australia): 1997-2004.
- Environmental Management in Mining Areas– Saxena NC, Singh Gurdeep and Ghosh R, (Ed.), Scientific Publishers (India), Jodhpur 2003.
- Industrial Noise Control and Acoustics – Randall F Barron, Marcel Dekker, Inc., New York, 2003.
- Engineering Noise Control: Theory and Practice – David Bies et. al., Routledge Publishers, 2003.
- Vibrations – Balakumar Balachandran and Edward B. Magrab, Thomson Asia Pte. Ltd., Singapore, 2003.
- Noise control: Principles and Practice - Bruel & Kjaer, 2nd ed. B & K Pub., Denmark, 1986.

MN602	ROCK MECHANICS	2L: 1T: 0P	3. Credit

Course Objective

The course is designed to provide a better understanding to evaluate physico-mechanical properties of rocks, elastic and time dependent behavior, laboratory and field test procedure, rock mass characteristics. Theories of rock failure, Influence of water on rock and soil behavior. Dynamic characteristics of rocks. Concept of in - situ stress and post mining redistribution of stress.

Syllabus

Concept of stress and strain in rock: Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks. Physico-mechanical properties rocks: Determination of physical properties, strength, strength indices and static elastic constants, parameters influencing strength, abrasivity and its determination. Physico-mechanical properties of soil: Physico-mechanical properties including consistency and gradation, classification of engineering soils, engineering properties of soils- compressibility, consolidation, compaction and strength. Time dependent properties of the rock. Creep formation and strength behavior, creep test and simple rheological models. Behavior of Rock Mass: Rock mass structure, in-situ elastic properties and strength determination. Failure criteria for rock and rock mass: Theories of rock failure, Column, Mohr, Griffith and Empirical criteria. Pre-mining state of stress: Sources, methods of determination including over coring and hydro-fracturing methods. Ground water: Influence of water on rock and soil behavior, permeability of rocks, measurement of permeability, ground water flow in rock mass, measurement of water pressure. Dynamic property of the rock and rock mass: Propagation of elastic wave in rock media, determination of properties and elastic constants.

Modules

Module 1. Introduction to Stress and Strain:

Concept of stress and strain in rock, Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks.

Module 2. Physico-mechanical properties rocks:

Determination of physical properties, strength, strength indices and static elastic constants, parameters influencing strength, abrasivity and its determination.

Module 3.Time dependent properties of the rock:

Creep formation and strength behavior, creep test and simple rheological models.

Module 4. Behavior of Rock Mass:

Rock mass structure, in-situ elastic properties and strength determination.

Module 5. Rock mass Failure criteria:

Failure criteria for rock and rock mass. Theories of rock failure, Coulomb - Navier, Mohr, Griffith and Empirical criteria.

Module 6. Influence of water on rock and soil behavior:

Ground water: Influence of water on rock and soil behavior, permeability of rocks, measurement of permeability, ground water flow in rock mass, measurement of water pressure.

Module 7. Dynamic behavior of Rock and Rock mass:

Dynamic property of the rock and rock mass. Propagation of elastic wave in rock media, determination of properties and elastic constants.

Text/Reference Books:

1. Fundamental of Rock Mechanics by J.C Jaeger & N.G.W. Cook, Blackwell Publishing
2. Coal Mining ground Control by Syd S. Peng, West Virginia University.
3. Rock Mechanics for underground Mining– BHG Brady & E T Brown, George Allen & Unwin Ltd, 1992.
4. Introduction to Rock Mechanics, Second Edition, Richard E. Goodman
5. Fundamental and Applied Rock Mechanics, D. Deb, A.K. Verma

Course Outcome:

After completion of the course, students will be able to:

1. Understand mechanical properties of rock, different theories of rock failure.
2. Know Causes and impacts of rock failure, rock strength and stresses induced in rocks.
3. Understand the time dependent deformation in rock structure.
4. Understand the effect of water on rock structure and their stability.
5. Understand the dynamic characteristics of rock and rock mass.

MN603	ADVANCED UNDERGROUD COAL MINING METHODS	2L: 1T: 0P	3. Credit

Course Objective

After getting exposed to basics of mining engineering, students should get a dig into different types of mines. When it comes to coal mines, especially underground coal mines where there is relatively high risk compare to other mines, students should be well familiar with risks and challenges associated with them, thus requiring some case studies essentially. Advance Underground coal mining methods covers many working methods which are applicable within different and rare circumstances. Students, after going through this subject, will be benefitted with deep knowledge of underground coal mining, as they have some basics in earlier.

This course is designed to address the following:

- To expose the students with the knowledge of special working methods carried out for abnormal cases.
- To expose the students with modern methods being carried out across the globe.
- To encourage the students for some innovative works by the exposure of some case studies.

Syllabus

Thick Seam Mining: Concept of thick seam, problems of the mining thick seams, past experience of working thick seams by Bord & Pillar method in multi sections. Modern multi-slicing method - incline slicing, horizontal slicing, cross slicing in ascending and descending order. Equipments for thick seam mining. Case Studies. Advanced Underground Winning Methods: Sublevel Caving, Integral Caving, Blasting Gallery Method, Descending Shield Method, Hydraulic Mining, Bhaska and Tipong Method. Case Study. Steep Seam Mining: Mining technology of inclined and steep seams Thin Seam Mining: Problems in thin seam mining, equipment and methods for thin seam extraction. Case Study. Underground Coal Gasification and Coal Bed Methane: Basic concepts, applications and limitations of the methods with case studies.

Modules

1. **Thick Seam Mining:** Concept of thick seam, problems of the mining thick seams, past experience of working thick seams by Bord & Pillar method in multi sections.
2. **Modern multi- slicing method:** incline slicing, horizontal slicing, cross slicing in ascending and descending order. Equipments for thick seam mining. Case Study.
3. **Advanced Underground Winning Methods:** Sublevel Caving, Integral Caving, Blasting Gallery Method, Descending Shield Method, 4. **Hydraulic Mining:** Bhaska and Tipong Method. Case Study.
5. **Steep Seam Mining:** Mining technology of inclined and steep seams
6. **Thin Seam Mining:** Problems in thin seam mining, equipments and methods for thin seam extraction. Case Study.
7. **Underground Coal Gasification (UCG):** Basic concepts, applications and limitations of the methods with case studies.

8. **Coal Bed Methane:** Basic concepts, applications and limitations of the methods with case studies.

Text/Reference Books:

1. Principles and Practices & Modern Coal Mining, R.D. Singh,New Age International Publication.
2. Underground Mining & Coal, Singh, T.N. Singh – Oxford Publication.
3. Modern Coal Mining Technology, Das S.K. – Lovely Prakasan publication.
4. Longwall mining, Peng S.S., Chiang H/S. – John Willey Publication.
5. Mine Planning for Coal, Mathur S.P. – M.J Consultant Publications.
6. Winning and Working Coal in India Vol.II- R.T. Deshmukh and D.J.Deshmukh, Dhanbad Publishers
7. Underground Coal Mining Methods – J.G. Singh, Braj-Kalpa Publishers.

Goals & Outcomes:

After completion of the course, students will be able to:

1. Understand mine planning, opening of deposits, pillar development, pillar extraction, Layout required for out puts, long well mining, mechanized extraction of long wall panel.
2. Understand the concept of gasification, Technology involved in it, Non-mining methods of UCG, Gasification at great depth, merits and demerits, Future scope and Development.

PROFESSIONAL ELECTIVE II

MNP604	ROCK EXCAVATION ENGINEERING	2L:1T:0P	3 Credits

Course Objectives:

When the students enter the college to pursue a degree in Mining Engineering and as well pursue a career in Mining Engineering after graduation, they need to understand the breadth and depth available in this field for different rock excavation methods. When many alternative disciplines of engineering appear to offer apparently more glamorous avenues for advancement, the Mining Engineering student should realize the solid foundations available in this mother of all engineering disciplines. The students should understand the enormous possibilities available for creative and innovative works in this all pervasive field of engineering.

This course is designed to address the following:

- To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Mining Engineering
- To motivate the student to pursue a career in one of the many areas of Mining Engineering with deep interest and keenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.

Syllabus:

Scope and importance: Rock excavation engineering in mining and construction industries; physico-mechanical and geotechnical properties of rocks Vis-à-vis excavation method; selection of excavation method.

Drilling: Mechanics of rock drilling; design and operating parameters of surface and underground drilling; evaluation of drill performance; drillability of rocks; mechanism of bit wear; bit selection; problems of drilling; economics of drilling.

Blasting: mechanics of rock fragmentation by explosives; advances in explosives and their selection criteria for rock excavation; blast design for surface excavations and optimization; advanced blast initiation systems; blast performance evaluation; cast blasting; technoeconomic and safety aspects of surface and underground blasting; advances in blast design for underground excavations; contour blasting; computer aided blast designs; review of tunnel blasting techniques in recent advances.

Rock Cutting: theories of rock tool interaction for surface excavation machinery- rippers, bucket wheel excavators, continuous surface miners; theories of rock tool interaction for underground excavation machinery- ploughs, shearers, road headers, continuous miners and tunnel boring machines; selection criteria for cutting tools; Advanced rock cutting techniques- high pressure water jet assisted cutting.

Modules:

Module 1: Basic Understanding: What is Rock Excavation Engineering? Basics of Rock Excavation Engineering in mining and construction industries; Importance of Rock Excavation Engineering; Possible scopes for a career in Rock Excavation Engineering. **Module 2:. Selection Criteria for Rock Excavation**: Physical and mechanical properties of rock materials; Geotechnical properties of rock materials in regard to method of excavation; Selection of excavation method.

Module 3: Drilling Mechanism, Performance and Problems: Mechanics of drilling; Design and operating parameters of surface drilling and underground drilling. Performance parameters of drilling; Evaluation of drilling performance; Drillability of rock; Selection of drill bit. Drill bit wear; Mechanism of drill bit wear; Economics of drilling.

Module 4: Blasting Operation, Blast Design, Performance and Advance underground blast: Mechanism of rock fragmentation by explosives; Advances in explosives and their selection criteria for rock excavation. Blast design for surface excavation; Optimization of blast design; Initiation system; advanced blast initiation system; Powder factor; Calculation of powder factor; techno-economic aspects in surface and underground blasting; safety aspects in surface and underground blasting. New technology for underground blast design for excavation; contour blasting; computer aided blast design; recent advances in tunnel blasting.

Module 5: Rock cutting technology and Selection: Theories of rock cuttings; rock and tool interaction for surface and underground excavation. Criteria for selecting cutting tools; advanced rock cutting techniques; High pressure jet assisted cutting.

Module 6: Surface and Underground excavation machineries: Ripper; Bucket wheel Excavator; Surface continuous miner; Ploughs; Shearers; Road headers; Continuous miner and Tunnel boring machines.

Module 7: Computational Methods, IT in Rock Excavation Engineering: Typical software used in Rock Excavation Engineering- Finite Element Method, Computational Fluid Dynamics; Computational geotechnical methods; Highlighting typical available software system (FLAC 2D, FLAC 3D, PLAXIS 2D and PLAXIS 3D)

Module 8: Industrial lectures: Case studies of large tunneling and shaft sinking engineering projects by industry professionals, covering comprehensive planning to commission the same.

Module 9: Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Rock Excavation Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in excavation method.

Text/Reference Books:

1. Ratan Raj Tatiya, Surface and underground excavation method.
2. Principles of Rock fragmentation,Cark G.B-John Wiley & Sons
3. Diamond Drilling, Chugh C.P-Oxford Publication
4. Introduction to Mining Engineers – Hartman. H.L, John Wiley & Sons.

Course Goals & Outcomes:

* Introduction to what constitutes Rock Excavation Engineering.
* Identifying the various areas available to pursue and specialize within the overall field of Rock Excavation Engineering.
* Highlighting the depth of engagement possible within each of these areas.
*Exploration of the various possibilities of a career in this field.
*Understanding the vast interfaces this field has with the society at large.
*Providing inspiration for doing creative and innovative work in Rock Excavation Technology.
* Showcasing the many tunnel construction, vertical shaft and incline for accessing the deposits, nationally important infrastructure, and impressive projects to serve as sources of inspiration.
* Highlighting possibilities for taking up entrepreneurial activities in this field.

* Providing a foundation for the student to launch off upon an inspired academic pursuit into this subject of engineering.
* Know about rock excavation, excavation methods, drill bit wear and drillability to cut rocks.
* Optimize, safety aspects of surface and underground blasting.

MNP60 5	ROCK SLOPE ENGINEERING	2L:1T:0P	3 Credits

Pre-requisite: Surface mining technology

Course Objectives:
To introduce the basic mechanics of rock slope failure to learn the types of rock failure and its influencing parameters

Syllabus:
Basic mechanics of rock slope failure: Rock slope economics, slope parameters, effect of water pressure, factor of safety of slopes, slope height vs. slope angle, design of slopes. Geological and strength properties: Geological parameters affecting slope stability; physicomechanical properties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure. Plane Failure: Plane failure analysis; graphical analysis of stability; influence of ground water on stability, Influence of tension crack; rock reinforcement; analysis of failure on a rough plane; case studies. Wedge Failure: Analysis of wedge failure; wedge analysis including cohesion and water pressure; case studies. Circular and toppling Failure: Conditions for circular failure; derivation of circular failure analysis; effect of ground water; Types of toppling failure; analysis of toppling failure; Influence of slope curvature on stability; slope depressurization: protection of slopes: control of rock falls. Slope Monitoring: Monitoring and instrumentation techniques of rock slopes. Investigations of failed slopes, Remedial Measure: Remedial and corrective measures. Remedial measures for slope stabilization. Numerical Analysis: Numerical analysis of slopes. Use of FLAC Software.

Modules:

Module 1: Basic mechanics of rock slope failure: Rock slope economics, slope parameters, effect of water pressure, factor of safety of slopes, slope height vs. slope angle, design of slopes. **Module 2: Geological and strength properties:** Geological parameters affecting slope stability; physico-mechanical properties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure.
Module 3: Plane Failure: Plane failure analysis; graphical analysis of stability; influence of ground water on stability, Influence of tension crack; rock reinforcement; analysis of failure on a rough plane; case studies.
Module 4: Wedge Failure: Analysis of wedge failure; wedge analysis including cohesion and water pressure; case studies.
Module 5: Circular and toppling Failure: Conditions for circular failure; derivation of circular failure analysis; effect of ground water; Types of toppling failure; analysis of toppling failure; Influence of slope curvature on stability; slope depressurization: protection of slopes: control of rock falls.
Module 6: Slope Monitoring: Monitoring and instrumentation techniques of rock slopes. Investigations of failed slopes.
Module 7: Remedial Measure: Remedial and corrective measures. Remedial measures for slope stabilization.
Module 8: Numerical Analysis: Numerical analysis of slopes. Use of FLAC Software.

Text/Reference Books:

1. Hoek, E and Bray, J.W., Rock Slope Engineering, Institution of Mining and Metallurgy, 1991.
2. Goodman, R.E., Rock Mechanics, John Wiley and Sons, 1989
3. Singh, R.N. and Ghose, A.K., Engineered Rock Structures in Mining and Civil Construction, A.A. Balkema, Netherlands, 2006.
4. Rock Slope Engineering: Civil and Mining by Duncan C. Wyllie
5. Cumming A.B. & Given I &V. & SME Vol. I & II, Society of Mining Engineers, USA.
6. Introduction to Mining Engineering, Hartman H.L. – John Willey & Sons.
7. Soil Slope Instability and Stabilization, Bruce F. Walker, Robin Fell, Proceedings of an Extension Course on Soil Slope Instability and Stabilization, Sydney
8. Rock Mechanics by Alfreds R. Jumikis, Trans Tech Publications,
9. Rock Mechanics by BGH Brady, ET Brown/Springer Publishing

Course Outcomes:

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

1. Understand Basic mechanics of rock slope failure
2. Understand Geological parameters and physico-mechanical properties affecting slope stability
3. Understand basics of Plane failure
4. Understand basics of Wedge failure
5. Understand basics of Circular and toppling failure.
6. Understand about data interpretation for slope stability analysis
7. Understand about mechanism of failure of rock mass,
8. Understand about influence of ground water on slopes and techniques of depressurization,
9. Understand about instrumentation techniques of rock slopes, use of software like FLAC.

MNP606	MINE VENTILATION PLANNING	2L:1T:0P	3 credits

Overview:

Mine Planning introduces you to key mine planning concepts. The mine planning process is complex and integrates several technical branches of the mining discipline including rock mechanics, rock breakage, ventilation and mine design. While mine planners should endeavour to design and implement plans that are safe, environmentally sustainable and socially acceptable, the overriding factor in the success of a mining operation and what ultimately determines whether it will proceed through feasibility studies and onto construction and development is the level of profitability. The drive to exploit a mineral resource such that it adds as much value as possible to the mining business requires a continual update of the mine plan and the rapid implementation of any value adding opportunities as they arise.

It is assumed that course participants have a good understanding of mining terms and descriptions, have been exposed to surface and underground mining methods, are familiar with mining development, operations and production and are keen to learn how to plan a mine for the purpose of maximizing value. Course participants are also expected to have a basic knowledge of rock mechanics, rock breakage, ventilation, typical mining equipment and other technical fundamentals which form the platform and constraints for generating mine plans.

Course Description:

This course applies ventilation principles to the design of underground mines and enables the ventilation requirements for underground mining methods to be met. Students work in groups for projects work that are focused on the ventilation requirements of the mine in question. The projects are structured in such a way as to lead each group through the processes that are required. In addition to the projects work, a site visit where ventilation techniques and data collection is practiced. A minor report completes this visit where the student provides a summary of the learnings from the visit. The visit is structured around a ventilation survey.

The objectives of this course are to:

- Apply ventilation principles to mine design
- Quantify ventilation requirements
- Identify risks associate with ventilation management ▪ Identify controls to manage ventilation.
- Determine fan / system performance and specification of requirements in complex coal and metalliferous ventilation systems, including trouble shooting and problem solving.
- Identify the requirements, and issues associated with, the application of appropriate ventilation monitoring systems in both coal and metalliferous mines.
- Develop ventilation designs for a coal mine and a metalliferous mine.
- Identify the requirements of appropriate management plans for the designed systems

Syllabus:

Ventilation planning: Objectives and steps in ventilation planning, system analysis of the planning procedure, desirable features of ventilation systems, ventilation plans.

Types of ventilation system, Central, Boundary and Combined ventilation systems, Air distribution with different mining methods: Board and Pillar method, Longwall methods, Shrinkage and Cut and Fill stopes, Open and Underhand stopes, Sublevel stopes. Top slicing and Sub-level caving, Block caving.

Air quantity requirement: Air quantity requirement in the workings, Strata gas, Diesel exhaust fumes, dust, heat, workshop and other ancillary areas, air requirements in drifts and tunnels, leakage of air, expansion in upcast, air velocities.

Pressure Requirement, Selection of fans, output control in fans, series and parallel combination of mine fans, forcing and exhaust, maintenance and monitoring of fans, booster fans, auxiliary ventilators, fan installations, diffuser and evasee.

Network Analysis: solution of complex ventilation network, solution by Hardy Cross Method of successive approximation, ventilation network analysis by digital computer, recent development in ventilation planning
Ventilation Economics: Analysis of ventilation cost, Interest payments, time value of money, present value, Equivalent annual cost, ventilation operating cost, optimum size of airway and shaft.

Modules:

1. **Introduction:** Objectives and steps in ventilation planning, desirable features of ventilation systems, ventilation plans.
2. **Types of ventilation system**: Central, Boundary and Combined ventilation systems
3. **Air distribution with different mining methods:** Bord and Pillar method, Longwall methods, Shrinkage and Cut and Fill stopes, Open and Underhand stopes, Sublevel stopes. Top slicing and Sub-level caving, Block caving.
4. **Air quantity requirement:** Air quantity requirement in the workings, Strata gas, Diesel exhaust fumes, dust, heat, workshop and other ancillary areas, air requirements in drifts and tunnels, leakage of air, expansion in upcast, air velocities.
5. **Pressure Requirement:** Selection of fans, output control in fans, series and parallel combination of mine fans, forcing and exhaust, maintenance and monitoring of fans, booster fans, auxiliary ventilators, fan installations, diffuser and evasee.
6. **Network Analysis:** solution of complex ventilation network, solution by Hardy Cross Method of successive approximation, ventilation network analysis by digital computer,
   recent development in ventilation planning.
7. **Ventilation Economics:** Analysis of ventilation cost, Interest payments, time value of money, present value, Equivalent annual cost, ventilation operating cost, optimum size of airway and shaft.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:

- *(Knowledge based)*

- To familiarize with the steps in ventilation planning.
- Know the various types of ventilation system.
- To get acquainted with the various air quality requirement in the working.
- To know the various causes of leakage of air.
- To have the knowledge of effects on various leakage of air.

(Skills)

Use operations research to:

- To apply the knowledge gained for solving problems related to mine ventilation planning.
- To make acquainted ventilation network.
- To have hands on the ventilation cost

Text/Reference Books:

1. Skochinsky, A. and Komarov, V., (1969) Mine ventilation, Mir Publisher, Moscow.
2. Roberts, A., (1960), mine ventilation, Clever Hume Press Ltd.
3. Graham, J.I., (1949-50), the methane content of unworked coal seams,ibid 109;2.
4. Penman, D and Penman, J.S., (1947), mine ventilation, Charles griffin &Co.
5. Ower. E., (1949), the measurement of air flow, 3rd., chapman and hall, London.
6. Rouse, H., (1956) elementary mechanics of fluids, Jhon willey and sons Inc.
7. Hinsely, F.B., (1950-51) 'natural and mechanical ventilation ', Tr. I.M.E 110;67.
8. Hall,C.J.,(1953), thermodynamics of mine ventilation', col.eng. 30; 66, 102, 158, 189 and 246.
9. Misra , G.B.,(1964) mine ventilation, thacker spink &Co.
10. Rouse,H., (1956), elementary of mechanis of fluids , Jhon wiley and Sons Inc.
11. Ower.E., (1949), the measurement of air flow, 3rd ed, Chapman and Hall, London.
12. 'mine fans', (1952), N.C.B bull.66.
13. Bromilow, J.G., (1962), ventilation of mechanised heading', Jr. Min met. F. special issue.

MNP607	ADVANCED MINE VENTILATION ENGINEERING	2L:1T:0P	3 CREDITS

Course Objectives:
To introduce advanced mine ventilation problems in underground coal as well metal mines. This course also gives exposures of various application of software in mine ventilation network analysis including recent developments in mine ventilation.

Syllabus:
Mine thermodynamics: Computation of thermodynamic properties of mine air; Basics of modes of heat transfer in mine roadways; Evaporation and consequent changes in mine air properties;

Thermal properties of rocks; Fourier and Biot numbers; Calculation of heat flow and temperature rise in mine airways; Sources of heat and moisture transfer in Bord and Pillar/Longwall and other workings.

Network analysis: Hardy Cross method of iterative analysis; Thermodynamic analysis of mine airflow in ventilation network without and with change in moisture content; Change in Darcy-Weisbach equation and square law due to variation of air density; Pseudo-pressure equation;

Leakage and recirculation; Application of thermodynamic network analysis for complete mine ventilation circuit; Application of software for solving real life ventilation problems in coal and metal mines.

Recent developments in mine ventilation; Air conditioning & ventilation in deep mines; Gas monitoring systems.

Modules:

1. **Mine thermodynamics:** Computation of thermodynamic properties of mine air; Basics of modes of heat transfer in mine roadways; Evaporation and consequent changes in mine air properties;
2. **Thermal properties of rocks;** Fourier and Biot numbers; Calculation of heat flow and temperature rise in mine airways; Sources of heat and moisture transfer in Bord and Pillar/Longwall and other workings.
3. **Network analysis:** Hardy Cross method of iterative analysis; Thermodynamic analysis of mine airflow in ventilation network without and with change in moisture content; Change in Darcy-Weisbach equation and square law due to variation of air density; Pseudo-pressure equation;
4. **Leakage and recirculation;** Application of thermodynamic network analysis for complete mine ventilation circuit;
5. **Software application:** Application of software for solving real life ventilation problems in coal and metal mines.
6. **Recent developments in mine ventilation;** Air conditioning & ventilation in deep mines; Gas monitoring systems.

Text/Reference Books:

1. Skochinsky, A. and Komarov, V., (1969) Mine ventilation, Mir Publisher, Moscow.
2. Roberts, A., (1960), mine ventilation, Clever Hume Press Ltd.
3. Graham, J.I., (1949-50), the methane content of unworked coal seams,ibid 109;2.
4. Penman, D and Penman, J.S., (1947), mine ventilation, Charles griffin &Co.
5. Ower. E., (1949), the measurement of air flow, 3rd., chapman and hall, London.
6. Rouse, H., (1956) elementary mechanics of fluids, Jhon willey and sons Inc.
7. Hinsely, F.B., (1950-51) 'natural and mechanical ventilation ', Tr. I.M.E 110;67.
8. Hall,C.J.,(1953), thermodynamics of mine ventilation', col.eng. 30; 66, 102, 158, 189 and 246.
9. Misra , G.B.,(1964) mine ventilation, thacker spink &Co.
10. Rouse,H., (1956), elementary of mechanis of fluids , Jhon wiley and Sons Inc.
11. Ower.E., (1949), the measurement of air flow, 3rd ed, Chapman and Hall, London.
12. 'mine fans', (1952), N.C.B bull.66.
13. Bromilow, J.G., (1962), ventilation of mechanised heading', Jr. Min met. F. special issue.

OPEN ELECTIVE II

MNO608	DATA ANALYTICS	2L:1T:0P	3 Credits

Course Objectives:

Data Analytics is the science of analyzing data to convert information to useful knowledge. This knowledge could help us understand our world better, and in many contexts enable us to make better decisions. While this is broad and grand objective, the last 20 years has seen steeply decreasing costs to gather, store, and process data, creating an even stronger motivation for the use of empirical approaches to problem solving. This course seeks to present you with a wide range of data analytic techniques and is structured around the broad contours of the different types of data analytics, namely, descriptive, inferential, predictive, and prescriptive analytics.

This course will cover fundamental algorithms and techniques used in Data Analytics. The statistical foundations will be covered first, followed by various machine learning techniques Supervised, Unsupervised, Semi-supervised and data mining algorithms. In summary, this course will provide exposure to theory as well as practical systems and software used in data analytics.

After completing this course, you will learn how to:

1. Find a meaningful pattern in data
2. Graphically interpret data
3. Implement the analytic algorithms
4. Handle large scale analytics projects from various domains
5. Develop intelligent decision support systems

Syllabus:

Data Definitions and Analysis Techniques: Concept of Data Science, Why/When/What, application in real scenarios, Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning and RProgramming. **Descriptive Statistics:** Measures of central tendency, Measures of location of dispersions, Practice and analysis with R. **Programming Tools for Data Science:** Basics of Python (file handling, case-folding, spell check, split, strip, Regex, find, replace, etc.); Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK; Visualizing Data: Bar Charts, Line Charts, Scatterplots. **Basic Analysis Techniques:** Basic analysis techniques, Statistical hypothesis generation and testing; Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Practice and analysis with R. **Data analysis techniques:** Regression analysis, Classification techniques, Clustering, Association rules analysis, Practice and analysis with R. **Machine Learning:** Overview of Machine learning concepts – Bias/variance, overfitting and train/test splits. Types of Machine learning – Supervised, Unsupervised, Semi-supervised. **Classification and Regression algorithms**Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees and induction rules, Hidden Markov Models; Linear Regression-model assumptions; Regularization (lasso, ridge, elastic net) from both the statistical and Bayesian inference viewpoint; Analysis of Time Series; Unsupervised learning: KMeans and Hierarchical clustering; Reinforcement learning.

Modules:

Module 1: Data Definitions and Analysis Techniques: Concept of Data Science, Why/When/What, application in real scenarios, Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning and R-Programming.

Module 2: Descriptive Statistics: Measures of central tendency, Measures of location of dispersions, Practice and analysis with R.

Module 3: Descriptive Statistics: Measures of central tendency Measures of location of dispersions, Practice and analysis with R Basic Analysis Techniques Basic analysis techniques;

Module 4: Programming Tools for Data Science: Basics of Python (file handling, casefolding, spell check, split, strip, Regex, find, replace, etc.); Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK; Visualizing Data: Bar Charts, Line Charts, Scatterplots.

Module 5: Basic Analysis Techniques: Basic analysis techniques, Statistical hypothesis generation and testing; Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Practice and analysis with R.

Module 6: Data analysis techniques: Regression analysis, Classification techniques, Clustering, Association rules analysis, Practice and analysis with R.

Module 7: Machine Learning: Overview of Machine learning concepts – Bias/variance, overfitting and train/test splits. Types of Machine learning – Supervised, Unsupervised, Semi-supervised.

Module 8: Classification and Regression algorithms-Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees and induction rules, Hidden Markov Models; Linear Regression-model assumptions;

Regularization (lasso, ridge, elastic net) from both the statistical and Bayesian inference viewpoint; Analysis of Time Series; Unsupervised learning: KMeans and Hierarchical clustering; Reinforcement learning

Text/Reference Books:

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010
3. Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc.
4. The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Trevor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014
5. An Introduction to Statistical Learning: with Applications in R, G James, D. Witten, T Hastie, and R. Tibshirani, Springer, 2013
6. Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer
7. Mining Massive Data Sets, A. Rajaraman and J. Ullman, Cambridge University Press, 2012
8. Advances in Complex Data Modeling and Computational Methods in Statistics, Anna Maria Paganoni and Piercesare Secchi, Springer, 2013
9. Data Mining and Analysis, Mohammed J. Zaki, Wagner Meira, Cambridge, 2012
10. Hadoop: The Definitive Guide (2nd Edn.) by Tom White, O'Reilly, 2014

11. Map Reduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems, Donald Miner, Adam Shook, O'Reilly, 2014
12. Beginning R: The Statistical Programming Language, Mark Gardener, Wiley, 2013
13. http://cse.iitkgp.ac.in/~dsamanta/courses/da/index.html

Course Outcomes:

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

1. Analyse data to evaluate meaningful pattern.
2. Demonstrate understanding of the mathematical foundations needed for data science.
3. Collect, explore, clean, munge and manipulate data.
4. Implement models such as k-nearest Neighbours, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
5. Build data science applications using Python based toolkits.
6. Graphically interpret data using different statistical tool and hypothesis tests.
7. Implement the analytic algorithms.
8. Develop intelligent decision support systems for various mining operations.

MNO609	RELIABILITY ENGINEERING	2L:1T:0P	3 credits

Overview:
This course introduces students to concepts and methods of modern statistical quality control. Students learn to apply standard quality control tools. They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations. They learn theory and methods for analyzing the performance of different quality control tools.

Course Description:
Principles of statistical quality control including control by variable and by attribute, construction and use of control charts for variables, fraction defectives and number of defects and use of standard plans, reliability and life cycle testing.

The objectives of this course are to:

- To define and describe concept of system structures
- To apply the principles of reliability, quality and asset management to mechanical engineering processes, production and manufactured products
- The use of appropriate software for statistical and quality analysis is taught and is necessary for successful completion of some homework assignments. Issues of ethics and professional responsibility and their relation to product quality are discussed.

Syllabus:
Introduction to reliability concept.
System Structures: Status functions, series systems, parallel systems, and equivalent structures.
Reliability of System Structures: Series systems, parallel systems, equivalent structures. Unit and system reliability- forward models, density and distribution functions, fault tree analysis, HAZOP analysis, risk and criticality analysis, maintainability analysis, calculation of maintainability parameters, availability calculations, maintenance management.
Introduction to product quality. Introduction to ISO 9000 series, concept of TQM and Business performance, HRD and quality management, organizing for TQM, CI.

Modules:

1. **Introduction to reliability concept:** Introduction to system and reliability
2. **System Structures:** Status functions, series systems, parallel systems, and equivalent structures
3. **Reliability of System Structures:** Series systems, parallel systems, equivalent structures
4. **Unit and system reliability:** forward models, density and distribution functions
5. **System Reliability Analysis:** fault tree analysis, HAZOP analysis, risk and criticality analysis
6. **System Reliability Analysis:** Maintainability analysis, calculation of maintainability parameters, availability calculations, maintenance management
7. **Introduction to product quality:** Introduction to ISO 9000 series, concept of TQM and Business performance
8. **Quality Management:** HRD and quality management, organizing for TQM, CI

Text/Reference Books:

6. Introduction to Quality and Reliability Engineering by Renyan Jiang, Springer, 2015

7. An Introduction to Reliability and Quality Engineering by John P. Bentley, Longman Scientific & Technical, 1993
8. Reliability Engineering, by E. Bala Guruswamy, Tata McGraw Hill, 1994.
9. Reliability Engineering, (3rd Edition), by LS Srinath, Affiliated East West Pvt Ltd, 1991.
10. Optimization &Variation Reduction in Quality, by W.A. Taylor, Tata McGraw Hill, 1991.

Goals & Outcomes:

Upon successful completion of this course, the student will be able to:

(Knowledge based)

- Understand and able to describe different system's structure
- Understand the concepts of reliability and maintainability
- Acquire basic knowledge of total quality management

(Skills)

Use reliability and quality engineering to:

- Use System structure concept to examine reliability of different systems
- Use different reliability analysis techniques to appraise and manage a system or process
- Describe standard control charts and use it to analyze and improve the product quality.

MNO610	GEOSTATISTICS	2L:1T:0P	3 credits

COURSE OUTCOME

The course is designed to provide a better understanding to use the statistical tool in mining industries. It will give the idea of interpretation of reserve estimation using three-dimensional modelling software.

SYLLABUS

Geo - statistics: Introduction, Concept.

Basics of Probability and Statistics: Mean, Median, Mode, Probability Distribution (normal & log normal), Variance, Cumulative frequency and Cumulative probability.

Mineral Inventory: Prospecting, exploration, method to quantify the size, shape & distribution of the ore reserve. Ore reserve calculation.

Extension method and application of classical statistics, regionalized variables, variogram and semi – variogram modeling, regularization, auxiliary functions.

Kriging; Introduction, concept of development, types of kriging, linear kriging methodology, and their application in mining industries, common problems associated with the use of kriging.

Geo - statistics for quality control, basis of non-parametric geo - statistics and indicator kriging. Introduction to SURPAC, STATISTICA, SPSS/SYSTAC software.

MODULE 1. Geo - statistics: Introduction, Concept.

MODULE 2. Basics of Probability and Statistics

Mean, Median, Mode, Probability Distribution (normal & log normal), Variance, Cumulative frequency and Cumulative probability.

MODULE 3. Mineral Inventory

Prospecting, exploration, method to quantify the size, shape & distribution of the ore reserve. Ore reserve calculation

MODULE 4. Extension method and application of classical statistics

regionalized variables, variogram and semi – variogram modeling, regularization, auxiliary functions.

MODULE 5. Kriging

Introduction, concept of development, types of kriging, linear kriging methodology, and their application in mining industries, common problems associated with the use of kriging.

MODULE 6. Geo - statistics for quality control

basis of non-parametric geo - statistics and indicator kriging. Introduction to

SURPAC, STATISTICA, SPSS/SYSTAC software.

Text/Reference Books:

6. Open Pit Mine Planning and Design, Two Volume Set, Second Edition by William A. Hustrulid (Author), Mark Kuchta (Author)
7. Mining Geostatistics by A. G Journel & Ch. J. Huijbregts.
8. Advanced Geostatistics in the Mining Industry: Proceedings of the NATO Advanced Study Institute held at the Istituto di Geologia Applicata of the ... 13–25 October 1975 (Nato Science Series C:) Paperback – Import, 26 Mar 2012 by M. Guarascio (Editor), C.J. Huybrechts (Editor), M. David (Editor)
9. Geostatistics, Rendu J.M
10. Surface Mining, Kennedy Wiley

Course Outcome:

After completion of the course, students will be able to:

6. Understand use of statistics tools to use in mining fields.
7. Know reserve estimation methods using statistics tool.
8. Understand and interpret the 3 – D model of reserve.
9. Understand the and use in mine modelling software like surpac minex.

PRACTICALS

MN601P	ROCH MECHANICS LAB	0L:0T:2P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Determination of uniaxial compressive strength of rock using compression testing machine/UTM.
2.	Indirect determination of uniaxial compressive strength of rock/coal using Protodyakonov strength index apparatus.
3.	Indirect determination of uniaxial compressive strength of coal using impact strength index apparatus.
4.	Determination of tensile strength of rock/coal by brazilian test.
5.	Determination of point load index of rock/coal and estimation of uniaxial compressive strength and tensile strength.
6.	Determination of shear strength of rock/coal using direct shear apparatus.
7.	Determination of cohesion and angle of internal friction of rock/coal using shear apparatus with normal loading.
8.	Determination of bulk density, dry density and specific gravity of rock sample.
9.	Determination of durability index of rock/coal using durability index apparatus.
10.	Determination of ultimate tensile strength of steel reinforcement using UTM.
11.	Determination of permeability of soil and rock under fixed head and variable head condition.

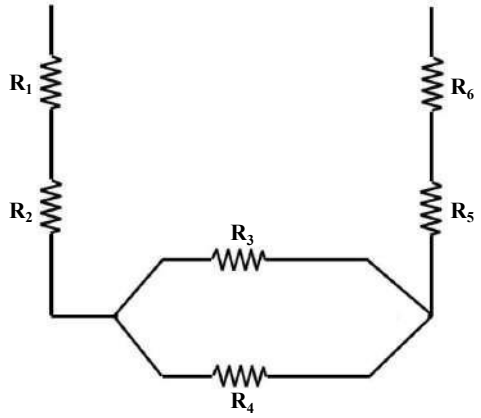
MN602P	MINE ENVIRONMENTAL ENGINEEIRNG LAB	0L:0T:2P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Determination of water quality and its suitability for industrial use.
2.	Determination of respirable particulate matter concentration by filtration method.
3.	Determination of particulate matter concentration by optical method.
4.	Determination of level of dust respirable exposure using personal dust sampler.
5.	Study and sketch of blastmate and micromate for measuring ground vibration.
6.	Study and sketch of radiationmeter.
7.	Study and sketch of weather monitoring station to measure local meteoroloical data.
8.	Study and sketch of haldane and orsat apparatus.
9.	Study and sketch of multi- gas detector.
10.	Determination of air velocity and quantity using digital anemometer.
11.	Study and sketch of lux meter.
12.	Study and sketch of sound level meters.

MN603P	DATA ANALYTICS LAB	0L:0T:2P	1 CREDITS

LIST OF EXPERIMENTS:

Sl. No.	Name of Experiment
1.	Find the Mean, Mode, Median, Variance, Skewness and Kurtosis for the given opencast blasting data using Excel.
2.	Find the Mean, Mode, Median, Variance, Skewness and Kurtosis for the given Mineral price data using C.
3.	Find the Mean, Mode, Median, Variance, Skewness and Kurtosis for the given average pull from the underground face data using C++.
4.	Find the Mean, Mode, Median, Variance, Skewness and Kurtosis for the given Mineral price data using python.
5.	Write a program in C or C++ or Python to predict the average pull from the underground face after the blast.
6.	Find the cohesion, angle of internal friction, failure angle and UCS from the given set of triaxial data (excel or other programming language).
7.	Write a program in C and C++ to determine the equivalent resistance of the mine, for the network given below (Fig 1).  *Mine Ventilation networks* (Resistance of air current network follows the same rule of addition as of Electrical current network.)
8.	Write a program in C, C++ and python to determine RQD of a core sample.
9.	Write a program in C, C++ and python to deduct Whole Circle Bearing (WCB) into Quadrantal Bearing (QB), with proper assumptions.
10.	Write a program in Python to predict the traffic on a new mode of transport for haul road for surface mine.

RADHA GOVIND UNIVERSITY, RAMGARH

MINING ENGINEERING

B.Tech, Semester VII (Fourth year)

Course Structure

SL NO.	Course code	Course Title	Hours per week			Credit
			L	T	P	
THEORY						
1.	MN701	Mine Legislation and Safety Engineering	3	0	0	3
2.	**Professional Elective – III (Any One of the Following)**					
I.	MNP702	Applied Rock Mechanics	3	0	0	3
II.	MNP703	Numerical Methods in Geo-mechanics	3	0	0	3
III.	MNP704	Geo-Statistics	3	0	0	3
IV.	MNP705	Instrumentation in Rock Mechanics	3	0	0	3
3.	**Professional Elective – IV (Any One of the following)**					
I.	MNP706	Mine Planning & Design	3	0	0	3
II.	MNP707	Mine Closure	3	0	0	3
III.	MNP708	Mine Reclamation & Rehabilitation	3	0	0	3
IV.	MNP709	Sustainable Mining Practices	3	0	0	3
4.	**Open Elective – III (Any One of the following)**					
I.	MNO710	Mine Economics & Resources Management	3	0	0	3
II.	MNO711	Mine Management	3	0	0	3
5.	**Open Elective – IV (Any One of the Following)**					
I.	MNO712	Remote Sensing & Resource Management	3	0	0	3
II.	MNO713	Socio Economic Impact of opencast Mines	3	0	0	3
III.	MNO714	Sustainable Energy Resources	3	0	0	3
IV.	MNO715	Opencast Mining Machinery	3	0	0	3
V.	MNO716	Mine Disaster & Prevention Management	3	0	0	3
PRACTICALS						
1.	MN701P	Mine Planning & Design Lab	0	0	2	1
2.	MN702D	Project - I	0	0	4	2
3.	MN703I	Internship/ Tour and Training /Industrial Training	0	0	3	2
				Total credits		**20**

*Number of subjects may be change subject to availability of other department

Mining Engineering			
MN701	**Mine Legislation & Safety Engineering**	**L**	**T**
		3	**0**

Course objective:

Introduce students to the different laws of Indian Mining industry. To categorize, analyze and develop capability by measure actions to prevent and mitigate mine accidents. To ameliorate different past and recent case studies dealing with mine hazards and accidents. Course aims for the students to identify and evaluate any real-life scenario of mine disasters henceforth, also comprehend and absorb inherent knowledge of mitigation strategies to achieve minimal casualties within the mines.

DETAILED SYLLABUS

Module-1: Statutory laws: Statutory law regarding development and conservation of minerals, Mines and mineral (regulation and development) act 1957.

Module-2: Mineral concession rules: Procedure for obtaining mineral concession, Mineral concession rules 1960, Mineral concession and development rules 1958.

Module-3: Regulation and Development: Coal mines (regulation and development) act 1974, Mines and mineral (regulation and development) act 1957, Mines act 1952.

Module-4: Mines Regulations: Coal mines regulations 1957, Metal liferous mines regulation 1961, Mine rules: Coal mines rescue rules, Crèche rules, Electricity act and rules pertaining to mining.

Module-5: Safety in Mining: Safety organization, Role of management, Supervisors and workers, Pit safety committees, Workmen's Inspector role, Role of safety officers.

Module-6: Accidents in Mining: Classification of accidents, Statistics, causes and prevention of accidents, Accidents rate in Indian mines, Accident enquiries and reports. Mine Fires; Surface and underground mine fire -causes and prevention, causes and nature of spontaneous heating. Dealing with the underground fire. Sealed off Area and Reopening: the study of atmosphere behind sealed off area. Factors, conditions, danger and safety measure for reopening. Methods of firefighting, firefighting-organization, and Rescue work related to connection with mine fires.

Inundations and Related Rescue Operations: Rescue work pertaining with connection with mine fires Causes and protective measures for inundations. Precautions to be taken while approaching the old-working design construction of water dams. Dewatering and recovery of waterlogged working and water danger plan, Rescue work related to mine inundations. Fire damp explosions, causes, preventive measures, Coal dust explosions, causes, preventive measures, Rescue work related to mine explosions.

Module-7: Health and disease in Mining: Health of workmen, Occupational disease in mining, International labour organization and its model code in the field of safety and accident prevention, Airborne Dust: Dust production, Assessment and control of mine dust and associated hazards.

Module-8: Management, relation and welfare in Mining: Principles of management and organization, Industrial relations, Welfare organization, Development of safety consciousness; Interest, publicity and propaganda for safety; Audio-visual aids, Safety drives campaigns. Different types of rescue equipment. Use of organization for rescue work, Disaster management plan of mines.

Course outcomes

To develop an understanding of the principles and concepts of law underpinning mining and energy law in India, including the following:

1. The development of mining legislation in India, including issues of constitutional law and international law.
2. The regulation of onshore and offshore mineral and petroleum exploration and production.
3. Judicial arrangements and appeals, in particular the jurisdiction of the Warden's Court.
4. The relationship between mining and indigenous peoples, including Native Title law;
5. Environmental controls over mining and energy production, including mining in protected areas such as national parks and reserves;
6. The regulation of the Indian electricity industry.
7. After completion of the course students will be able to find and explain the various kinds of the disasters which takes place within underground mines and opencast mines.
8. Able to summarize the categories hazards due to fire, inundation, dust and explosions.
9. Able to recall and identify various causes, factors and mitigation strategies associated with the above risks.
10. Able to demonstrate, distinguish and perform various rescue operations, apparatus their specification, and workings in case of any mishap in the mines.
11. Able to recall and relate main provisions, regulations and rules laid down by the statutory bodies in the country concerning the safety of mine workers.

Reference/text books:

1. Banerjee S. P., "Prevention combating Mine Fires", Lovely Prakashan, Dhanbad, India.
2. The coal mines regulations – CMR 2017.
3. The mines rule Coal mines pithead bath rules, Mineral concession rules Mines and minerals (development and regulation) act, The metalliferous mines regulations, Mines Act - 1952

4. Banerjee S.P. (2003); "Mine Ventilation"; Lovely Prakashan, Dhanbad, India.
5. Deshmukh, D. J. (2008); "Elements of Mining Technology, Vol. II"; Denett& Co., Nagpur, India.
6. Hartman, H. L., Mutmansky, J. M. & Wang, Y. J. (1982); "Mine Ventilation and Air Conditioning"; John Wiley & Sons, New York.
7. Karmakar, N. C. (2001); "Handbook of gas testing"; Lovely Prakashan, Dhanbad, India.
8. Le Roux, W. L. (1972); Mine Ventilation Notes for Beginners"; The Mine Ventilation Society of South Africa.
9. McPherson, M. J. (1993); Subsurface Ventilation and Environmental Engineering"; Chapman & Hall, London.
10. Misra G.B. (1986); "Mine Environment and Ventilation"; Oxford University Press, Calcutta, India.
11. Ramlu, M. A. (1991); "Mine fires, Explosions, Rescue, Recovery and Inundations"; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Vutukuri, V. S. & Lama, R. D. (1986); "Environmental Engineering in Mines"; Cambridge University Press, Cambridge.
13. Kejriwal, B.K," A Survey ofAccidents, Their Causes &Prevention".
14. Kaku L.C, "Fire in Coal Mine", LovelyPrakashan, Dhanbad, India.
15. GhatakS., "Mine Ventilation. 1 & Vol. 2, LovelyPrakashan, Dhanbad, India.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3							3				
CO2		3		2		3	2		2	3	3	3
CO3				2	3			3				
CO4			2			2	3		3	1	2	2
Avg.	3	3	2	2	3	2.5	2.5	3	2.5	2	2.5	2.5

Mining Engineering			
MNP702	**Applied Rock Mechanics**	**L**	**T**
		3	**0**

Course Objectives:

The course is designed to provide a better understanding of the applied aspects of rock mechanics in mining, design and stability analysis of underground excavations including pillar design, design of protective pillar, support design and reinforcement requirement, mechanics of surface subsidence and slope stability in surface mines which depicts bench slope and waste dump slope stability analysis.

Course Outcome:

After completion of the course, students will be able to:

1. Understand the stability of rock structure, support and reinforcement requirement in underground excavation.
2. Understand the subsidence impacts and mechanics, caving mechanism and rock burst and bump in underground structure.
3. Understand the blasting mechanics which include tensile cracking and blastability of rocks.
4. Understanding on the stability aspects of rock slopes.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2							3				
CO2		3		2		2	3		2	3	2	3
CO3	2			2	3			3			2	2
CO4			2			2	2		3	2	2	
Avg.	2	3	2	2	3	2	2.5	3	2.5	2.5	2	2.5

DETAILED SYLLABUS

Module 1. Design and stability of underground structures in rock:Intact rock and rock mass classification systems, methods for design and stability analysis of underground excavations, design of single and multiple openings in massive, stratified and jointed rock mass, mine pillars and their classification, pillar stresses, pillar design, stability analysis of pillars, design of protective pillar

Module 2. Design of support and reinforcement for underground excavation: Types& classification of support and reinforcement systems, support and reinforcement requirement – influencing parameters, estimation and selection, support and reinforcement principle, method of design

Module 3. Subsidence:Causes and impacts of subsidence, mechanics of surface subsidence, discontinuous andcontinuous subsidence, monitoring, prediction, control and management of subsidence.

Module 4. Caving of overlying rock mass:Rock caving in underground mining, mechanics of rock caving, assessment of cavability, induced caving methods. Rockburst and Coal Bumps: Phenomenology of rock bursts, prediction and control of rock bursts, coal bumps and gas outbursts.

Module 5. Mechanics of Blasting: Mechanics of blasting, tensile cracking and blastability of rocks.

Module 6. Slope stability in surface mines: Types of mine slope including waste dumps, common modes of slope failure, factors influencing slope stability, slope stability assessment techniques, stability analysis, measures to enhance slope stability, monitoring of slopes.

Text/Reference Books:

1. Rock Mechanics for underground mining, third edition B. H. G. Brady, E. T. Brown
2. Engineering rock mechanics, Vol. I & II, John A. Hudson and John P. Harrison
3. Engineering rock mass classification, Z.T Bieniawski.
4. Rock Slopes: Design, Excavation, Stabilization, Hoek Y Bray
5. Fundamental and Applied Rock Mechanics, D. Deb, A.K. Verma
6. Rock Blasting, P. Pal Roy

Mining Engineering			
MN703	**Numerical Methods in Geomechanics**	**L**	**T**
		3	**0**

Course objectives:

This course starts with Principle of continuum mechanics and Numerical Methods. It will elaborate the different numerical methods for Mathematical Modelling and need of Numerical Modelling in designing excavation by analysing stresses around the excavation. The course will also explain different Numerical Techniques such FDM, FEM, BEM and introduction to some software's based on these techniques.

The objective of this course are to:

- Introduce students to application of Numerical Methods in Mathematical Modelling
- Introduce students to practical application of Numerical Simulation in civil and mining industry
- Introduce students to different Numerical Techniques and software's based on this.

Course outcomes

Upon successful completion of this course, the student will be able to:

Knowledge based

- Understand different Numerical Methods.
- Identify and apply different Numerical Methods in different kind of Modelling
- Understand working of different FEM/ FDM/ BEM based software's

Skills

- Analyse and evaluate different kind of Numerical Techniques (FEM) for different conditions
- Can use different software's for designing Civil and Mining structures
  Able to write some programmes for various applications in Civil and Mining Industry

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3					2		2			3	
CO2		3		2			3	2	3	2		2
CO3				2	3	2		2			3	
CO4			2				2		3	2		2
Avg.	3	3	2	2	3	2	2.5	2	3	2	3	2

DETAILED SYLLABUS

Module-1: Introduction:Principle of continuum mechanics, Numerical Methodsin general, Solutionof Equations by Iteration, Interpolation.

Module-2: Numerical Integration and Differentiation**:** Numerical Integration and Differentiation

Module-3: Numerical Methods in Linear Algebra:Linear systems: Gauss Elimination, Solution byIteration.

Module-4: Numerical Modelling:Need for numerical modelling in design of excavation in mines,domain and boundary conditions and its application in Mathematical Modelling.

Module-5: Finite Element Method:Basic principle, assembling elements to form a structuralstiffness matrix, imposing boundary conditions, solving structural equations using plane truss, elements on assumed displacements, constant strain triangle, iso-parametric formulation.

Module-6: Finite Difference Method:Basic principle, explicitfinite difference method, finitedifference equation, solution stability.

Module-7: Boundary Element Method:Basic principle, introductory ideas of its application inmining excavations.

Text/Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th edition; John wiley& sons, Part E (Numerical Methods)
2. Debasis Deb, Finite Element Method: Concept and Applications in Geomechanics; Prentice Hall of India
3. J. B. Martins, Numerical Methods in Geomechanics; Springer
4. G. Swoboda, Numerical Methods in Geomechanics, 6th edition; CRC Press
5. http://vle.du.ac.in/course/view.php?id=562

Mining Engineering			
MNP704	**GEO-Statistics**	**L**	**T**
		3	**0**

Course Objectives:

The course is designed to provide a better understanding to use the statistical tool in mining industries. It will give the idea of interpretation of reserve estimation using threedimensional modelling software.

Course Outcome:

After completion of the course, students will be able to:

1. Understand use of statistics tools to use in mining fields.
2. Know reserve estimation methods using statistics tool.
3. Understand and interpret the 3 – D model of reserve.
4. Understand the use of mine modelling software like Surpac, Minex.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2			2			
CO2		3		2			3	3		3	2	3
CO3				2	3	2			2			
CO4			2				3	2		3	3	2
Avg.	3	3	2	2	3	2	3	2.5	2	3	2.5	2.5

DETAILED SYLLABUS

Module 1: Geo - statistics: Introduction, Concept.

Module 2: Basics of Probability and Statistics: Mean, Median, Mode, Probability Distribution (normal & log normal), Variance, Cumulative frequency and Cumulative probability.

Module 3. Mineral Inventory: Prospecting, exploration, method to quantify the size, shape & distribution of the ore reserve. Ore reserve calculation

Module 4. Extension method and application of classical statistics: Regionalized variables, variogram and semi – variogram modelling, regularization, auxiliary functions.

Module 5. Kriging: Introduction, concept of development, types of kriging, linear kriging methodology, and their application in mining industries, common problems associated with the use of kriging.

Module 6. Geo - statistics for quality control: Basis of non-parametric geo - statistics and indicator kriging. Introduction to SURPAC, STATISTICA, SPSS/SYSTAC software.

Text/Reference Books:

1. Open Pit Mine Planning and Design, Two Volume Set, Second Edition by William A. Hustrulid (Author), Mark Kuchta (Author)
2. Mining Geostatistics by A. G Journel& Ch. J. Huijbregts.
3. Advanced Geostatistics in the Mining Industry: Proceedings of the NATO Advanced Study Institute held at the Istituto di Geologia Applicata of the 13–25 October 1975 (Nato Science Series C:) Paperback – Import, 26 Mar 2012 by M. Guarascio (Editor), C.J. Huybrechts (Editor), M. David (Editor).
4. Geostatistics, Rendu J.M
5. Surface Mining, Kennedy Wiley

Mining Engineering			
MN705	**Instrumentation in Rock Mechanics**	**L**	**T**
		3	**0**

Course Outcome:

The course is designed to provide a better understanding to evaluate use of instrumentation in mining and civil engineering projects. Strata control instrumentation and monitoring aims at evaluation and monitoring the trends of changing rock mechanical parameters, namely, dilation, load, convergence, stress and axial loading etc., during mining so that rock mechanical un-eventualities are apprehended well before for effective corrective measures. Host rock geometry in coal mining is represented by stratified rock masses of relative weaker strength. Such stratifications are compound and unite in their virgin state before any kind of mining. Dilation / bed separation causes change in stress from its in-situ state, which in turn is propagated in the rocks around. Such induced effect of stress can be revealed in the workings with the help of instrumentation, aiding apprehension of strata movement and subsequent assessments.

Course Outcomes:

After completion of the course, students will be able to:

1. Understand use of instrumentation of in rock mechanics.
2. Know Causes and impacts of rock failure, rock strength and stresses induced in rocks.
3. Understand the time dependent deformation in rock structure.
4. Understand the effect of water on rock structure and their stability.
5. Understand the dynamic characteristics of rock and rock mass.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					3		3		3		3
CO2		3		2			2		2		2	
CO3				2	3	2		2		3		3
CO4			2				2		2		3	
Avg.	3	3	2	2	3		2	2.5	2	3	2.5	3

DETAILED SYLLABUS

Module 1: Load and Pressure Measuring Instruments: Load cells, pressure measuring instruments – stress capsules, stress meters, borehole pressure cells and flat jacks. Strain gauges and transducers, readout units, sensors, transmitters and data acquisition systems.

Module 2: Deformation and Strain Measuring Instruments: Convergence meters, convergence recorders, tape extensometers, bore hole deformation gauge, multipoint borehole extensometers and bore hole camera.

Module 3: Testing Equipment: UTM, MTS and acoustic emission equipment. Rock bolt pull tester. Monitoring and interpretation of the data.

Module 4: Soil Mechanics: Instrumentation for shear strength and bearing capacity of soils.

Module 5: Applications: Mining and Civil Engineering applications.

Text/Reference Books:

1. Rock mechanics instrumentation for mine design by U.S. Dept. of the Interior, Bureau of Mines, 1973.
2. Fundamental and Applied Rock Mechanics, D. Deb, A.K. Verma
3. Fundamental and Rock Mechanics, B. K. Shrivastava, A. Jaiswal

Mining Engineering			
MNP706	**Mine Planning and Design**	**L**	**T**
		3	**0**

Course Objectives:

The course is designed to provide a better understanding of planning and design stage, for opening of the mine. This subject focuses on understanding the complete mining context and characteristics of the deposit, and of recognizing and addressing the specific constraints of each project in order to select the appropriate mining method and a robust mine plan.

Course Outcome:

After completion of the course, students will be able to:

1. Prepare the conceptual note, mine planning report, feasibility report and mine closure report.
2. Evaluate economic reserve estimation for ore and sedimentary deposit
3. Understand the choice of technology deploy in the mine
4. Understand the optimum location of mine entries
5. Understand the selection of equipment, size of the mine and mine life.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				2		3	2		2		3
CO2		3	2	2		3			3		3	
CO3	2			2	3		2	2		2		
CO4		2	2			3		2	2		3	3
Avg.	2	2.5	2	2	2.5	3	2.5	2	2.5	2	3	3

DETAILED SYLLABUS

Module 1: Introduction to Mine Planning: Principle of the planning, short range and longrange planning, role of planning in mining ventures.

Module 2: Reserve Estimation: Ore reserve estimation, economic block model.

Module 3: Mine Planning Input: Geological, mineralogical, structural, economical, environmental and technical inputs.

Module 4: Mine Life: Determination of optimum output, life of a mine and size of mine field based on economic consideration, Taylor's mine life rule, ultimate pit configuration.

Module 5: Mine Entry: Optimum location of mine entries, theoretical considerations of opening and development of mine field.

Module 6: Production Planning and Scheduling**:** Production planning and scheduling, mine equipment planning, estimation of their numbers, infrastructure planning.

Module 7: Mine Closure: Mine Closure-ongoing and final report preparation

Module 8: Mine Planning Report**:** Feasibility report and project report - contents and preparation

Text/Reference Books:

1. Principles of Mine Planning, Jayant Bhattacharjee
2. Open Pit Mine Planning and Design, 3rd Edition, 2013 Vol. I & II, William A. Hustrulid, MarkKuchta, Randall K. Martin
3. SME Mining Engineering Handbook, Third Edition, 2011Vol. I & II, Peter Darling
4. Mine Planning and Equipment Selection 2001: Proceedings of the Tenth International Symposium on Mine Planning and Equipment Selection, New Delhi, India, November 19-21, 2001, Raj K. Singhal, Bhaskar P. Singh
5. Underground Winning of Coal, 1992, T.N. Singh
6. GEOVIA SURPAC, Tutorials for ore deposit
7. GEOVIA MINEX, Tutorials for sedimentary deposit

Mining Engineering			
MNP707	**Mine Closure**	**L**	**T**
		3	**0**

Course objectives:

The course objectifies to ensure long term physical, chemical and biological stability of the site to minimize potential environmental and health risk.

Goals and Outcomes:

This course provides the necessary and legal aspects of mine closure to comply with uninterrupted mining process. It gives special focus on the preparation of mine closure plan on elemental basis. With this course, the students will be able to:

- Know the insight into mine closure plan
- Prepare a mine closure plan
- Know the various legal aspects related with mine closure plan **CO-PO Mapping:**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3						3			3		
CO2		3		2		3		3	2		2	3
CO3				2	3					3		
CO4			2			2	2	2	2		3	3
Avg.	3	3	2	2	3	2.5	2.5	2.5	2	3	2.5	3

DETAILED SYLLABUS

Module-1: Mine closure planning: importance, methodology, statutes concerning mine closure.

Module-2: Principles, planning, financial provisions, implementation, standards for closure criteria, systems approach for mine closure.

Module-3: Various legal aspectsof mine closure planning, its advantages and amendments. Guidelines from ministry of environment and forest.

Module-4: Mine closure plan, guidelinesfor preparation of mine closure plan.

Module-5: Standards of Mine Closure in Indian Mines, components, process, monitoring rules.

Text/reference books:

1. Guide for mine closure planning, Sánchez, L.E.; Silva-Sánchez, S.S.; Neri, A.C, Brasília, 2014, IBRAM – Brazilian Mining Association.
2. Mine Closure - A. Robertson & S. Shaw
3. Mineral Conservation and Development Rules, 2017, Indian Bureau of Mines
4. Guidelines for preparation of Mine Closure Plan, Ministry of Coal, GOI

Mining Engineering			
MNP708	**Mine Reclamation and Rehabilitation**	**L**	**T**
		3	**0**

Course objectives:

The role of reclamation and closure in any mineral exploration project can be regarded as the final chapter in the life of that project. When the exploration project develops further into a feasibility study or a full-scale mining operation, however, then the reclamation process undertaken at the exploration stage becomes the first step in the final rehabilitation of the mine. There are many definitions used in describing reclamation and closure. These include: Decommissioning. This is the transitional period between the cessation of operations and the final closure of that operation. Reclamation. This refers to the physical aspects of earth moving, regrading and revegetation. Rehabilitation.

Goals and outcomes:

This course provides the basis for estimating the financial liability associated with a mining project. The objective of rehabilitating a typical exploration site is to minimize long-term environmental liability by maintaining geotechnical stability, restoring native ecosystems, striving to achieve a more beneficial land use, etc. Provide ideas and process about closing a mine, how to do reclamation and necessity of reclamation. The students will be able to:

- Understand the post mining liabilities associated with mines.
- Know the technical aspects to mitigate the adverse impacts.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				2		3			2		3
CO2		3	2	2		2		2	3		3	
CO3	3			2	3		3			3		3
CO4		2	2			2		2	1		2	
Avg.	2.5	2.5	2	2	2.5	2	3	2	2	2.5	2.5	3

DETAILED SYLLABUS

Module-1: Economical and technical aspects of reclamation of mined out land.

Module-2: Reclamation Methods: Back filling, outside dumps and their stability.

Module-3: Top soil handling, assessment of soil productivity potential, re-vegetation, factors for plant Growth, parameters for soil quality and their importance.

Module-4: Reclamation plan and land use plan, general requirements of protection of hydrologic balance.

Module-5: Erosion of soil: types of erosion, estimation of top soil erosion, Landscaping of disturbed and, estimation of reclamation cost and benefits, use of reclaimed land and structures.

Module-6: Mine Closure Planning: Importance, methodology, statutes concerning mine closure, Land reclamation as post mining operation, Statutes concerning reclamation of mined out area. Mine rehabilitation: Planning, Principles of Rehabilitation, Standard Rehabilitation, Monitoring, Maintenance and Relinquishment of Restored Mines.

Text/reference books:

1. Surface Mining Technology, S.K. Das
2. Elements of Mining Technology Vol I, D.J. Deshmukh
3. Bio-Geotechnologies for Mine Site Rehabilitation, M.N.V. Prasad, Paulo Jorge deCampos Favas, Subodh Kumar Maiti
4. Spoil to Soil: Mine Site Rehabilitation and Revegetation. 1st Edition, by N.S. Bolan,M.B. Kirkham, Y.S. Ok
5. Mine rehabilitation: A Handbook for the Coal Mining Industry – 1984, J. C. Hannan

Mining Engineering			
MNP709	**Sustainable Mining Practices**	**L**	**T**
		3	**0**

Course objectives:

The Strategy for incorporating involved in extracting non-renewable resources have come under increasing pressure to embed the concept of sustainability into strategic decision-making processes and operations. In addition to these considerations, responsible corporations have been able to move towards sustainability by developing a range of appropriate stewardship initiatives. Economic development, environmental impact and social responsibilities must be well managed, and productive relationships must exist between government, non-government organisations, industry and stakeholders.

Goals and outcomes:

This course provides the inside into the less know environment impacts related with coal preparation plants and throw the light into regulatory frameworks related with these plants. The students will be able to understand the:

- Environmental problems associated with the coal preparation plants.
- The mitigating measures associated with those issues.
- Regulatory frameworks associated with those issues.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3							2				2
CO2		3	2	2		2	3		3	2	3	
CO3	2			3	3							3
CO4			2			2	2	2	2	2	1	
Avg.	2.5	3	2	2.5	3	2	2.5	2	2.5	2	2	2.5

DETAILED SYLLABUS

Module-1: Coal preparation and washing: The Needs of Coal Preparation, Coal preparation process –physical, chemical or mechanical processes

Module-2: Coal dust generation: Sources, characterization, ill effects, measurement, monitoring, standards, mitigating measures

Module-3: Air pollution: Sources, characterization, ill effects, measurement, monitoring, standards, mitigating measures.

Module-4: Water pollution: Sources, ill effects, water quality parameters–physico-chemical, biological and bacteriological. Water quality criteria, standards, monitoring and mitigating measures. Heavy metal pollution and its abatement; Surface water pollution – detection and management.

Module-5: Environmental Impact Assessment: Methods of EIA and their applicability.

Module-6: EnvironmentalManagement Plan: Structure and preparation of EMP, Environmental Laws

Text/reference books:

1. Elements of Fuel technology, Godfrey Wilfred Himus, Leonard Hill Limited. 1958.

2. Fuels: Solid, liquid and gaseous fuels, J. Brame and King, Kessinger Publishing, LLC, 2007.
3. Coal, Oil Shale, Natural Bitumen, Heavy Oil and Peat - Volume I, Gao Jinsheng - 2009
4. Coal, Oil Shale, Natural Bitumen, Heavy Oil and Peat - Volume II, Gao Jinsheng - 2009

Mining Engineering			
MNO710	**MineEconomics and Resource Management**	**L**	**T**
		3	**0**

Course Objective:

This course examines the economic factors affecting the mining cycle; it consists of mineral economics, exploration of the global resource market, performing project economic evaluations. Assessing and estimating the resource and reserve estimation techniques of coal and metal liferous deposits. Learners should be able to skim the roadmap regarding resource management and planning by focusing on the cost efficiency at every mining process and developing decision making based on costs.

Course outcomes:

Upon the successful completion of the course, the students would be able to:

- Analyze and construct essential and relevant economic forecasts and financing plans throughout the mine life cycle.
- Assemble cash flow information and able to evaluate and determine the economic feasibility of the mine project.
- Able to recognize and interpret the sustainability perspective related to the mineral industry.
- Assess the project's impact on the economy of the country and, apply and improve economic criteria to real life decision making.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2							2		2		2
CO2		3		2		3	2		3		3	
CO3	2			2	3			2		2		
CO4			2			2	2		2		2	3
Avg.	2	3	2	2	3	2.5	2	2	2.5	2	2.5	2.5

DETAILED SYLLABUS

Module1: Mineral Sampling: Definition, purpose, and classes of samples, Chip, Grab, Groove, Bore hole, Dump, Alluvial & Bulk sampling. Development & stope sampling, Samples size reduction techniques. Errors in sampling- its minimization.

Module 2: Geo-Statistics: Use of statistical techniques in mine sampling. Reliability of samplingresults. Calculation of average assay, width and tonnage of mineral deposits, Introductory principles of Geo-statistics.

Module 3: Mineral resource: Mineral reserve estimations - various categories. Mine Valuation: Depreciation. Amortization of capital. Theory of mine valuation- its purpose, Factors affecting the value of a mine.

Module 4: cash flow evaluation: Hoskold, Morkill and other classical methods for mine valuation. Pay back method and Discount cash flow (DCF) methods of project evaluation (NPV & IRR).

Module5: Financial Management: Mine accounts, mining costs, cost categorization, break even analysis, balance sheet, profit and loss accounts, mine budgeting.

Module 6: Management Techniques: Elements of Management function, Project management, Organizational structures in mines.

Module7: Application of operation research techniques in mining PERT, CPM and Linear Programming methods with special reference to mining industry.

Reference/text books:

1. Sharma N.L, "Mineral Economics".
2. Rubawsky "Mineral Economics", Elsevier Science Pub.
3. Deshmukh R.T "Mineral Economics", Meera Publication, Nagpur.
4. Chatterjee K.K "Mineral Economics", Willey Eastern.
5. Misra G.B- "Mineral Economics".
6. Mineral Economics Sinha & Roy
7. Mine Valuation, Baxter, Addition Wesley
8. Mine Economics & Strategy, Runge, SME, USA

Mining Engineering			
MNO711	**Mine Management**	**L**	**T**
		3	**0**

Course Objectives:

This course introduces Objective of mine management, characteristics of minerals and coal, crushing methods, separation methods, methods of concentration, fields of application and limitations.

Course Outcomes:

1. Recognize and appreciate the holistic nature of the mine management process

2. Identify the key stakeholders in a mining project and their respective needs.
3. Demonstrate an awareness of management theory and processes.
4. Recognize the factors that motivate people's behaviour in the mine working environment.
5. Apply the principal performance measures used in mine management.
6. Demonstrate an awareness of mining law (safety, mining leases etc).
7. Recognize and appraise the factors contributing to safety & risk management issues in specific mining-related processes.
8. Investigate the causes and consequences of mining-related serious incidents and propose risk management strategies
9. Demonstrate an awareness of contractor management (vs owner-operated).
10. Assess and understand the economic conditions in which the mining industry operates

CO-PO Mapping:

COs/POs		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3						3					
CO2			3		2		3		2	3	2	3	3
CO3		2			2	3		2					
CO4				2			2		2	2	2	2	
Avg.		2.5	3	2	2	3	2.5	2.5	2	2.5	2	2.5	3

DETAILED SYLLABUS

Module 1: Introduction: Evolution of management; theory and practice; principles of scientific management; elements of management function; planning; organization and control; structure and design of organization for mining enterprises.

Module 2: Personal Management: Selection; training and development of human resources formining enterprises; leadership; study of traditional leader behaviour; autocratic; democratic and Laissez-Faire behaviour;

Module 3: Production Management: Determination of norms and standards of operations by work study; analysis of mine capacities and capability; production planning; scheduling and control; short term and long-term planning; productivity; concepts and measurements; application of Ergonomics in mine operation.

Module 4: Financial Management: Capital budgeting; techniques for mining project; project evaluation; payback period and IRR; methods of cost analysis and cost control; breakeven charts; working capital management.

Module 5: Materials Management: ABC Analysis, Inventory Management; Purchase policies, P and Q system, inventory control, Review period, lead time.

Module 6: Behavioural Sciences for Management: Conflict management; conflict in organization; sources of conflict; dealing with conflict; organizing for conflict resolution; conflict and growth; Individual motivation; two-way personal communication.

Module 7: Maintenance Management: Definition, Classifying Reliability, Types of Maintenance; Break-down, scheduled, preventive, predictive, protective and lean maintenance.

Module 8: Marketing Management: Strategic planning & marketing management processes, marketing environment, marketing information systems, market management and forecasting; New product development processes.

Text/Reference Books:

1. I M Pandey, Financial Management, Vikash Publishing House Pvt. Ltd., New Delhi
2. P. Gopalakrishnan & M. Sundaresam, Materials Management- An Integrate Approach, Prentice Hall India Pvt. Ltd., New Delhi
3. SC Saksena, Business Administration and Management, Sahitya Bhawan, Agra.
4. P. Kstler, Marketing Management, Prentice Hall India Pvt. Ltd. New Delhi
5. M. Telsang, Industrial Engineering and Production Management, S. Chand & Co. Ltd., New Delhi
6. Lee &Dobbler, Purchasing and Materials Management, Tata Mc-Grand Hill Publishing Co. Ltd. New Delhi

Mining Engineering			
	Remote Sensing & Geographical Information System	**L**	**T**
		3	**0**

Course Objectives:

Remote Sensing and GIS is a relatively young scientific discipline and is an area of emerging technology which has witnessed phenomenal growth over last three decades. In the recent past, there has been tremendous development in the field of Remote Sensing data collection, analysis and utilization. The science of Remote Sensing is no more an art of Map making from satellite image. The digital data handling led to the development of GIS (Geographical Information System) followed by another innovation of GPS (Global Positing System). Remote Sensing coupled with GIS and GPS techniques has dramatically enhanced human capability for resources exploration, mapping and monitoring on local and global scale.The application of Remote Sensing techniques and Geographical Information System(GIS) in various activities including resources evaluation, environmental monitoring and Landuse/Landcover mapping etc, have grown considerably during the last three decades and Remote Sensing data products are being increasingly used for plan information at all levels. An essentials pre-requisite to partaking in these opportunities is the building of various indigenous capacities for the development and utilization of space science and technology. This has led to a spurt in the demand for qualified manpower.

This course is designed to address the following:

- Understanding the Geo-informatics approach
- Teach fundamental principles involved in RS and GIS
- Understand the Fundamentals of Remote Sensing Products
- Know the Indian Remote Sensing Program
- Role of Remote Sensing for various surveys and information extraction
- Know about different software available in RS and GIS
- Learn fundamental procedures in RS and GIS
- Teach data integration and defining problems in digital format

Course outcomes

Upon successful completion of this course, the student will be able to:

Knowledge based

- Know Understand the remote sensing process;
- Understand digital data in different and their formats

- Know about National and International RS Programs
- Know about various satellites and images
- Know about changing field practices in Survey
- Know how to generate different types of digital data
- Know about Application areas

Skills

Use operations of RS & GIS to:

- Geotechnical investigations (soil studies, dam site studies)
- Water resources management
- Environmental studies (EIA and Land Use Land cover studies)
- Transportation planning, Urban Planning, E-Governance.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3		2		3		3	3	3	2	3
CO3				2	3							3
CO4			2			2		2	1	3	3	
Avg.	3	3	2	2	3	2.5		2.5	2	3	2.5	3

DETAILED SYLLABUS

Module 1: Definition & Scope of Remote Sensing: Electromagnetic energy & spectrum, Atmospheric windows. Remote Sensing Systems, Sensors & Scanners, Resolution of sensors, Multispectral, thermal & Radar data. Radiometers, spectral Signatures.

Module 2: Elements of Remote Sensing Systems: Terrestrial, airborne &spaceborneplatforms, sunsynchronous & Geostationary satellites. Various earth resources satellites, Indian Remote Sensing Programs.

Module 3: Remote Sensing Data products & their types: Analogue & Digital data Formats,errors.

Module 4: Interpretation Techniques: Elements & Methods of interpretation, Reliefdisplacement and vertical exaggeration, Photogrammetric determination of elevation from Remote Sensing Data.

Module 5: Digital Image Processing: Image rectification & restoration, imageenhancements, image classification; supervised & unsupervised, accuracy assessments.

Module 6: Geographical Information Systems: Raster & Vector Data, Components of GIS, concepts & basic characteristics of Vectorization, topology generation, attribute data attachment, editing and analysis. Buffer, Overlay and Interpolation techniques. Managing networks in GIS.

Module 7: Global Positioning Systems:Types and method, Applications:Integrated approach of RS & GIS application; Geotechnicalinvestigations (soil studies, dam site studies), water resources management, environmental studies (EIA and Land Use Land cover studies), transportation planning, Urban Planning, E-Governance.

Text/Reference Books:

1. M. Anji Reddy BS Publications Remote Sensing and Geographical Information Systems Third Edition.

2. C.P LO Albert KW Yeung, Concepts and techniques of Geographic Information Systems Pritince Hall of India 2002.

3. John R Jensen Remote Sensing of the Environment an Earth Resource Perspective Pearson Education 2006.

4. Geographic Information System and Environment Modelling Keith C. Clerk, Bradley O Parks, Michel P Crane Pritince Hall of India 2002.

5. Bhatta Remote Sensing and GIS Oxford University Press First Edition.Surveying (Vol – 1,2 & 3), by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain – Laxmi Publications (P) Ltd., New Delhi.

Mining Engineering			
MNO713	**Social-Environmetal Impact of Opencast Mines**	**L**	**T**
		3	**0**

Course objective:

This course outlines various factors which effects the ecological and societal imbalance, repercussions due to mega open cast mining projects. Following course summarizes those environmental and social issues that formed the basis for the Mining and Critical Ecosystems framework. Environmental and social impacts are divided into waste management issues, impacts to biodiversity and habitat, indirect impacts, and poverty alleviation and wealth distribution.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2		3	2	2		2		3	2		3	3
CO3	2			2	3							
CO4		2	2					2	2		2	
Avg.	2	2.5	2	2	3	2		2.5	2		2.5	3

Detailed Syllabus

Module-1: Introduction: History of environmental problems in mines and present environmental scenario. Techno-economics of environmental management.

Module-2: Environmental Parameters and Standards: Baseline data. Impact of mining activities on environmental parameters. Mitigating measures, monitoring and control. National and international standards and regulations. ISO principles and series

Module-3: Environmental Standards: National and International standards of various environmental parameters.

Module-4: Environmental Impact Assessment (EIA**)**: Framework for EIA, screening, scoping and baseline studies. EIA methodologies and their applicability, Environmental Impact Indices, uncertainties in EIA.

Module-5: Environmental Management Plan (EMP):Scope, structure and legislative requirements. Preparation of EMP

Module-6: Land Acquisition & Revenue: Concepts, Related laws and regulations. Corporate Social Responsibility: Concepts and principles. Mine closure**:** Concepts and principles. Environmental administration: Laws related to mining environment.

References:

1. Environmental Legislation in India, Region Asia.
2. Pollution control acts, rules and notifications issued thereunder, CPCB-India Environmental Law of India, S.K. Choudhury, Oxford & IBH Publishers.
3. Handbook of Environmental laws, Acts, Guidelines, Compliances & Standards Policy, Trivedy, BS Publishers.
4. Environmental Impact Assessment -Larry, W. Canter (2nd ed), McGraw Hill Inc. Singapore, 1996.
5. Strategic Environmental Assessment – Riki Therirvel, E. Wilson, S. Thompson, D. Heaney, D. Pritchard. Earth scan, London, 1992.
6. Environmental Impact Assessment-Cutting edge for the 21st century - Alan Gilpin, CUP, London, 1994.

7. Environmental Impact Assessment-Theory & Practice - Peter Wathern, Unwin Hynman, Sydney, 1988.
8. Renewable Energy Environment and Development-Maheswar Dayal Konark Pub. Pvt. Ltd. 1998.

Mining Engineering			
MNO714	**Sustainable Energy Resources**	**L**	**T**
		3	**0**

Course objectives:

The course should enable the students to:

1. Understand the various forms of conventional energy resources.
2. Learn the present energy scenario and the need for energy conservation
3. Explain the concept of various forms of renewable energy
4. Outline division aspects and utilization of renewable energy sources for both domestics and industrial application
5. Analyse the environmental aspects of renewable energy resources.

Goals and Outcomes:

This course gives a flavour of sustainable sources of energy to the students. This covers generation, design, efficiency and characteristics of various sustainable energy sources including wind, hydro and tidal systems. Student should be able to

- Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface.
- Design solar thermal collections.
- Design solar photo voltaic systems.
- Develop maximum power point techniques in solar PV and wind.
- Explain wind energy conversion systems, Betz coefficient, tip speed ratio.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2		3		2		3	3	2	3	2	3	3
CO3				2	3							
CO4			2			2		2	2	2	2	
Avg.	3	3	2	2	3	2.5	3	2	2.5	2	2.5	3

DETAILED SYLLABUS

Module-1: Wind Energy Conversion: Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics. Site Selection Criteria: Advantages, Limitations, Wind Rose Diagram, Indian Wind Energy Data, Organizations like C-WET etc., Wind Energy Conversion System, Design, Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandtl's tip loss correction.

Module-2: Design of Wind Turbine: Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods. Wind Energy Application - Wind pumps: Performance analysis, design concept and testing; Principle of WEG; Stand alone, grid connected and hybrid applications of WECS; Economics of wind energy utilization; Wind energy in India; Case studies.

Module-3: Small Hydropower Systems: Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection and civil works.

Module-4: Speed and voltage regulation: Investment issues load management and tariff collection; Distribution and marketing issues: case studies; Potential of small hydro power in India. SHP: Renovation and Modernization, Testing Methods

Module-5: OTEC-Tidal Energy: Geothermal, MHD, Thermionic- Thermoelectric energy conversion system, Fuel Cells, Batteries, Micro Alge, Biodiesel from Alge.

Text/reference books:

1. G L Johnson, Wind Energy Systems, Prentice Hall Inc, New Jersey, 1985.
2. David A. Spera, (Editor) Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering, American Society of Mechanical Engineers; (1994)
3. Erich Hau, Wind Turbines: Fundamentals, Technologies, Application and Economics, Springer Verlag; (2000)
4. Paul Gipe, Karen Perez, Wind Energy Basics: A Guide to Small and Micro Wind Systems, Chelsea Green Publishing Company; (1999)
5. J. F. Manwell, J. G. McGowan, A. L. Rogers, Wind Energy Explained, John Wiley & Sons; 1st edition (2002)

MNO715	OPENCAST MINING MACHINERY	3L-0T-0P	3 CREDITS

Course Objective:
To give an overall idea about the various heavy-duty machines employed in mines and their structure and applications.

Syllabus
Module 1: Introduction to Surface mining equipment. Hydraulic Transmission system, Suspension System, Tyres, Wheels and Axle assembly, Braking and Steering system, Under Carriage unit of Crawler mounted machine; Hydraulic systems used in Heavy Earth Moving Equipment.
Module 2: Classification of equipment; system with different combination of excavator and transport equipment. Applicability of different surface mining equipment, Mechanics of rock cutting / loading by excavator bucket.
Module 3: Prime movers used in surface mining equipment: Turbo-charged diesel engine, construction, operation and maintenance of its subsystems, trouble shooting of the engine.
Module 4: Classification, construction, operation and maintenance of various sub-systems of Shovel, Dragline, Bucket wheel excavator, Scraper, Surface Miner, Dumper, Dozer, Ripper, Grader, Loader, Compactor, Drills and Highwall miner Construction and Operations of subsystems of HEMM.
Module 5: Drilling Machine: Classification, construction, operation and maintenance of Rotary Blast Hole Drill, Jack Hammer Drill, DTH Drill; Drill Bits and Tubes / Rods, Drilling fluids., Construction and Operation of Exploratory drilling.
Module 6: Recent trends and development of surface mining equipment: Automation and control in HEMM. Selection criteria of open cast mining equipment. Safety aspects related to open cast mining equipment: Fire protection system used in HEMM.

Outcome Assessment Strategies:
- Individual, small group and full class discussions may be used as part of student assessment. Homework assignments, tutorials, surprise tests, mid semester examination and end semester examination will be used to assess outcomes.
- Specific details of the assessment procedure will be given the first week of class. In general, student assessment would depend on class attendance, input and feedback during the lecture and problem-solving sessions, homework, and written examinations.

Course Outcome:
Students will have a brief idea about the various systems and functioning of the heavy-duty machineries in terms of hydraulic circuits being employed and the transmission systems.

References/Books:
1. Recent Development of Heavy earth Moving machineries – A. De, Lovely Prakashan
2. Moving the Earth – Nicholes
3. On and with the Earth – J. Singh
4. Drilling Technology Handbook– C. P. Chugh

Mining Engineering			
MNO716	**Mine Disaster and Prevention Management**	**L**	**T**
		3	**0**

Course Objective:

To categorize, analyze and develop capability by measure actions to prevent and mitigate mine accidents. To ameliorate different past and recent case studies dealing with mine hazards and accidents.
Course aims for the students to identify and evaluate any real-life scenario of mine disasters henceforth, also comprehend and absorb inherent knowledge of mitigation strategies to achieve minimal casualties within the mines.

Module:

Module 1: Mine Fires; Surface and underground mine fire -causes and prevention, causes and nature of spontaneous heating. Dealing with the underground fire.
Module 2: Sealed Off Area and Reopening: the study of atmosphere behind sealed off area. Factors, conditions, danger and safety measure for reopening.
Module 3: Mitigation of Fire: Methods of firefighting, firefighting- organization, and Rescue work related to connection with mine fires.
Module 4: Inundations and Related Rescue Operations: Rescue work pertaining with connection with mine fires Causes and protective measures for inundations. Precautions to be taken while approaching the old- working design construction of water dams. Dewatering and recovery of waterlogged working and water danger plan, Rescue work related to mine inundations.
Module 5: Firedamp and Coal Dust Explosion: Fire damp explosions, causes, preventive measures, Coal dust explosions, causes, preventive measures, Rescue work related to mine explosions.
Module 6: Airborne Dust: Dust production, Assessment and control of mine dust and associated hazards.
Module 7: Rescue Operation: Different types of rescue equipment. Use of organization for rescue work Disaster management plan of mines.

Course outcomes:

- After completion of the course students will be able to find and explain the various kinds of the disasters which takes place within underground mines and opencast mines.
- Able to summarize the categories hazards due to fire, inundation, dust and explosions.
- Able to recall and identify various causes, factors and mitigation strategies associated with the above risks.

- Able to demonstrate, distinguish and perform various rescue operations, apparatus their specification, and workings in case of any mishap in the mines.
- Able to recall and relate main provisions, regulations and rules laid down by the statutory bodies in the country concerning the safety of mine workers.

Reference/text books:

1. Banerjee S.P. (2003); "Mine Ventilation"; Lovely Prakashan, Dhanbad, India.
2. Deshmukh, D. J. (2008); "Elements of Mining Technology, Vol. II"; Denett & Co., Nagpur, India.
3. Hartman, H. L., Mutmansky, J. M. & Wang, Y. J. (1982); "Mine Ventilation and Air Conditioning"; John Wiley & Sons, New York.
4. Karmakar, N. C. (2001); "Handbook of gas testing"; Lovely Prakashan, Dhanbad, India.
5. Le Roux, W. L. (1972); Mine Ventilation Notes for Beginners"; The Mine Ventilation Society of South Africa.
6. McPherson, M. J. (1993); Subsurface Ventilation and Environmental Engineering"; Chapman & Hall, London.
7. Misra G.B. (1986); "Mine Environment and Ventilation"; Oxford University Press, Calcutta, India.
8. Ramlu, M. A. (1991); "Mine fires, Explosions, Rescue, Recovery and Inundations"; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
9. Vutukuri, V. S. & Lama, R. D. (1986); "Environmental Engineering in Mines"; Cambridge University Press, Cambridge.
10. Kejriwal, B.K," A Survey of Accidents, Their Causes &Prevention''.
11. Kaku L.C, "Fire in Coal Mine", Lovely Prakashan, Dhanbad, India.
12. Ghatak S., "Mine Ventilation" Vol. 1 & Vol. 2, Lovely Prakashan, Dhanbad, India. 13. Banerjee S.P., "Prevention combating Mine Fires", Lovely Prakashan, Dhanbad, India.

Mine Planning & Design Lab

The list of experiments

MN 701P	Mine Planning & Design Lab	0L:0T:3P	1 CREDITS

S. No.	Name of Experiment
1.	To determine the percentage of extraction and its variation in B & P mining as per regulation 99 of CMR 2017.
2.	To design the layout of semi mechanized B & P depillaring working with caving under given geo -mining condition including estimation of OMS.
3.	To design the layout of semi mechanized B & P depillaring working with hydraulic sand stowing under given geo -mining condition including estimation of OMS.
4.	To design systematic support for a depillaring panel under Caving & Hydraulic sand stowing.
5.	To design the layout of mechanized longwall working including gate roads and face elements under given geo - mining conditions and target production.
6.	Layout of Open stoping in thin and steep ore body following (a) Overhand sequence of extraction (b) Underhand sequence of extraction
7.	To design the layout for cut & fill stoping in thick and steep ore body.
8.	To design the layout of a mechanized opencast mine for specified unit operation under given geo-mining conditions.
9.	To draw the layout of tandem operation of dragline excavator.
10.	To design the shovel – dumper combination for a given targeted output.
11.	To draw the layout of in-pit crushing and conveying system.
12.	Manpower planning against given targeted production in an underground project including estimation of OMS & EMS.

RADHA GOVIND UNIVERSITY, RAMGARH
Semester – VIII
Mining Engineering

SL.NO	Code	Course Title	L	T	P	Credits
1.	MN801D	Project - II			16	08
				Total Credits		08

NOTE – A Students can be allowed to do project outside after the permission of departmental Academic Committee. Those students doing project outside has present their project progress every month. Those students doing project outside can be permitted to present progress every fortnight though video conferencing. Students doing project in house has present their project progress every week.