

# JHARKHAND RAI UNIVERSITY



## **MINING ENGINEERING**

### **B.Tech**



## SYLLABUS SEMESTER V

**Kamre | Ratu Road | Ranchi | Jharkhand**

**Web : [www.jru.edu.in](http://www.jru.edu.in) | Email : [info@jru.edu.in](mailto:info@jru.edu.in)**

## B.TECH SEMESTER V

<b>B.TECH IN MINING ENGINEERING</b>													
<b>SEMESTER V</b>													
S. No	Subject code	Name of Subject	Period			Evaluation Scheme				Subject	Credit	Hours	
			L	T	P	Assign ment	T A	Total	ESC				
1	8.301	Mining machinery I	3	0	0	20	10	30	70	100	3	3	
2	8.302	Surface Mining	3	0	0	20	10	30	70	100	3	3	
3	8.304	Underground coal Mining	3	0	0	20	10	30	70	100	3	3	
4	8.305	Rock Mechanics	3	0	0	20	10	30	70	100	3	3	
5	8.306	Numerical & Statistical Methods	3	0	0	20	10	30	70	100	3	3	
6	8.307	Map Projection & GIS	3	0	0	20	10	30	70	100	3	3	
7	40B.301	Intellectual and Aural Skills	2	0	0	20	10	30	70	100	2	2	
<b>PRACTICAL / SESSIONAL</b>													
1	8P.305	Rock Mechanics Lab	0	0	2		20	20	30	50	1	2	
2	8.345	Vocational Training Report I								100	2		
										<b>Total</b>	<b>800</b>	<b>23</b>	<b>22</b>

- Vocational Training in a Surface / Underground Mine of minimum 30 (Thirty) days to be taken at the end of IVth Semester Will be Credited in VIIth Semester.
- MOOCS introduced through SWAYAM in all semester.

**Program:** B.Tech

**Semester:** Five

**Course:** Mining Machinery I

**Course Code:** 8.301

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L	T	P	C
3	0	0	3

### **Course Objective:**

- Enables the students to select appropriate machinery for various mining operations based on the production targets.
- Enables the students to be familiar with the various machines used in opencast mine, their construction and performance.
- The students will get exposure towards the material handling methods and systems and its Principle to convey the minerals or materials from mines, plants and workshops.
- The students will have knowledge on function of winding engines, winding accessories, pit-top and bottom mine circuits.
- They will also know about working of various coal face machinery, face haulage systems and conveyors.
- The students will have basic knowledge on motive power used in mines, pumping, rope haulage and other transport systems. They also will know about mine electrical engineering in all statutory aspects.

### **Unit I**

Classification, application, constructional features of drilling machines used in coal and metal mining, Coal cutters, shearer, plough, continuous miner, road header and dint header. Loading and transport equipment, man riding systems.

### **Unit II**

Classification and constructional difference of different types of winders, mechanics of winding, power calculation, rope selection, inspection and maintenance. Safety features and contrivances. Classification, construction and selection steps for mine dewatering pumps.

### **Unit III**

Transmission of Power Belt, rope, chain, gear, hydraulic and electro-hydraulic transmission. Compressed Air Comparison with other sources of power. Air compressors – types, construction, installation and maintenance. Compressed air transmission and distribution, compressed air drills, pneumatic picks, air motors and other compressed air equipment.

### **Unit IV**

Wire Ropes Types, construction and uses. Rope deterioration and maintenance. Capping and splicing of rope. Rope haulages. Track, mine tubs and cars. Safety appliances on haulage roads. Locomotive haulage. Mono rail. Statutory Provisions

### **Suggested Reading:**

1. *D.J. Deshmukh VOL III*
2. *Mine pump, haulage, winding. S. GHATAK*

**Program:** B.Tech  
**Semester:** Five  
**Course:** Surface Mining  
**Course Code:** 8.302

L	T	P	C
3	0	0	3

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### Course Objective:

- Enables the students to apply the knowledge of mining machinery in their economic deployment for achieving the production targets in opencast mines.
- The students will have insight about the advanced techniques for mine planning, geotechnical investigation and equipment management and also will understand the modern trends in opencast mines, safety and environment.
- To introduce the various techniques for mine planning, geotechnical investigation and equipment management.
- To appreciate the modern trends in opencast mines, safety and environment.
- The students will have ability to classify and select the suitable surface mining methods and equipment based on site conditions. They will also have a concept of waste dump formations And slope failures in surface mines.

### Unit I

Introduction: Surface mining-basic concepts, applicability, advantages and disadvantages; Role of surface mining in total mineral production; Deposits amenable to surface mining vis-à-vis excavation characteristics; Surface mining unit operations; Surface mining systems vis-à-vis equipment systems–classification, applicability, advantages and disadvantages. Opening up of deposits: Box cut –objective, types, parameters, methods; Factors affecting selection of box cut site; Production benches– formation, parameters and factors affecting their selection. Preparation for excavation: Ripper: Types, classification, applicability and limitations; Method and cycle of operation; Estimation of output; Estimation of number of drills required for a given mine production.

### Unit II

Discontinuous/cyclic methods of excavation and transport: Shovel-dumper operation: Applicability and limitations of electric shovel, hydraulic excavators and dumpers; Cycle time and productivity calculation for shovel and dumper; Estimation for equipment (shovel, dumper and other heavy earth moving machines ) required for a given mine production; Drag line operation: Applicability and limitations, different modes of operation; Side cast diagram and calculation of reach; Cycle time and productivity calculation; Calculation of required bucket capacity for a given handling requirement; Maximum usefulness factor and its significance in selection of dragline for a given situation; Scrapers: Applicability and limitations, various types; Method and cycle of operation; Pusher dozer and push-pull operation. Dozers: Applicability and limitations; Types and classification; Types of blade and corresponding merits and demerits; Method and cycle of operation. Front-end- loaders: Applicability and limitations; Method and cycle of operation; Calculation of maximum working load and selection of bucket capacity of a front-end-loader for a given job condition.

### Unit III

Continuous methods of excavation and transport: Bucket wheel excavators: Applicability and limitations; Types and principle of operation; Calculation of productivity. Continuous surface miners: Types, classification, applicability and limitations; Principles of operation; Operational methods–classification; Wide/full bench method, block mining method and stepped cut method; Conveyor/truck loading method, side casting method and windrowing method, Respective merits & demerits and applicability & limitations

of these methods. Conveyors: Shift able and high angle conveyors; Mode of operation, applicability and limitations; Merits and demerits of conveyor as a system of transportation.

#### **Unit IV**

**Semi-continuous methods of excavation and transport:** Continuous excavation and partly/fully cyclic transport system: Different methods and applicability limitations. Cyclic excavation and partly/fully continuous transport system: Different in-pit crushing and conveying methods and their respective applicability & limitations, Types of mine slope—high wall and waste dumps; Common modes of slope failure; Factors influencing stability of slopes; Slope stability assessment techniques; Waste dumps-types and formation methods; Slope protection, stabilization and monitoring.

#### ***Suggested Reading:***

1. *Explosive and Blasting Techniques*, G.K. Pradhan
2. *Explosives and Blasting Techniques*, S.K. Das
3. *Surface Mining*, G.B. Mishra

**Program:** B.Tech

**Semester:** Five

**Course:** Underground Coal Mining

**Course Code:** 8.304

L	T	P	C
3	0	0	3

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### Course Objective:

- The students will have good exposure about the various advanced methods of coal mining with the knowledge about advanced coal face mechanization.
- To pioneer the history of longwall mining and its development stages.
- To understand the extraction, support and transport on a longwall face.
- Enables the students to appreciate various coal mining methods and to ably manage highly mechanized mines.
- To introduce the recent trends of level of mechanization for coal face.
- To understand the various advanced methods of coal mining.

### Unit I

Introduction: History of coal mining; coal resource and their geographical distributions; Coalification and factors affecting coalification process, modes of accumulation of coal, evidences in support of in-situ and drift theories; Geological time scale vis -à-vis formation of coal, occurrence and distribution of coal in various stratigraphic horizons; Coal seam structure and abnormalities, geological and other features of Indian coalfields. Bord and Pillar Mining: Choice of methods of mining coal seams; factors affecting choice of mining methods. General principles of Bord and Pillar (B&P) development, different schemes of development and associated merits/demerits; Design of B&P workings, statutory provisions related to B&P workings, Semi- mechanized and mechanized schemes of B&P development; Mechanized face loading. Conditions suitable for mechanical loaders and continuous miners.

### Unit II

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

### Unit III

Long wall Mining: Factors affecting long wall mining, long wall face layouts, advancing and retreating faces, single versus double unit long wall faces, orientation of longwall faces; single versus multiple heading gate roads, factors affecting length and width of long wall panel. Extraction of Long wall panel, working with shearer and plough, support system of long wall face and gate roads, case studies of long wall faces in India.

### Unit IV

Roof Supports: Timber props and cogs; friction/hydraulic props and chocks; other steel supports; types of roof bolts; function, applicability and advantage of roof bolting and cable bolting; powered supports; systematic support rules; supporting scheme of development gallery, B &P and L/W faces, depillaring district; withdrawal of support.

**Suggested Reading:**

1. *Underground Winning of Coal*, T.N.Singh
2. *Modern Coal Mining Technology*, S.K. Das
3. *Elements of Mining Technology Vol I*, D.J. Deshmukh

**Program:** B.Tech  
**Semester:** Five  
**Course:** Rock Mechanics  
**Course Code:** 8.305

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### Course Objective:

- The course provides detailed knowledge on rock properties
- This will equip the students with the ability to carry out various tests and monitoring the rock behavior.
- Students will be able in analysis of analysis of data and solving rock mechanics problem in mining and excavation projects.
- Provides detailed knowledge on rock properties and equips the students with the ability to carry out various tests.
- Students will be able in analyzing the data and solving rock mechanics problem in mining and excavation projects.
- Data and solving rock mechanics problem in mining and excavation projects.

### Unit I

Rock mechanics: Definition, history, inherent complexities, source of information and field of application of rock mechanics. Concept of stress and strain in rock: Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks. Physico-mechanical properties of rock: Determination of physical properties, strengths, strength indices and static elastic constants; Parameters influencing strength; Abrasivity of rock and its determination.

### Unit II

Dynamic properties of rock and rock mass: Propagation of elastic wave in rock media; Determination of dynamic strength and elastic constants of rock. Time dependent properties of rock: Creep deformation and strength behavior; Creep test and rheological models. Strength and Deformability of Rock Mass: In situ shear tests; Evaluation of shear strength; In situ bearing strength test; In situ deformability tests-Plate Loading Test, Plate Jacking Test and Bore hole Jack Tests

### Unit III

Failure criteria for rock and rock mass: Theories of rock failure; Coulomb, Mohr and Griffith criteria; Empirical criteria. Pre-mining state of stress: Sources, methods of determination including over coring, hydro-fracturing methods and other methods.

### Unit IV

Physico-mechanical properties of soil: Origin of soils; Basic relationships; Index properties including consistency and gradation; Clay mineralogy; Classification of engineering soils; Engineering properties of soils compressibility, consolidation, compaction and strength. Groundwater: Free and confined ground water ; Exploration and engineering importance of groundwater; Influence of water on rock and soil behavior; Permeability of rocks; Measurement of permeability; Ground water flow in rock mass; Ground water pressure in rock mass and its measurement.

### Suggested Reading:

1. *Elements of Mining Technology Vol I, D.J. Deshmukh*
2. *The elements of mechanics of mining ground, B.S. Verma*
3. *Rock Mechanics for Engineers, Dr. B.P. Verma*



**Program:** B.Tech

**Semester:** Five

**Course:** Rock Mechanics Lab

**Course Code:** 8P.305

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0	0	2	1

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### List of Experiments:

1. Preparation of rock sample for testing in laboratory.
2. Methods for determination of compressive strength, tensile strength, shear strength and triaxial strength of rock.
3. Porosity of rock.
4. Abrasivity of rock.
5. Strength indices of rock.
6. Modulus of elasticity and Poisson's ratio.
7. Slake durability of rock.
8. Shear strength, consistency, consolidation and compaction of soil.
9. Determination of in situ stresses in rock.

**Program:** B.Tech

**Semester:** Five

**Course:** Numerical and Statistical Method

**Course Code:** 8.306

L	T	P	C
3	0	0	3

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### Course Objective:

- The students will get the concept about finite element models, methods and boundary elements method and its practical applications in mining and rock mechanics.
- To understand the practical applications of numerical methods in mining field.
- The understanding of the mathematical principles on numerical differentiation and integration and numerical solutions to ODE would provide them the ability to formulate and solve some of the physical problems of engineering.
- To acquaint the student with analysis of correlation and Eigen value problems used in wide variety of situations.

### Unit I

Numerical Methods: Solution of algebraic and transcendental equations by bisection, iteration, false position and Newton Raphson methods. Solution of a system of linear simultaneous equations by Gauss elimination, Gauss-Jordan, Crout's triangularisation, Jacobi and Gauss Seidel methods.

### Unit II

Finite difference, Symbolic relations, Interpolation and extra polation, Newton-Gregory forward and backward, Gauss forward and backward, Numerical differentiation and integration, Trapezoidal, Simpson's  $1/3^{\text{rd}}$ , Simpson's  $3/8^{\text{th}}$  and Weddle quadrature formulae. Numerical solution of first order ordinary differential equations by Taylor's series, Picard's, Euler's, Modified Euler's, Runge-Kutta and Milne's methods.

### Unit III

Probability: Various approaches of probability, two theorems (without proof), conditional probability, Bayes Theorem. Random variable: Definition, probability mass & density functions, distribution function, mathematical expectation and moment generating function. Probability distributions: Bernoulli, binomial, Poisson and normal distributions.

### Unit IV

Statistical Methods: Moments, skewness and kurtosis; Theory of least squares and curve fitting. Correlation and Regression: Simple, multiple & partial correlation coefficients, regression lines, regression coefficients and their properties. Tests of significance: Normal test, t-test, Chi-square test and F-test.

### Suggested Reading:

1. *Numerical & Statistical method, D.R. Vittal*
2. *Numerical Methods in Engineering and Science" by Grewal B.S. and Grewal J.S*

**Program:** B.Tech

**Semester:** Five

**Course:** Map Projections & GIS

**Course Code:** 8.307

L	T	P	C
3	0	0	3

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### **Course Objective:**

- This course enables students to create a map that accurately shows distances, areas, or directions.
- Applications of remote sensing and GIS in geological mapping and mineral exploration.
- They will have deep knowledge about geophysics, remote sensing and GIS.

### **Unit I**

Map Projections: Introduction and concept of map projections; Spherical co-ordinates; classification of map projections; Polyconic, Conformal, Cassini, Mercator and universal traverse Mercator projections (UTM), scale factors.

### **Unit II**

Calculations on projections, state plane coordinates (national grid), transformation of coordinates.

### **Unit III**

GIS: Concepts and terminology, Development of Mapping Techniques; types of features on Earth's surface. Spatial Data, topology; Scales of the Special Data; Essential components of a GIS.

### **Unit IV**

GIS analysis, Data Structure, Projection, Spatial Referencing, Database Management, Data Management and Analysis; Advantages and disadvantages of Raster or Vector Data ; Uses of GIS.

### **Suggested Reading:**

1. *Surveying and Levelling – R. Agor*
2. *Higher Surveying – B C Punamia*
3. *Surveying and Levelling – Basak*

**Program:** B.Tech  
**Semester:** Five  
**Course:** Intellectual & Aural Skills  
**Course Code:** 40B.351

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2	0	0	2

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**Course Objective:** This course aims to

- Students should be able to understand in Standard Indian English, and speak reasonably and clearly.
- Students should speak with proper word stress, intonation pattern, accent and perfect articulation.
- Teaching Phonetic Symbols, Stress, and Intonation etc. the aim should be to enable the Student to find out for himself/herself the correct pronunciation of a word from a Learner's Dictionary.
- To make the students comprehend speaking and listening skills.
- Students understand differences between Standard Indian English & AE/BE.

## **SOFT SKILLS**

### **UNIT I**

#### **INTRODUCTION**

- Introduction and importance of Soft Skills
- Skill Analysis
- Attributes regarded as Soft Skills
- Identifying and Improving your Soft Skills
- Accept your limitations
- Personality
- Motivation

### **UNIT II**

#### **IMPROVING YOUR SOFT SKILLS**

- Positive reinforcement
- Accept and Learn from criticism
- Confidence Development
- Speaking & Listening Skills
- Rapport Building
- Adaptability
- Assertiveness
- Command Over the Subject Matter

## **PHONETICS & PHONOLOGY**

### **UNIT III**

#### **BASICS OF PHONETICS**

- Introduction
- Speech Mechanism
- Phonetics Symbols
- Classification of Sounds

- Consonants, Vowels & Diphthongs
- Stress Pattern, I notation

#### **UNIT IV**

##### **USAGE OF PHONETICS**

- Syllable, Syllable Division, Word Syllable
- Tone/ Accent/Pitch/Rhythm
- Manner of Articulation
- Voice Modulation

#### **Suggested Readings:**

1. *Monippally, Matthukutty. M. 2001. Business Communication Strategies. 11<sup>th</sup> Reprint. Tata McGraw-Hill. New Delhi*
2. *Swets, Paul. W. 1983. The Art of Talking So That People Will Listen: Getting Through to Family, Friends and Business Associates. Prentice Hall Press. New York*
3. *Lewis, Norman. 1991. Word Power Made Easy. Pocket Books*
4. *Sen, Leena. Communication Skills ; Eastern Economy Edition*
5. *Ghanekar, Dr. Anjali. Essentials of Business Communication Skills ; Everest Publishing House*
6. *David Green. Contemporary English Grammar, Structure & Composition ; MacMillan*
7. *Dictionary; Oxford*
8. *Dictionary ; Longman*

#### **Websites**

- [www.tatamcgrawhill.com/digital\\_solutions/monippally](http://www.tatamcgrawhill.com/digital_solutions/monippally)
- [www.dictionary.cambridge.org](http://www.dictionary.cambridge.org)
- [www.wordsmith.org](http://www.wordsmith.org)
- [www.edufind.com](http://www.edufind.com)
- [www.english\\_the\\_easy\\_eay.com](http://www.english_the_easy_eay.com)
- [www.englishclub.com](http://www.englishclub.com)
- [www.english\\_grammar\\_lessons.com](http://www.english_grammar_lessons.com)
- [www.wikipedia.org/wiki/english\\_grammar](http://www.wikipedia.org/wiki/english_grammar)

**Program:** B.Tech

**Semester:** Five

**Course:** Vocational Trainee Report II

**Course Code:** 8.345

L	T	P	C
0	0	0	2

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**Course Objective:**

1. To provide training in mines for gaining thorough understanding of all the theoretical knowledge.
2. Gaining practical experience is an important aspect of the mining engineering programme having many characteristic features of its own.
3. The students will have insight about mining methods and techniques.
4. The outcome at the place of work is always much more than what can be learned in the class room.
5. To provide the students an opportunity to express their skills, academic knowledge, practical experience and ability to analyze problems.
6. To provide the students an opportunity to express their skills, academic knowledge, practical experience and ability to analyze problems.

**Vocational Training in a Surface / Underground Mine of minimum 30 (Thirty) days to be taken at the end of Semesters.**