

# **SEMESTER V**

**Program:** B.Tech

**Semester:** Five

**Course:** Mining Machinery I

**Course Code:** 8PCCMiE301

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**Course Learning Objective:**

**CLO 1:** Enables the students to select appropriate machinery for various mining operations based on the production targets.

**CLO 2:** The students will have knowledge on function of winding engines, winding accessories, pit-top and bottom mine circuits.

**CLO 3:** They will also know about working of various coal face machinery, face haulage systems and conveyors.

**CLO 4:** The students will have basic knowledge on motive power used in mines, rope haulage and other transport systems.

**Course Outcome:**

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

**CO1:** Understand the classification & application of mine machinery.

**CO2:** Understand the winding system and safety features.

**CO3:** Able to apply the knowledge of power transmission system and installation in mines.

**CO4:** Explain the types, selection and uses of mining ropes and able to apply the knowledge of rope capping and splicing.

**Course Content:**

Topics	Hours
<b>Unit I:</b>	
Classification, application, constructional features of drilling machines used in coal and metal mining, Coal cutters, shearer, plough, continuous miner, road header and dirt header. Loading and transport equipment, man riding systems.	<b>8</b>
<b>Unit II:</b>	
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.	<b>6</b>
<b>Unit III:</b>	
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.	<b>10</b>
<b>Unit IV:</b>	
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.	<b>8</b>

**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:** 8PCCMiE302

L	T	P	C
3	0	0	3

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### **Course Learning Objective:**

**CLO 1:** Enables the students to apply the knowledge of mining machinery in their economic deployment for achieving the production targets in opencast mines.

**CLO 2:** 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.

**CLO 3:** 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.

### **Course Outcome:**

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

**CO1:** Understand the basic concept of surface mining for understanding the applicability & slope stability problem in any opencast mine.

**CO2:** Understand the application and operation of shovel, dragline, dozer and other opencast machinery.

**CO3:** Understand the application, operation and limitation of bucket wheel excavator and surface transport system.

**CO4:** Explain the applicability of the different in-pit crushing and conveying methods & interpretation of slope stability.

**Course Content:**

Topics	Hours
<b>Unit 1:</b>	
Introduction: Surface mining-basic concepts, applicability, advantages and disadvantages; Role of surface mining in total mineral production; Surface mining unit operations; Surface mining equipment systems– classification, applicability, advantages and disadvantages. Opening up of deposits: Boxcut – objective, types, parameters, methods; Factors affecting selection of box cut site; Production benches– formation, parameters and factors affecting their selection.	<b>8</b>
<b>Unit II:</b>	
Discontinuous/cyclic methods of excavation and transport: Shovel: Applicability and limitations of shovel, Cycle time and productivity calculation for shovel; Dragline operation: Applicability and limitations, different modes of operation; Cycle time and productivity calculation; 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; Dozers: Applicability and limitations; Types and classification; merits and demerits; Method and cycle of operation. Front-end- loaders: Applicability and limitations.	<b>10</b>
<b>Unit III:</b>	
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; Conveyors: types of conveyors; Mode of operation, applicability and limitations; Merits and demerits of conveyor as a system of transportation.	<b>8</b>
<b>Unit IV:</b>	
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.	<b>6</b>

**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:** 8PCCMiE303

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**Course Learning Objective:**

**CLO 1:** The students will have good exposure about the various advanced methods of coal mining with the knowledge about advanced coal face mechanization.

**CLO 2:** To pioneer the history of longwall mining and its development stages.

**CLO 3:** To understand the extraction, support and transport on a longwall face.

**CLO 4:** Enables the students to appreciate various coal mining methods and to ably manage highly mechanized mines.

**CLO 5:** To introduce the recent trends of level of mechanization for coal face.

**CLO 6:** To understand the various advanced methods of coal mining.

**Course Outcome:**

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

**CO1:** Explain the technical knowledge on development & extraction of coal by board & pillar mining.

**CO2:** Understand the method & problems of extraction of coal from the underground mines along with stowing.

**CO3:** Explain the basic knowledge of long wall mining with its applicability, components and machinery required for mining.

**CO4:** Apply the knowledge of various support system in mines with its advantages & applicability.

**Course Content:**

Topics	Hours
<b>Unit 1:</b> 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 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.	<b>10</b>
<b>Unit II:</b> 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.	<b>8</b>
<b>Unit III:</b> 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.	<b>8</b>
<b>Unit IV:</b> 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.	<b>6</b>

**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:** 8PCCMiE304

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**Course Learning Objective:**

**CLO 1:** The course provides detailed knowledge on rock properties

**CLO 2:** This will equip the students with the ability to carry out various tests and monitoring the rock behavior.

**CLO 3:** Students will be able in analysis of analysis of data and solving rock mechanics problem in mining and excavation projects.

**CLO 4:** Provides detailed knowledge on rock properties and equips the students with the ability to carry out various tests.

**CLO 5:** Students will be able in analyzing the data and solving rock mechanics problem in mining and excavation projects.

**CLO 6:** Data and solving rock mechanics problem in mining and excavation projects.

**Course Outcome:**

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

**CO1:** Understand the basic knowledge of rock mechanics for understanding, formulating and solving strata control problem in any underground mine.

**CO2:** Explain the various physico mechanical properties of rock in respect to mining.

**CO3:** Acquire knowledge and hands-on competence in applying the concepts of rock failure theories.

**CO4:** Evaluate the dynamic properties of rock, creep theory and rock mass by various Laboratory test & in situ test



**Course Content:**

Topics	Hours
<b>Unit 1:</b>	
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.	<b>8</b>
<b>Unit II:</b>	
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.	<b>6</b>
<b>Unit III:</b>	
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.	<b>8</b>
<b>Unit IV:</b>	
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.	<b>10</b>

**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:** 8PCCMiE304P

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**List of Experiments:**

1. Preparation of rock sample for testing in laboratory.
2. Determination of compressive strength of rock.
3. Determination of tensile strength of rock.
4. Determination of triaxial strength of rock.
5. Porosity of rock.
6. Modulus of elasticity and Poisson's ratio.

**Program:** B.Tech

**Semester:** Five

**Course:** Numerical and Statistical Method

**Course Code:** 8PCCMiE305

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### **Course Learning Objective:**

**CLO 1:** The students will get the concept about finite element models, methods and boundary elements method and its practical applications in mining and rock mechanics.

**CLO 2:** To understand the practical applications of numerical methods in mining field.

**CLO 3:** 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.

**CLO 4:** To acquaint the student with analysis of correlation and Eigen value problems used in wide variety of situations.

### **Course Outcome:**

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

CO 1: - Apply numerical methods to find solutions of algebraic and transcendental equations using different methods under different conditions

CO 2: - Apply various interpolation methods and finite difference concepts to solve practical problems of Numerical Integration.

CO 3: - To give a brief idea about advance probability concepts for solving practical problems of real world.

CO 4: - Apply statistical tools like correlation, regression to solve various engineering problems.

**Course Content:**

Topics	Hours
<b>Unit I:</b>	
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, Jacobi and Gauss Seidel methods.	<b>8</b>
<b>Unit II:</b>	
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 $3/8^{\text{th}}$ , Euler's, Modified Euler's, Runge-Kutta and Milne's methods.	<b>8</b>
<b>Unit III:</b>	
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.	<b>8</b>
<b>Unit IV:</b>	
Measure of central tendency, Measure of Dispersion. Statistical Methods: Moments, skewness and kurtosis; curve fitting. Correlation and Regression: correlation coefficients, regression lines, regression coefficients and their properties.	<b>8</b>

**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:** Remote Sensing & GIS

**Course Code:** 8PCCMiE306

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**Course Learning Objective:**

**CLO 1:** This course enables students to create a map that accurately shows distances, areas, or directions.

**CLO 2:** Applications of remote sensing and GIS in geological mapping and mineral exploration.

**CLO 3:** They will have deep knowledge about geophysics, remote sensing and GIS.

**Course Outcome:**

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

**CO1:** Understand the basic knowledge of remote sensing & concept of EMR.

**CO2:** Apply the knowledge of Aerial photography and photogrammetry.-electromagnetic Radiation, Remote, Sensing Data Product, Spatial Filtering, Band Rationings Image Classification GIS-Project Planning, Management and Implementation.

**CO3:** Learners know about Basics of GIS -components of GIS, History, Geospatial data architecture, Operations, Geographic co ordinate systems, Map projections etc.

**CO4:** Analyze the vector data & processing and applying the use of GIS.

**Course Content:**

Topics	Hours
<b>Unit 1: REMOTE SENSING -INTRODUCTION AND CONCEPTS</b>	
Introduction to Remote Sensing – Energy sources and Radiation principles, Energy equation, EMR and Spectrum, EMR interaction with Atmosphere-scattering, Absorption, EMR interaction with earth surface features- reflection, absorption, emission and transmission, Spectral response pattern , vegetation, soil, water bodies- Spectral reflectance, Platforms – types and characteristics; satellites and characteristics, Sensors.	<b>9</b>
<b>Unit II: AERIAL PHOTOGRAPHY AND PHOTOGRAMMETRY</b>	
Introduction – Photogrammetry – Classifications of Photogrammetry, Vertical and oblique photographs, height determination, photographic interpretations, Aerial photography- Basics of aerial photography, Planning and execution of photographic flights, characteristics of aerial photographs- Types of aerial photographs, Flight strips, Nadir line, End lap, Side lap, stereoscopic coverage and stereopairs, Relief displacement, Photographic Scale.	<b>9</b>
<b>Unit III: BASICS OF GIS</b>	
Introduction, concepts , Information system , components of GIS, History, Recent trends and application of GIS, spatial data models – Raster and Vector data base design, Data inputting in GIS, Transformation methods – Root Mean Square (RMS) Error.	<b>9</b>
<b>Unit IV: VECTOR DATA &amp; PROCESSING</b>	
Data sources, typical GIS data sets, Data Acquisition, classification scheme of vector based and raster based GIS operations, data structure, Data Management and Analysis; Advantages and disadvantages of Raster or Vector Data ; Uses of GIS.	<b>9</b>

**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:** Vocational Trainee Report II  
**Course Code:** 8PROJMiE301

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### Course Learning Objective:

**CLO 1:** To provide training in mines for gaining thorough understanding of all the theoretical knowledge.

**CLO 2:** Gaining practical experience is an important aspect of the mining engineering program having many characteristic features of its own.

**CLO 3:** The students will have insight about mining methods and techniques.

**CLO 4:** The outcome at the place of work is always much more than what can be learned in the class room.

**CLO 5:** To provide the students an opportunity to express their skills, academic knowledge, practical experience and ability to analyze problems.

**CLO 6:** To provide the students an opportunity to express their skills, academic knowledge, practical experience and ability to analyze problems.

### Course Outcome:

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

CO 1: Mining graduates would be equipped with managerial skill which would be useful to them for achieving their program educational outputs.

### Course Content:

1. Study of History of Mine – Note name of the Owner, Agent, Manager, Safety Officer
2. Study of Mine geological information
3. Study of Mine Plans and Sections
4. Study of Surface features related to Mine
5. Study of method of working
6. Study of method of blasting
7. Study of Transportation system and layouts
8. Study of Ventilation systems and layouts
9. Study of Drainage system
10. Study of Pit top and Pit bottom layouts.
11. Study of man Power plan
12. Develop the Lamp room layout and Magazine Layout
13. Draw the charts depicting instructional items related to Mining subjects

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

**Program:** B.Tech

**Semester:** Five

**Course:** Character Building and Holistic Development of Personality 3  
(Universal Human Values and Ethics)

**Course Code:** 8VAC301

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2	0	0	2

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### **Course Learning Objective:**

**CLO 1:** To familiarize students with Indian cultural values.

**CLO 2:** To inspire students to preserve and protect values and ethics.

**CLO 3:** To build moral, ethical, energetic individual dedicated towards the service of humanity.

**CLO 4:** To focus on holistic development of an individual.

### **Course Outcome:**

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

**CO 1:** Understand the importance of Indian cultural values.

**CO 2:** Learn to adapt, protect and preserve values and ethics.

**CO3:** Become a responsible citizen for serving the mankind.

**CO4:** Develop one's personality holistically in a balanced manner.

**Course Content:**

Topics	Hours
<b>Unit I: Personality Development</b>	
<ul style="list-style-type: none"> <li>• Personality Development: Meaning, Concept, Constituent elements of personality and Means/Ways of Personality Development.</li> <li>• Panchakosha: General Introduction, Meaning, Objectives, Characteristics and Significance.</li> <li>• Benefits of Panchakosha, development and deficiencies due to underdevelopment of Panchkosha.</li> </ul>	<b>4</b>
<b>Unit II: Mental Emotional Development</b>	
<ul style="list-style-type: none"> <li>• Values and Individual: Non-Possession, Non- Stealing, Self Restrain, Enthusiasm, Dutifulness, Reticence, Silence, Self-study, Considerateness and Self-respect.</li> <li>• Values and Family: Respectful Salutation, Obedience, Contentment, Patience, hospitality, Parent Service, Rectitude, Good Behaviour, Family feeling and worship.</li> </ul>	<b>4</b>
<b>Unit III: Indian Values</b>	
<ul style="list-style-type: none"> <li>• Values and Society: Discipline, Social Responsibility and Duties of Citizens, Altruism/ Charity, Keeping good company, Gratefulness, Fraternity/ Friendship, Courtesy, Tactfulness, Soft Spoken and Feeling for the Oppressed.</li> <li>• Values and Constitution: Dignity of an Individual, Fundamental Duties, Fundamental rights, Directive Principles of State Policies, Social Equality, Democracy, Justice, Freedom, Sarva-Pantha Samman and Scientific Approach.</li> </ul>	<b>8</b>
<b>Unit IV: Practice of Values and Ethics</b>	
<ul style="list-style-type: none"> <li>• Values and Indian Culture: Integrity of the nation, Glory of the Past, Swadeshi, Nation Building, Patriotism, Mother Tongue, National Unity, Public Welfare, Equality and Spirituality.</li> <li>• Values and Vision of the World: Humanity, Integrity, Human rights, The Highest or Most Sublime Good, Vasudhaiva Kutumbakam, Tolerance, Peaceful Coexistence, World-Welfare, Environmental Protection, Swavalamban/Self-reliance</li> </ul>	<b>8</b>

**Suggested Readings:**

1. *My Idea of Education*, Swami Vivekanand, Advaita Ashram, Kolkata
2. *Personality Development*, Swami Vivekananda, Advaita Ashram, Kolkata.
3. *The Man India Missed the Most*; Subhash Chandra Bose, huvan Lall, Notion Press, Chennai



**OPEN ELECTIVE (Any one of the following subjects)****Program:** B.Tech**Semester:** Five**Course:** Constitution of India**Course Code:** 8OEEL301

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**Course Learning Objective:**

**CLO 1:** The basic object of the course is to provide the acquaintance with the basic features of Indian Constitution e.g. Fundamental Rights, Fundamental Duties and Directive Principles of State policy.

**CLO 2:** To impart the knowledge about Judicial system in India.

**Course Outcome:**

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

**CO1:** Understand the basic features of our constitution.

**CO2:** Learn the concept of Right to Equality & Prohibition on grounds of Religion, Race, Caste, sex & Place of Birth.

**CO3:** Understand the concept of Basic freedoms, Protection in respect of conviction for offences & Right to Life and Personal Liberty.

**CO4:** Explain the Right against exploitation & Freedom of Religion.

**CO5:** Understand the concept of Directive Principles of State Policy and their relation with Fundamental Rights, Fundamental Duties & Right to Property.

**Course Content:**

Topics	Hours
<b>Unit I:</b>	
1. Nature of Indian Constitution 2. Preamble 3. Union and its Territory (Arts 1-4) 4. Citizenship (Arts 5-11) 5. Definition of State (Art 12)	
<b>Unit II:</b>	
1. Judicial Review (Article 13) 2. Right to Equality (Article 14) 3. Prohibition on grounds of Religion, Race, Caste, Sex, Place of Birth (Article 15) 4. Equality of Opportunity in Public Employment (Article 16) 5. Abolition of Untouchability and Titles (Articles 17-18)	<b>6</b>
<b>Unit III:</b>	
1. Basic freedoms (Article 19) 2. Protection in respect of conviction for offences (Article 20) 3. Right to Life and Personal Liberty (Article 21) 4. Safeguards against arbitrary arrest and detention (Article 22)	<b>6</b>
<b>Unit IV:</b>	
1. Right against exploitation (Articles 23-24) 2. Freedom of Religion (Articles 25-28) 3. Cultural and Educational Rights of Minorities (Articles 29-30) 4. Constitutional Remedies (Articles 32-35)	<b>6</b>
<b>Unit V:</b>	
1. Directive Principles of State Policy and their relation with Fundamental Rights (Articles 36-51) 2. Fundamental Duties (Article 51-A) 3. Right to Property (Article 300-A) 4. Facts and Law laid down in Maneka Gandhi V Union of India AIR 1978 SC597 5. Facts and Law laid down in Indira Sawhney V Union of India AIR 1993SC 477	<b>8</b>

**Suggested Reading:**

1. Austin Granville- *The Indian constitution: Cornerstone of a Nation.*
2. Seervai H.M. - *Constitution of India*
3. Jain M.P. – *Indian Constitutional Law*
4. Shukla V N- *Constitution of India (ed. By M.P. Singh)*
5. Basu D.D. – *Shorter Constitution of India*

**Program:** B.Tech

**Semester:** Five

**Course:** Indian Knowledge System (IKS)- Concepts and Applications in Engineering

**Course Code:** 8OEEL302

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**Course Learning Objective:**

**CLO 1:** The basic object of the course is to provide the acquaintance with the basic features of Indian Constitution e.g. Fundamental Rights, Fundamental Duties and Directive Principles of State policy.

**CLO 2:** To impart the knowledge about Judicial system in India.

**Course Outcome:**

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

**CO1:** Understand the basic features of our constitution.

**CO2:** Learn the concept of Right to Equality & Prohibition on grounds of Religion, Race, Caste, sex & Place of Birth.

**CO3:** Understand the concept of Basic freedoms, Protection in respect of conviction for offences & Right to Life and Personal Liberty.

**CO4:** Explain the Right against exploitation & Freedom of Religion.

**CO5:** Understand the concept of Directive Principles of State Policy and their relation with Fundamental Rights, Fundamental Duties & Right to Property.

**Course Content:**

Topics	Hours
<b>Unit 1: Indian Knowledge System – An Introduction:</b>	
1. What is IKS? 2. Why do we need IKS? 3. Organization of IKS 4. Historicity of IKS 5. Some salient aspects of IKS	<b>3</b>
<b>Unit II: The Vedic Corpus:</b>	
1. Introduction to Vedas 2. A synopsis of the four Vedas 3. Sub-classification of Vedas 4. Messages in Vedas 5. Introduction to Vedāṅgas 6. Prologue on Śikṣā and Vyākaraṇa 7. Basics of Nirukta and Chandas 8. Introduction to Kalpa and Jyotiṣa 9. Vedic Life: A Distinctive Features	<b>4</b>
<b>Unit III: Number Systems and Units of Measurement:</b>	
1. Number systems in India - Historical evidence 2. Salient aspects of Indian Mathematics 3. Bhūta-Saṃkhyā system 4. Kaṭapayādi system 5. Measurements for time, distance, and weight 6. Piṅgala and the Binary system 5.	<b>4</b>
<b>Unit IV: Mathematics:</b>	
1. Introduction to Indian Mathematics 2. Unique aspects of Indian Mathematics 3. Indian Mathematicians and their Contributions 4. Algebra 5. Geometry 6. Trigonometry 7. Binary mathematics and combinatorial problems in Chandaḥ Śāstra 8. Magic squares in India	<b>4</b>
<b>Unit V: Astronomy:</b>	
1. Introduction to Indian astronomy 2. Indian contributions in astronomy 3. The celestial coordinate system 4. Elements of the Indian calendar 5. Notion of years and months 6. Pañcāṅga – The Indian calendar system 7. Astronomical Instruments (Yantras) 8. Jantar Mantar of Rājā Jai Singh Sawai	<b>6</b>
<b>Unit VI: Engineering and Technology: Metals and Metalworking:</b>	
1. Wootz Steel: The rise and fall of a great Indian technology 2. The Indian S & T heritage 3. Mining and ore extraction	<b>4</b>

4. Metals and metalworking technology 5. Iron and steel in India 6. Lost wax casting of idols and artefacts 7. Apparatuses used for extraction of metallic components	
<b>Unit VII: Engineering and Technology: Other applications:</b>	
1. Irrigation systems and practices in South India 2. Literary sources for science and technology 3. Physical structures in India 4. Irrigation and water management 5. Dyes and painting technology 6. The art of making perfumes 7. Surgical techniques 8. Shipbuilding 9. Sixty-four art forms (64 Kalās) 10. Status of Indigenous S & T	<b>6</b>
<b>Unit VIII: Town Planning and Architecture:</b>	
1. Perspective of Arthaśāstra on town planning 2. Vāstu-śāstra – The science of architecture 3. Eight limbs of Vāstu 4. Town planning 5. Temples in India: marvelous stone architecture for eternity 6. Temple architecture in India 7. Iconography	<b>4</b>
<b>Unit IX: Knowledge Framework and classifications:</b>	
1. Indian scheme of knowledge 2. The knowledge triangle 3. Prameya – A vaiśeṣikan approach to physical reality 4. Dravyas – the constituents of the physical reality 5. Attributes – the properties of substances and Action – the driver of conjunction and disjunction 6. Sāmānya, viśēṣa, samavāya 7. Pramāṇa – the means of valid knowledge 8. Saṁśaya – ambiguities in existing knowledge 9. Framework for establishing valid knowledge 10. Deductive or inductive logic framework 11. Potential fallacies in the reasoning process 12. Siddhānta: established tenets in a field of study	<b>8</b>
<b>Unit X: Linguistics</b>	
1. Introduction to Linguistics 2. Aṣṭādhyāyī 3. Phonetics 4. Word generation 5. Computational aspects 6. Mnemonics 7. Recursive operations 8. Rule based operations 9. Sentence formation 10. Verbs and prefixes 11. Role of Sanskrit in natural language processing	<b>4</b>

**Suggested Reading:**

6. *Austin Granville- The Indian constitution: Cornerstone of a Nation.*
7. *Seervai H.M. - Constitution of India*