

Jharkhand University of Technology

Ranchi, 834010



TENTATIVE SYLLABUS

For Diploma Program in

Mining Engineering

(Effective from 2025-26)

DEPARTMENT OF MINING ENGINEERING

(5th – SEMESTER

WINNING AND WORKING (METAL & COAL) (Theory + Practical)

Course Code-

L:T:P

Introduction:

The metals and minerals we rely on in our everyday life is staggering. If you really take a moment to think about it, look around to observe the objects you are surrounded by which are not manufactured by plant-based resources. From the cement you walk, on to the screen you are reading, **our world and our way of life depends on the products of modern mining practices.**

But what does our future hold for us? Sustainable power, renewable energy, electric vehicles, advanced engineering, and commercial space travel will all rely on an increased source of the materials we already depend on. **The mining industry supports our everyday life** but also provides the foundations of engineering achievements for the decades to come.

As well as providing the metals and minerals that are essential for modern society, mining provides economic and social development opportunities throughout the world.

Mining Diploma is truly multi-disciplinary, Hence, this **Winning and Working (Metal & Coal)** Course including elements of Mineral Processing, Geology, Rock Mechanics, Drilling & Blasting, Mine Machinery, Gas testing, First Aid, Environmental management and health and safety.

It's also highly vocational, so in addition to lecture based study, the programme includes field trips, tours, vocational practical trainings and practical classes.

Therefore, upon completion of the program, **the students will be able to** pursue employment opportunities in the mining of limestone, iron-ore, coal, lignite, bauxite, copper, lead-zinc, gold, manganese, uranium, rare earth minerals, granite and other minerals.

Course outcome: A student should be able to

CO1	Organize safe, scientific, efficient and environmentally sustainable mining operations
CO2	Apply the principles of Rock Mechanics and perform drilling & blasting activities in Mines
CO3	Carry out the Mine Surveying
CO4	Apply the Govt. Rules, Regulations and general safety precautions in the field of Mining engineering.
CO5	Handle Flame Safety Lamp and perform First Aid procedures

Detailed Course Content

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	Present an overview on importance of Winning and Working of Metal and Coal.	4			Present an overview of mining exams conducted by DGMS • Metal (Restricted and Unrestricted) • Coal (Restricted and Unrestricted)		3	
	1	1	2	Appreciate the importance of: • Open cast workings • Underground workings • Concepts of Rock Mechanics • Mine Surveying methods.	4			Distinguish the role of mining industries in the national economy.		3	
	1	1	3	Appreciate the concepts of mine Planning and Designing in modern technology.	2	2		Discuss the developments of present day technologies in mining industries.			3
	1	1	4	Virtual tour on Opencast metal and coal Mines.		1	3	Virtual tour on Underground Metal and Coal Mines.			3
	1	1	5	Weekly developmental Assessment				Assessment Review and corrective action			3
	1	1	6	Industry Class- and Industry Assignment			5				
2	1	2,5,7	1	Tutorial (Peer discussion on Industrial assignment)		4		Present an overview on importance of Environmental impact due to mining. Contrast the awareness of Environment and Ecology.			3
	1	2,5,7	2	Ecosystem and its classification. • Terrestrial and aquatic biomes. • Tropical forest, deciduous forest.				Analyze: • The effects of air pollution on eco- systems.			3

			Grass land and desert biomes. Impact of human interference with natural environment. The Environmental (Protection) Act 1986.	4		- Effects of water pollution on ecology and environment. - Effects of water pollution on mine workers. - Remedial measures to be followed to check air pollution. - TLV for different dusts.			
1	2,5,7	3	Distinguish the Importance of Ozone for sustenance of Biosphere. - Ozone cycle. - Ozone layer depletion. - Remedial measures to check ozone depletion. Causes and effects of: - Acid rains. - Greenhouse effect. - Global warming. India's Initiatives on Global Warming. Sources effects of air, water and Noise pollutions in mines.	2	2	Prepare the Remedial measures: - In reduction of noise in mines - To minimize ground vibration. Analyse the TLV for noise. Analyse Sources of ground vibration in mines. Analyse Statutory standards of ground vibrations.			3
1	2,5,7	4	Analyze the Environmental Management: - Mine environment monitoring and control. - EMP (Environment Management Plan). - Mine closure plan; - R&R (rehabilitation and resettlement).	2	2	Propose the need for reclamation. Procedure of preparation of an E.M.P Prevention, control and abatement of environmental Pollution.			3
1	2,5,7	5	Weekly developmental Assessment			Assessment Review and corrective action			3
1	2,5,7	6	Industry Class- and Industry Assignment		5				

				- Rock quality designation - Methods of Geophysical Prospecting			2) Compressive Strength of Rocks by Tri-Axial Compressive Strength(TCS). Flexural strength.			
	2	4	3	Present an overview of different Physical and Mechanical Properties of rocks.	2	2	Determine Direct Shear Strength of Rocks by 1) Shear Box Test. 2) Rock Cube Test.			3
	2	4	4	Analyse the Geological considerations in Tunneling.		4	Virtual classes on the improvements of properties of Rock mass.			3
	2	4	5	Developmental Weekly Assessment.			Assessment Review and corrective action			3
	2	4	6	Industry Class +Industry assessments		5				
5	2	3	1	PEER Discussion on Industry Assignment		4	Overview of Mining and Processing of Dimensional Stone			3
	2	3	2	An overview of Resources of Marble, Granite, Slate, Sandstone and Limestone as Dimensional stones in India, uses, marketing export. Convention mining of sandstone, Limestone, Marble and Granite,	2	2	Virtual class on Wire saw, Chain saw, Hydraulic splitting flam jet cutting, water channeling, etc.			3
	2	3	3	Analyse the different types of bench failures in the Opencast mines	2	2	Distinguish the Blasting in dimensional stone mines, Development of mine, Mine layout.			3
	2	3	4	Distinguish the Environmental impact due to mining Distinguish the different controlled blasting methods.	2	2	Virtual classes on Controlled blasting.			3
	2	3	5	CIE 2– Written and practice test			Assessment Review and corrective action			3

	2		6	Industry Class- and Industry Assignment		5				
6	2	3,4,7	1	Present an overview on Selection of different drills in mining operation.		4	Analyze the use of: • Vertical Drilling. • Horizontal Drilling. • Multilateral Drilling. • Extended Reach Drilling. • Complex Path Drilling.			3
	2	3,4,7	2	DRILLING & BLASTING Present an overview of Special Methods of Drilling like: • Water jet Drilling. • Thermal Drilling. • Over burden drilling with eccentric.	4		Analyze the: • Drilling Parameters. • Drilling Patterns. • Burden and spacing.			3
	2	3,4,7	3	Contrast between: • Classification of Explosives. • Permitted & non permitted explosives. • Plain Detonators & Electric Detonators. Accessories - Safety fuse, Plastic Igniter cord, Detonating fuse, Detonating relay, Shock tubes.	2	2	Analyze the: • Calculation of Drilling costs. • Calculation of explosive quantity. Powder factor.			3
	2	3,4,7	4	Present the Over view of Shot-firing tools. • Ohm Meter. • Shot firing cables. Exploders - Types, Construction and safety features. Mechanism of rock fragmentation, • Factors affecting rock fragmentation,	2	2	Discuss the optimization of Rock fragmentation:			3

	2	3,4,7	5	Developmental Weekly Assessment				Assessment Review and corrective action			3
	2	3,4,7	6	Industry Class on and Industry Assignment			5				
W e e k	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
7	3	2,4,7	1	Tutorial (Peer discussion on Industrial assignment)			4	Discuss the role of the mine surveyor and his legal responsibilities. Appraise the application of Modern surveying instruments. • Mine surveyor's related skills • Areas where well qualified Surveyor are needed in India.			3
	3	2,4,7	2	Photographic survey: Analyse the advantages and field work of terrestrial photographic surveying.	4			Solve numerical problems on drift ,full dip, apparent dip, borehole and fault, percentage extraction of pillars.			3
	3	2,4,7	3	Global Positioning System (GPS) – Give a Fundamentals details of: GPS receivers, GPS observations, transformation of GPS results, working principles of GPS navigator.	4			Hands on Practice: • GPS.			3
	3	2,4,7	4	Modern Surveying Instruments- Infer the Principles and uses of (i) Electronic Theodolite (ii) EDM	2		2	Demonstrate the principles and operation of: • Electronic Theodolite and • EDM.			3
	3	2,4,7	5	CIE 3– Written and practice test				Assessment Review and corrective action			3
	3	2,4,7	6	Industry Class and Industry Assignment			5				
8	4	6,7	1	Tutorial (Peer discussion on Industrial assignment) Introduction:			4	Introduction: An overview of Management and its importance in Mining.			3

	4	6,7	2	Infer the Principles and uses of • Total station. • Differential Global Positioning System (DGPS)	2	2	Hands on Practice: • Total Station.			3
	4	6,7	3	Management: Introduction: Principles of scientific management; management functions; planning; organization and control; structure of organization for mining enterprises. Personal Management: Selection; training and development of human resources for mining enterprises.	4		Practice the use of software's related to mine surveying.			3
	4	6,7	4	Apply the Mine Legislation: Health and Safety Laws: The Mines Act, 1952; The Occupational Safety, Health and working conditions code 2020. Inspectors and Certifying Surgeons, Committees, Provisions to health and Safety, Hours and Limitations of Employment, Leave with wages. Apply the Mines Rules, 1955; Committee, Certifying Surgeons, Medical examination of persons employed or to be employed in mines, workmen's inspector and safety committee, health and sanitation provisions, first-aid and medical appliances, leave with wages and overtime, welfare amenities. Apply the Mines Crèche Rules: standards of crèches, provision of latrines, provision of bath room, medical arrangement, and provision for staff.	4		Analyse the procedure to obtain • Prospecting licence • Mining lease • Transporting and storage of minerals (The Mines and Minerals (Development & Regulation) Act, 1957: General restrictions on undertaking prospecting and mining operations, Rules for regulating the grant of reconnaissance permits, prospecting licences and mining leases, power of state government to make rules for preventing illegal mining, transportation and storage of minerals. Rates of royalty. Apply the Mineral Concession Rules, 1960: Application for reconnaissance permit, Conditions of a reconnaissance			3

				Apply the Mines Rescue Rules: Definitions: rescue stations and rescue rooms, duties and responsibilities of superintendents etc. organisation and equipment in mines. conduct of rescue work			permit, Conditions of a prospecting licence. Mineral Conservation and Development Rules, 1988: General requirements about plans and sections, types of plans and sections.			
	4	6,7	5	Weekly developmental Assessment			Assessment Review and corrective action			3
	4	6,7	6	Industry Class and Industry Assignment		5				
9	4	6,7	1	Tutorial (Peer discussion on Industrial assignment)		4	An Over view of Mine's Act and The Occupational Safety, Health and working conditions code 2020.			3
	4	6,7	2	Apply the Metalliferous Mining Regulations 1961/Coal Mine Regulation, 1957 Definitions, Returns, Notices and Records, Examinations and Certificates of Competency and of Fitness, Inspection and Mine Officials, Duties and Responsibilities of Workmen, Competent Persons and Officials.		4	Discuss the Duties and responsibilities of different mining officials.			3
	4	6,7	3	Apply the Metalliferous Mining Regulations 1961/Coal Mine Regulation, 1957 Plans and Sections, Means of Access and Egress ,Ladders and Ladder ways, Transport of Men and Materials – Winding in shafts, Transport of Men and Materials – Haulage, Mine Workings.		4	Discuss the information regarding Transport of Men and Materials in the nearby mines, from the mining officials or from mine visit.			3
		6,7		Metalliferous Mining Regulations 1961/ Coal Mine Regulation, 1957			Collect the information regarding use of explosives in the nearby mines, from the mining officials or from mine visit.			3

10	4		4	Precautions against Dangers from Fire, Dust, Gas and Water, Ventilation, Lighting and Safety Lamps, Explosives and Shot firing, Machinery and Plant.	4					
	4	6,7	5	CIE 4– Written and practice test			Assessment Review and corrective action.			3
	4	6,7	6	Industry Class and Industry Assignment		5				
	4	6,7	1	Tutorial (Peer discussion on Industrial assignment)	4					3
	4	6,7	2	Apply the Mines Rescue Rules, 1985	4		Analyse the importance of Vocational Training Rules, 1966			3
	4	6,7	3	Analyze the General Safety in Mines: Safety in Mines: Causes and prevention of accidents and their classification. - investigations into accidents and accident reports. - measures for improving safety in mines; safety management system; human elements in mine safety, worker's participation in safety management.	4		Collect and discuss the information of: Safety management system to prevent accidents, from any one mines.			3
	4	6,7	4	Distinguish the Notified and occupational diseases; silicosis and pneumoconiosis; Physiological aspects of breathing in dust laden atmosphere; dust sampling and sampling instruments, methods.	4		Collect and discuss the information of - Notified occupational disease in the mine by visiting or from the mining authorities. - Dust suppression methods adopted in mines.			3
	4	6,7	5	Weekly developmental Assessment			Assessment Review and corrective action			3
	4	6,7	6	Industry Class- and Industry Assignment		5				

We ek	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
11	5	4	1	Tutorial (Peer discussion on Industrial assignment)		4		Present an overview on importance of Gas testing certificate of competency. Assemble the Flame safety Lamp.			3
	5	4	2	Appraise the Indian regulations pertaining to methane concentration.	2		2	Demonstrate the safety features of a Flame safety lamp.			3
	5	4	3	Analyze, the achievement of heat transference in a flame safety lamp. Justify, why still Safety lamp is used in underground mines?	4			Demonstrate the Variation in shape and height of gas cap with methane percentage.			3
	5	4	4	Analyse the Components of flame safety lamp in different sections along with their functional details. Analyze the Working principle of flame safety lamp and different types of flame safety lamp.			4	Demonstrate the use of Flame safety Lamp to determine the Accumulation and Percentage of Methane.			3
	5	4	5	CIE 5– Written and practice test				Assessment Review and corrective action			3
	5	4	6	Industry Class and Industry Assignment			5				
12	5	7	1	Tutorial (Peer discussion on Industrial assignment)		4		Present an overview on importance and need for First Aid Certificate. ABCs of First Aid			3
	5	7	2	Appraise the Human anatomy: • Structure of the Human body • Human skeleton • Blood Circulation system Analyse the First Aid procedure for: • Control of bleeding • Fractures • Burns • Shock			4	Demonstrate the First Aid Procedure for: • Control of bleeding • fractures • Burns • Shock • Wounds			3

				• Wounds						
	5	7	3	Analyse the First Aid procedure for: • eye injuries • bleeding nose • suffocation electric shock / injuries • unconsciousness • snake bite			4	Demonstrate the First Aid Procedure for: • eye injuries • bleeding nose • snake bite		3
	5	7	4	Analyse the First Aid procedure for: • poisoning • heat stroke • suffocation electric shock / injuries • unconsciousness			4	Practice the different artificial Respiration methods.		3
	5	7	5	Weekly developmental Assessment				Assessment Review and corrective action		3

References:

- Wining and working Vol 1,2, by R.T.Deshmuk
- Rock mechanics for Engineers, by B.P.Verma
- Elements of Mining Technology, by D.J.Deshmukh –Vol 1,2 ,3
- Rock Mechanics & Ground Control, by D.Biswas, Lovely Prakashan, Dhanbad.
- Rock Mechanics- Leonard Obert and Wilbur I.Duvall
- Ground Control, Peng, S.S, Wiley Publications, New York, 1987
- Engineering Rock Mechanics- An introduction to the principles, John A Hudson and John P Harrison, Pergamon Press, 1997.
- Mine Management, Legislation and General safety: S.Ghattak.
- CMR/MMR 1957 / 61 3. Critical Appraisal: Rakesh & Prasad
- DGMS Circulars
- Mines vocational training rules, 1966
- The Indian electricity rules, 1956.
- Mine Surveying and Levelling, Vol.I, II &III by Ghatak, COALFIELD PUBLISHERS,Ukhra, Burdwan,W.B.
- W. Schofield and M. Breach, Engineering Surveying, Sixth edition,2007, ELSEVIER,B & H.
- B. C. Punmia, Surveying, Vol - I, II, III, Laxmi Publication, New Delhi, 12th Edition, 1990.
- V. Maslov, Geodetic Surveying, Mir Publication, Moscow, Revised edition, 1980. 5 Fedorov, Elementary Plane and Mine Surveying, Mir Publication, Moscow, Revised Edition,1986.
- V. Natarajan, Advanced Surveying, B. I. Publication, Bombay, First edition, 1976.
- T. P. Kanetkar, Surveying and Levelling, Pune Vidyarthi Griha Prakashan, Reprints, 1995.
- Principles of Mineral Dressing----- A.M. Gaudin.
- S. K. Das, Surface Mining Technology, Lovely prakshan Dhanbad, 1stedn, 1994.
- Operational Hand Book of Mineral Processing – Vedula V RamanaMurty
- Mineral processing technology ----- B.A. Wills (Eighth edition.)
- Mining Geology, Agor.
- Gems & Jewelry, Hand Book.
- Reports on Marble Mining.

List of Software/Learning Websites:

<http://www.slideshare.net/charujaiswal/enviornmental-protection-act-1986-21418888>
http://www.slideshare.net/PadmapriyaG/environment-protection-act?next_slideshow=1
<http://www.slideshare.net/alagar2012/environmental-protection-act-1986-38322064>
<http://www.joy.com/ii>. [http://en.wikipedia.org/wiki/Underground_mining_\(hard_rock\)](http://en.wikipedia.org/wiki/Underground_mining_(hard_rock))
<http://www.greatmining.com/Underground-Mining.html> v. YouTube
<http://www.groundtruthtrekking.org/Issues/MetalsMining/MineTailings.htm>
<http://www.tailings.info/basics/tailings.htm>
<http://www.telsmith.com/files/Mineral-Processing-Handbook.pdf>
http://www.dbc.wroc.pl/Content/2070/Drzymala_mineral.pdf
www.slideshare.net/hzharraz/mineral-processing-32988543
<http://yashevents.in/13871/mineral-processing-of-copper-ppt/>
www2.fiu.edu/~srimal/Pollution/Mining.ppt

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS

Course Code-

L:T:P-

Course Description:

This course provides polytechnic students with a foundational understanding of the entrepreneurial mindset, processes, and skills required to identify opportunities, develop innovative solutions, and create sustainable ventures. Throughout the semester, Critical Thinking, Excellent communicator (Good story teller), and Empathetic Leadership skills development for the students, through a blend of theoretical concepts, case studies, and practical exercises, students will learn to think like entrepreneurs, fostering creativity, problem-solving, and a proactive approach to career and economic development. The course emphasizes practical tools and methodologies applicable across various technical and vocational fields. This course will focus towards small Businesses including services and products

Course Learning Outcomes (CLOs):

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

1. **Define and explain** core concepts of entrepreneurship, innovation, and small business management.
 2. **Identify and evaluate** entrepreneurial opportunities using various ideation and market research techniques.
 3. **Develop a basic business model** using tools like the Business Model Canvas.
 4. **Understand fundamental aspects** of market analysis, competitive landscape, and target customer identification.
 5. **Articulate key considerations** in managing startup finances, legal structures, and intellectual property.
 6. **Develop and deliver a compelling pitch** for a new business idea.
 7. **Cultivate an entrepreneurial mindset**, including adaptability, resilience, and a willingness to take calculated risks.
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Course Content Outline (Weekly Breakdown):

Unit 1: Understanding Entrepreneurship and the Entrepreneurial Mindset (Weeks 1-2)

- **Week 1: What is Entrepreneurship? The Journey Begins.**
 - Definition of entrepreneurship, innovation, and intrapreneurship.
 - Dispelling myths about entrepreneurs.
 - The role of entrepreneurship in economic development and job creation (local and global context).
 - Types of entrepreneurships: lifestyle, scalable, social, tech, side-hustle.
 - Introduction to JUT's entrepreneurial ecosystem and local success stories

- **Activity: Ice-breaker: "What problem bothers you the most in your daily life/local community?"**
- **Week 2: The Entrepreneurial Mindset & Traits of Successful Entrepreneurs.**
 - Key entrepreneurial characteristics: passion, resilience, adaptability, creativity, risk-taking (calculated), problem-solving.
 - Growth mindset vs. fixed mindset.
 - Identifying personal strengths and weaknesses as potential entrepreneurs.
 - Importance of networking and mentorship.
 - *Case Study:* Analyze a local polytechnic graduate who started a successful business.
 - **Activity: Self-assessment quiz: "Are you ready for entrepreneurship?"**

Unit 2: Opportunity Identification & Ideation (Weeks 3-4)

- **Week 3: Finding Your Big Idea: Problem-Solving Approach.**
 - Sources of entrepreneurial opportunities: pain points, market gaps, trends, technological advancements, personal hobbies/skills.
 - Design Thinking principles for problem identification.
 - Techniques for observing and understanding customer needs (empathy mapping).
 - **Activity: Field observation exercise: Identify 3 problems in a chosen environment (e.g., campus, local market).**
- **Week 4: Ideation & Validation Techniques.**
 - Brainstorming methods: SCAMPER, S- Substitute, C-Combine, A- Adapt, M- Modify, P- Put to another Use, E-Eliminate, R- Reverse/Rearrange (Mind Mapping, Reverse Brainstorming)
 - Concept generation and prototyping
 - Introduction to Minimum Viable Product (MVP) concept.
 - Initial idea validation: informal surveys, interviews with potential customers.
 - **Activity: Group ideation session for a chosen problem; develop a basic MVP concept.**

Unit 3: Business Model Fundamentals (Weeks 5-6)

- **Week 5: Introduction to the Business Model Canvas (BMC).**
 - Understanding the nine building blocks of the BMC: Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, Cost Structure.
 - How the BMC provides a holistic view of a business.
 - *Activity:* Analyze the BMC of a well-known local or global company.
- **Week 6: Developing Your Value Proposition & Customer Segments.**
 - Deep dive into Value Proposition Design: understanding customer jobs, pains, and gains.
 - Defining your ideal customer segments: demographics, psychographics, behaviors.
 - Niche markets vs. broad markets.
 - **Activity: Students start populating the Customer Segments and Value Propositions blocks of their own business idea's BMC.**

Unit 4: Market Analysis & Strategy (Weeks 7-8)

- **Week 7: Market Research Essentials.**
 - Importance of market research: primary vs. secondary research.

- Basic tools for market research: online surveys (e.g., Google Forms), competitor analysis, industry reports.
- Analyzing market size, trends, and growth potential.
- **Activity: Conduct preliminary secondary market research for their chosen industry.**
- **Week 8: Understanding Your Competition & Marketing Basics.**
 - Competitor analysis: identifying direct and indirect competitors, SWOT analysis (Strength, Weakness, Opportunity, Threat).
 - Developing a competitive advantage.
 - Introduction to the Marketing Mix (4 Ps: Product, Price, Place, Promotion) in a startup context.
 - Branding basics for new ventures.
 - *Guest Speaker (Optional):* Local entrepreneur sharing marketing strategies.

Unit 5: Financial, Legal & Operational Foundations (Weeks 9-11)

- **Week 9: Startup Financial Basics.**
 - Understanding startup costs (fixed vs. variable).
 - Revenue models: how businesses make money.
 - Basic concepts of pricing strategies.
 - Sources of funding: bootstrapping, FFF (Friends, Family, Bootstrap), grants, basic loans, angel investors (brief overview).
 - **Activity: Calculate initial startup costs for their business idea.**
- **Week 10: Legal & Regulatory Aspects for Startups.**
 - Choosing a business structure: Sole Proprietorship, Partnership, LLC (simple overview, focus on local context).
 - Importance of business registration and licensing.
 - Basic understanding of contracts and agreements.
 - Introduction to Intellectual Property (IP): patents, trademarks, copyrights (relevance to polytechnic innovations).
 - *Guest Speaker (Optional):* Small business lawyer or a representative from a local business registration office.
- **Week 11: Operations & Team Building.**
 - Key operational considerations: supply chain, production/service delivery, quality control.
 - Building an effective founding team: complementary skills, roles, and responsibilities.
 - Importance of company culture in a startup.
 - **Activity: Define key activities and key partners for their BMC.**

Unit 6: Pitching, Growth, and Next Steps (Weeks 12-14)

- **Week 12: Crafting Your Pitch & Storytelling.**
 - Purpose of a pitch deck.
 - Components of a compelling pitch: problem, solution, market, team, business model, ask.
 - Storytelling techniques for engaging an audience.
 - Verbal and non-verbal communication skills.
 - *Activity:* Students draft their initial pitch script.
- **Week 13: Developing Your Business Plan (Lean Approach) & Refining Your Pitch.**
 - Overview of a lean business plan (as opposed to a traditional, lengthy one).
 - Refining the Business Model Canvas into a more comprehensive plan.
 - Peer feedback session on draft pitches.
 - **Workshop: Pitch practice session.**

- **Week 14: Final Pitch Presentations & Future Directions.**
 - **Final Project:** Students present their business idea pitch (could be 5-7 minutes with Q&A).
 - Discussion on continuous learning, adaptation, and potential next steps for their entrepreneurial journey.
 - Resources available for aspiring entrepreneurs at JUT and in the local community.
 - *Activity:* Course wrap-up and Q&A.
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Assessment Methods:

To ensure a balance between theoretical understanding and practical application, the assessment for this course could include:

- **Participation & Engagement (10-15%):** Active involvement in discussions, group activities, and case study analyses.
 - **Module Activities/Quizzes (20-25%):** Short quizzes, completion of assigned BMC sections, market research exercises, ideation assignments.
 - **Individual/Group Assignments (30-35%):**
 - **Mid-Term Assignment:** Developed Business Model Canvas for their chosen idea (could be individual or small groups).
 - **Research Report:** A brief report on their market research and competitive analysis.
 - **Final Project (30-35%):**
 - **Business Pitch Deck:** A professional-looking presentation outlining their business idea.
 - **Oral Pitch Presentation:** Delivering a concise and compelling pitch to the class (and potentially invited faculty/local entrepreneurs).
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Recommended Resources & Tools:

- **Primary Textbook**
- **Online Platforms/Tools: Introduction to Entrepreneurship Dr Prakah Kumar, Raj Jaswa, Ramesh Yadava**
 - Google Workspace (Docs, Sheets, Slides, Forms) for collaboration and surveys. Canva for creating visual aids and pitch decks. URL <https://www.canva.com/>
 - web.showreelapp.com Sabeer Bhatia
 - Online market research tools (e.g., Statista, government statistical websites, industry association sites).
 - Whiteboards, sticky notes, and markers for brainstorming sessions.
- **Guest Speakers:** Local entrepreneurs, business development agencies, IP lawyers, startup mentors.

Case Studies: A mix of successful and failed startups, particularly those relevant to polytechnic fields (e.g., tech, engineering, design, trades).

PROFESSIONAL ELECTIVE

ROCK MECHANICS (Theory+ Lab)

Course Code-

L:T:P-

Introduction:

The metals and minerals we rely on in our everyday life is staggering. If you really take a moment to think about it, look around to observe the objects you are surrounded by which are not manufactured by plant-based resources. From the cement you walk on to the screen you are reading, **our world and our way of life depends on the products of modern mining practices.**

But what does our future hold for us? Sustainable power, renewable energy, electric vehicles, advanced engineering, and commercial space travel will all rely on an increased source of the materials we already depend on. **The mining industry supports our everyday life** but also provides the foundations of engineering achievements for the decades to come.

As well as providing the metals and minerals that are essential for modern society, mining provides economic and social development opportunities throughout the world

This course provides detailed knowledge on rock properties and equips the students with the ability to carry out various tests, monitoring the rock behavior, analysis of data and solving rock mechanics problem in mining projects

Mining Diploma is truly multidisciplinary, Hence, this **Rock Mechanics** Course including elements of Geology, Drilling & Blasting, Environmental management and health and safety.

It's also highly Skill oriented, so in addition to lecture based study, the programme includes field trips, tours, Practical trainings.

Therefore, upon completion of the program, **the students will be able to** pursue employment opportunities in both the private and public sectors, engaged in the research and mining fields.

Pre-requisite.

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Mining Engineering, Mining Geology.

2nd year- Mine Development- Underground, Opencast Mining, Underground Metalliferous Mining, Underground Coal Mining, Mine Surveying, in this year of study, you shall be applying your previous years learning along with specialised field of study into projects and real-world applications.

Course outcome: A student should be able to:

CO1	Apply the Rock mechanics concepts Underground and Surface mining.
CO2	Carryout Controlled blasting, Geophysical prospecting, Processing of Dimensional Stone, Control subsidence and slope stability.
CO3	Carry out the precautionary measures for the aspects of Pollution due to air, water, noise and land degradation in mining, and Prepare the EMP/EIA for various mineral industries, Practice the Modern Mine surveying methods

CO4	Familiarize the Mines act, various rules and regulations made for safe working and appear Mine Manager's certificate of competency.
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Detailed Course Content

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	Present an overview on Scope and application of Rock mechanics in Mining.	4			Identify of the Constraints in rock mechanics application. Problems associated with rock mechanics,	3		
	1	1	2	Analyze different techniques to enhance scientific field applications of Rock Mechanics that are needed for today's industry.	4			Demonstration of Discontinuities in rock mass by using models and virtual class.			3
	1	1	3	An overview of Physical and Mechanical properties of Rock.	4			Discuss the developments of present day technologies in mining industries.			3
	1	1	4	Virtual tour on Opencast metal and coal Mines.			4	Virtual tour on Underground Metal and Coal Mines.			3
	1	1	5	Weekly developmental Assessment				Assessment Review and corrective action			3
	1	1	6	Industry Class- and Industry Assignment			5				
2	1	4	1	PEER Discussion on Industry Assignment		4		An overview of Physical and Mechanical properties of Rocks	3		
	1	4	2	PHYSICAL PROPERTIES OF ROCKS Distinguish: Porosity, Density & its types, moisture content, Degree of Saturation, Thermal and Electrical properties, Swelling of rocks, Anisotropy and Durability.	2		2	Experimental determination of Permeability: • Longitudinal Test • Radial Test.			3
	1	4	3	MECHANICAL PROPERTIES OF ROCKS Discuss Mohr's Scale of hardness. Discuss the factors on which mechanical properties of rocks depends.			4	Demonstrate Mohr's scale of hardness.			3

	1	4	4	ROCK TESTING: Sampling and Sample preparation Discuss the determination of Uniaxial Compressive Strength Test and Tensile strength tests.			4	Preparation of specimen sample Determination of Tensile Strength of a rock specimen by Brazilian Method.			3
	1	4	5	Weekly developmental Assessment				Assessment Review and corrective action			3
	1	4	6	Industry Class- and Industry Assignment			5				

	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
3	1	4	1	PEER Discussion on Industry Assignment Discuss static and dynamic methods for evaluation of elastic constants of rocks.			4	To determine the Shear strength of the given specimen by - punch shear test - shear box test			3
	1	2,4	2	Dynamic elastic constant by Resonance frequency method, Ultrasonic pulse method. Creep in rocks and its measurements.			4	Analyse the Rock mass classification by RMR and Q- System.			3
	1	2,4	3	Present an overview of Methods of Rock Exploration and geophysical prospecting: - Methods. - Core Recovery - Rock quality designation Methods of Geophysical Prospecting.			4	Discuss the methods of Geophysical Prospecting.			3
	1	2,4	4	Analyse the Geological considerations in Tunneling.			4	Virtual classes on the improvements of properties of Rock mass.			3

	1	4	5	CIE 1– Written and practice test			Assessment Review and corrective action			3
	1	4	6	Industry Class- and Industry Assignment		5				
4	2	2,3	1	PEER Discussion on Industry Assignment Slope stability- Factors influencing the slope stability of a bench.		4	Analyse the Overall slope of bench - Simple numerical problems to calculate the overall slope of the bench.			3
	2	2,3	2	Analyze the types of slope failures - Parameters required for slope design.	2	2	Solve simple numerical problems to calculate the factor of safety of bench slope.			3
	2	2,3	3	Methods of preventing slope failures - Formula to calculate the factor of safety of bench slope.	2	2	Practice preventive measures due to blasting practice in open cast mines.			3
	2	2,3	4	Analyse the Controlled blasting techniques to Control of fly rocks, vibrations, sound, dust generation - Muffled blasting, cushion blasting ,chamber blasting and Deck blasting and their applicability-- Conditions for adopting sleeping hole.		4	Virtual class on controlled blasting.			3
	2	2,3	5	Developmental Weekly Assessment.			Assessment Review and corrective action			3
	2	2,3	6	Industry Class +Industry assessments		5				
5	2	3,7	1	PEER Discussion on Industry Assignment		4	An overview of Subsidence:	3		
	2	3,7	2	Subsidence: Angle of draw, Critical width, Critical area, Sub-critical area, Super critical area, factors influencing subsidence damages, Causes, impacts, prediction, Preventive measures,	4		Supports - Necessity materials used, Classification of Supporting Systems, Dome's theory of Subsidence.			3

	2	3,7	3	Principles, merits and demerits of rock bolting and Roof stitching. Rigid and Yielding props -Constructional details of Friction props and Hydraulic props.		4	Applicability of various types of supports underground			3
	2	3,7	4	Method of setting various supports at different situations -Safari supporting, Junction Supports. Systematic supporting, withdrawal of supports.		4	Constructional details of Friction props and Hydraulic props.			3
	2	3,7	5	CIE 2 – Written and Practice Test			Assessment Review and corrective action			3
	2	3,7	6	Industry Class and Industry Assignment		5				
6	2	3	1	PEER Discussion on Industry Assignment		4	Overview of Mining and Processing of Dimensional Stone	3		
	2	3	2	Resources of Marble, Granite, Slate, Sandstone and Limestone as Dimensional stones in India, uses, marketing export.	4		Convention mining of sandstone, Limestone, Marble and Granite, Wire saw, Chain saw, hydraulic splitting flame jet cutting, water channeling, etc.			3
	2	3	3	Geological, Mineralogical and physio-mechanical properties of dimensional stones. Criteria for selection of dimensional stone deposit.	4		Blasting in dimensional stone mines, Development of mine, Mine layout.			3
	2	3	4	Environmental impact of mining and processing of dimensional stones, Secondary use of quarried land and waste of the industry.	4		Virtual classes on Dimensional stone quarries.			3
	2	3	5	Developmental Assessment			Assessment Review and corrective action			3
	2	3	6	Industry Class and Industry Assignment		5				

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
7	3	5,7	1	Tutorial (Peer discussion on Industrial assignment)			4	Present an overview on importance of Environmental impact due to mining.	3		
	3	5,7	2	Contrast the awareness of Environment and Ecology: <i>Differentiate between:</i> Terrestrial and aquatic biomes. Tropical forest, deciduous forest, Grass land and desert biomes. Ecosystem and its classification. Impact of human interference with natural environment.	4			Analyze: The effects of air pollution on eco-systems. Effects of water pollution on ecology and environment Effects of water pollution on mine workers Remedial measures to be followed to check air pollution TLV for different dusts.			3
	3	5,7	3	Importance of Ozone for sustenance of biosphere. - Ozone cycle, - Ozone layer depletion. - Remedial measures to check ozone depletion. Analyze the Causes and effects of: - Acid rains, - Greenhouse effect, - Global warming. - India's Initiatives on Global Warming. Sources and effects of air, water and Noise pollutions in mines.	2		2	Remedial measures: - In reduction of noise in mines - To minimize ground vibration. Analyse the TLV for noise. Analyse Sources of ground vibration in mines. Analyse Statutory standards of ground vibrations.			3
	3	5,7	4	Analyze the Environmental Management: Mine environment monitoring and control; EMP (Environment Management Plan);	2		2	Propose the need for reclamation. Procedure of preparation of an E.M.P			3

				mine closure plan; R&R (rehabilitation and resettlement).			Prevention, control and abatement of environmental Pollution.			
	3	5,7	5	CIE 3 – Written and Practice Test			Assessment Review and corrective action			3
	3	5,7	6	Industry Class- and Industry Assignment		5				
8	3	3,7	1	Tutorial (Peer discussion on Industrial assignment) Present an overview on Selection of different drills in mining operation.		4	Present an over view of Various Drilling like: • Vertical Drilling • Horizontal Drilling. • Multilateral Drilling. • Extended Reach Drilling. • Complex Path Drilling.	3		
	3	3,7	2	Present an overview of Special Methods of Drilling like: • Water jet Drilling. • Thermal Drilling. • Over burden drilling with eccentric.	2	2	Present the: • Drilling Parameters. • Calculation of Drilling costs. • Calculate burden and spacing. Decide the quantity of explosives required			3
	3	3,7	3	Distinguish: • Classify and Explain the Explosives • Permitted & non permitted explosives. • Plain Detonators & Electric Detonators. Accessories - Safety fuse, Plastic Igniter cord, Detonating fuse, Detonating relay, Shock tubes.	2	2	• Drilling Patterns. • Preparation of charge. • Procedure for firing shots. • Calculation of explosive quantity. Powder factor.			3
		3,7	4	Present the Over view of Shot-firing tools. • Ohm Meter. • Shot firing cables.	2	2	Discuss the optimization of ROCK FRAGMENTATION:	3		

				Exploders - Types, Construction and safety features. • Precautions during blasting. • Direct & Indirect initiation. • Deck Charging.			• Mechanism of rock fragmentation, • Factors affecting rock fragmentation, • Techniques to improve rock fragmentation			
	3	3,7	5	Developmental Weekly Assessment			Assessment Review and corrective action			3
	3	3,7	6	Industry Class on and Industry Assignment		5				
9	3	2,7	1	Tutorial (Peer discussion on Industrial assignment) Present an overview on • The role of the mine surveyor and his legal responsibilities.		4	Present an overview on • Mine surveyor's related skills. • Areas where well qualified Surveyor are needed in India.	3		
	3	2,7	2	Photographic survey- advantages, Field work of terrestrial photographic surveying.	2	2	Different type of numerical problems on drift ,full dip, apparent dip, borehole and fault, percentage extraction of pillars.			3
	3	2,7	3	Global Positioning System (GPS) - Fundamentals, GPS receivers, GPS observations, transformation of GPS results, working principles of GPS navigator.		4	Demonstrate the use of: • GPS. • Electronic Theodolite and • EDM.			3
	3	2,7	4	Practice Modern Surveying Instruments- Principles and uses of (i) Electronic Theodolite (ii) EDM (iii) Total station.		4	Demonstrate the application of: • Total Station. • software's related to mine surveying.			3
	3	2,7	5	CIE 4 – Written and Practice Test			Assessment Review and corrective action			3

	3	2,7	6	Industry Class and Industry Assignment		5				
10	4	6,7	1	Tutorial (Peer discussion on Industrial assignment)		4	An Over view of different Mining operations as well as preventive measures from dangers in compliance with the Mine's Act, Rules, Regulations and orders there under.	3		
	4	6,7	2	Metalliferous Mining Regulations 1961/ Coal Mine Regulation, 1957; Definitions, Returns, Notices and Records, Examinations and Certificates of Competency and of Fitness, Inspection and Mine Officials, Duties and Responsibilities of Workmen, Competent Persons and Officials.	4		Collect and discuss the information regarding Duties and responsibilities of different mining officials from the mining officials or from mine visit.			3
	4	6,7	3	Metalliferous Mining Regulations 1961/Coal Mine Regulation, 1957; Plans and Sections, Means of Access and Egress ,Ladders and Ladder ways, Transport of Men and Materials – Winding in shafts, Transport of Men and Materials – Haulage, Mine Workings.	4		Collect the information regarding Transport of Men and Materials in the nearby mines, from the mining officials or from mine visit.			3
	4	6,7	4	Metalliferous Mining Regulations 1961/ Coal Mine Regulation, 1957; Precautions against Dangers from Fire, Dust, Gas and Water, Ventilation, Lighting and Safety Lamps, Explosives and Shot firing, Machinery and Plant.	4		Collect the information regarding use of explosives in the nearby mines, from the mining officials or from mine visit.			3
	4	6,7	5	Developmental Assessment			Assessment Review and corrective action.			3
	4	6,7	6	Industry Class and Industry Assignment		5				
Week	C O	P O	Days							

11	4	6,7	1	Tutorial (Peer discussion on Industrial assignment) Appraise the Rules and Regulations applied in Mines.		4	Discuss the importance of Crèche Rules.	3		
	4	6,7	2	Mines Rescue Rules, 1985.	4		Discuss the importance of Vocational Training Rules, 1966			3
	4	6,7	3	General Safety in Mines: Safety in Mines: Causes and prevention of accidents and their classification; • investigations into accidents and accident reports. • measures for improving safety in mines; safety management system; human elements in mine safety. worker's participation in safety management	4		Collect and discuss the information of: Safety management system to prevent accidents, from any one mines.			3
	4	6,7	4	Notified and occupational diseases; silicosis and pneumoconiosis. physiological aspects of breathing in dust laden atmosphere. dust sampling and sampling instruments; methods.	2	2	Collect and discuss the information of • Notified occupational disease in the mine by visiting or from the mining authorities. • Dust suppression methods adopted in mines.			3
	4	6,7	5	CIE 5 – Written and Practice Test			Assessment Review and corrective action			3
	4	6,7	6	Industry Class- and Industry Assignment		5				
12	4	4	1	Tutorial (Peer discussion on Industrial assignment)		4	Present an overview on importance of Gas testing certificate of competency. Assemble the Flame safety Lamp.			3
	4	4	2	Appraise the Indian regulations pertaining to methane concentration.	2	2	Demonstrate the safety features of a Flame safety lamp.			3

	4	4	3	Analyze, the achievement of heat transference in a flame safety lamp. Justify, why still Safety lamp is used in underground mines?				Demonstrate the Variation in shape and height of gas cap with methane percentage.			3
	4	4	4	Analyse the Components of flame safety lamp in different sections along with their functional details.			4	Demonstrate the use of Flame safety Lamp to determine the Accumulation and Percentage of Methane.			3
	4	4	5	Developmental				Assessment Review and corrective action			3

References:

- Rock mechanics for Engineers, by B.P.Verma
- Elements of Mining Technology, by D.J.Deshmukh –Vol 1,2 ,3
- Rock Mechanics & Ground Control, by D.Biswas, Lovely Prakashan, Dhanbad.
- Rock Mechanics- Leonard Obert and Wilbur I.Duvall
- Ground Control, Peng, S.S, Wiley Publications, New York, 1987
- Engineering Rock Mechanics- An introduction to the principles, John A Hudson and John P Harrison, Pergamon Press, 1997.
- Mine Management, Legislation and General safety: S.Ghattak.
- CMR/MMR 1957 / 61 3. Critical Appraisal: Rakesh & Prasad
- DGMS Circulars
- Mines vocational training rules, 1966
- Mine Surveying and Levelling, Vol.I, II &III by Ghatak, COALFIELD PUBLISHERS,Ukhra, Burdwan,W.B.
- B. C. Punmia, Surveying, Vol - I, II, III, Laxmi Publication, New Delhi, 12th Edition, 1990.
- V. Natarajan, Advanced Surveying, B. I. Publication, Bombay, First edition, 1976.
- T. P. Kanetkar, Surveying and Levelling, Pune Vidyarthi Griha Prakashan, Reprints, 1995.
- S. K. Das, Surface Mining Technology, Lovely Prakshan Dhanbad, 1stedn, 1994.
- Reports on Marble Mining.

List of Software/Learning Websites

<http://www.slideshare.net/charujaiswal/enviornmental-protection-act-1986-21418888>

http://www.slideshare.net/PadmapriyaG/environment-protection-act?next_slideshow=1

<http://www.slideshare.net/alagar2012/environmental-protection-act-1986-38322064>

<http://www.joy.com/ii>.

[http://en.wikipedia.org/wiki/Underground_mining_\(hard_rock\)](http://en.wikipedia.org/wiki/Underground_mining_(hard_rock)) <http://www.mtu-online.com/mtu/applications/mining/undergroundminingmachines/>

<http://www.greatmining.com/Underground-Mining.html> v. YouTube

<http://www.groundtruthtrekking.org/Issues/MetalsMining/MineTailings.htm>

<http://www.tailings.info/basics/tailings.htm> <http://www.telsmith.com/files/Mineral-Processing-Handbook.pdf>

http://www.dbc.wroc.pl/Content/2070/Drzymala_mineral.pdf

www.slideshare.net/hzharraz/mineral-processing-32988543

<http://yashevents.in/13871/mineral-processing-of-copper-ppt/> www2.fiu.edu/~srimal/Pollution/Mining.ppt

MINE LEGISLATION & MANAGMENT

Course Code- **Pre requisites**

L:T:P

This course requires the general knowledge of mining operations.

Course Outcomes

After completion of the course, the student should be able to:

CO1	Acquiring knowledge on statutory provisions relating to actual structure and making of laws, health and safety of persons employed in mines
CO2	Apply statutory knowledge to improve welfare and safety of persons employed in mines
CO3	Learn about qualification, practical experience, duties and responsibilities of mine officials
CO4	Provides knowledge of establishment and location of rescue station, room and conduct of rescue work in mines when emergency exist
CO5	Learn basic terminology and practical experience, duties and responsibilities of various designated persons in mines
CO6	Apply the statutory provisions to improve safety and methods to be followed in mines

COURSE CONTENT:

Acquiring knowledge on statutory provisions relating to actual structure and making of laws, health and safety of persons employed in mines

Duration: 12 periods (L: 9-T: 3)

Definitions of adult, Agent, committee, day, chief inspector, district magistrate, employed, inspector, office of the mine, relay and shift, open cast working, qualified medical practitioner, reportable injury, serious bodily injury, week- situations under which act does not apply- Committee – Notice of Accident – Provisions of Mines Act in respect of Hour and limitations of Employment - Leave with wages –regulations, rules, bye laws.

Apply statutory knowledge to improve welfare and safety of persons employed in mines

Duration: 12 periods (L: 9- T: 3)

Mine Rules related to definitions of court of inquiry, manager, form, certifying surgeon, ordinarily employed, leave, schedule, and calendar year - medical examination – underground and surface latrines, drinking water, shelters, and workmen inspector – pit safety committee – first aid – canteen – welfare officer.

Learn about qualification, practical experience, duties and responsibilities of mine officials

Duration: 08 periods (L: 6-T: 2)

Short title, extent, Approved safety lamp and Approved electric torch, Banks man, blaster, Bellman, Landing, Material, Metal ferrous mine, mining mate, official, permitted explosive, Socket, Winze and rise, working place – practical experience for managers, mate's and blaster's examinations – suspension or cancellation of statutory certificate – appointment of assistant managers or underground managers – duties of persons employed in mines – duties and responsibilities of mining mates - Provisions of ladder ways.

Provides knowledge of establishment and location of rescue station, room and conduct of rescue work in mines when emergency exist

Duration: 08 periods (L: 6- T: 2)

Terminology of below ground mine, inspector, principal official, qualified medical practitioner, rescue trained person – establishment and locations of rescue station, rooms – functions of rescue station, room – qualifications and experience of superintendent, instructors, room in charge – appointment of rescue trained person in mines – selection of persons for training in rescue.

Learn basic terminology and practical experience, duties and responsibilities of various designated persons in mines

Duration: 16 periods (L: 12-T: 4)

Definitions – abandoned working, approved safety lamp, competent person, discontinued working, disused working, face, – board of mining examination – qualification and appointment of manager, ventilation officer, safety officer – age limit and general qualifications of candidates - duties of competent person, managers, safety officer, Over man, support man, attendant of main mechanical ventilator – haulage road ways – travelling road ways – general requirements about mine planes – types of planes – Fencings and gates.

Apply the statutory provisions to improve safety and methods to be followed in mines

Duration: 19 periods (L: 14- T: 5)

Definition of haul road, quarter, ventilation district, working, working place, fiery seam, general body of air - mechanical Open cast workings – development work – depillaring operations – multi section and contiguous working – strata control and monitoring plan - Setting of supports – steep working - intentional flooding – Standard of ventilation – storage of explosives – magazines, stores and premises to store explosives – drilling charging stemming and firing of shot holes – misfires – duties of shot firer at the end of his shift – notice of intention or proposal of exploration for methane – protective foot wear – helmet – man power distribution plan.

REFERENCE BOOKS:

1. The mines act – 1952 (lovely prakashan publishers)
2. The mines rules – 1955 (lovely prakashan publishers)
3. The metalliferous mines regulations - 1961(lovely prakashan publishers)
4. The mine rescue rules – 1985 (lovely prakashan publishers)
5. Coal mines regulations – 2017 (lovely prakashan publishers)
6. Critical appraisal - Rakesh and prasad

Suggested E-Learning references

1. ibm.nic.in
2. www.dgms.gov.in
3. www.nptel.ac.in

HEALTH & SAFETY IN MINING

Course Code-

L:T:P

Course Objectives: Mine health and safety engineering is very important area which will address the different aspects of mine health and safety related problems. In any mine, the safety of men and material is very important along with production of mineral. Mining is considered as a hazardous profession which involves, occupational diseases during prolonged exposure to work environment. Safety of the work men is considered to be of paramount importance.

Course outcome:

The students will have the opportunity to understand and analyze the envisaged problems related to safety aspects and mine health related problems. The statutory provisions related to mine safety and health related problems will help in competing the examinations organized by the Director General of Mines Safety.

Course Content

UNIT I

Mine accidents, types of accidents, roof fall accidents.

UNIT II

Planning for safety, Safety analysis, Safety prevention and precautions.

UNIT III

Information system and safety audits.

UNIT IV

Hazard control- engineering approach, systems approach, Hazard analysis.

UNIT V

Safety management, Economics of safety and cost- effectiveness.

UNIT VI

Occupational hygiene, occupational diseases, Occupational hazards in mines.

TEXT BOOKS:

1. ridley,J & C Channing: Safety at work: Butter worth- Heinemaan. Oxford,2001.
2. Rodgers. W.P: Introduction of system safety Engineering: John Wiley & Sons Inc., NewYork, 1971.
3. Greem A R; Safety in Mines Reserch : A,R. Balkena, Rotterdam,1985.

MINE & MINERAL ECONOMICS

Course Code:

L:T:P

Course Objective:

The course enables the students to understand the economics of business enterprise to become a successful manager. → Students gain knowledge on the basic management principles to become management(s) professional. → Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully. → Expertise the students to brings employment, government revenues, and opportunities for economic growth and diversification through mining. → Study of estimation and valuation of mineral deposit and study of project appraisal.

Unit I

Mineral Industry: Mineral Industries in India, Role of Mineral Industries in National Economy. Major Economical minerals coal, Iron, Copper, Manganese, Limestone, Lead and Zinc, Gold, Radioactive minerals. Geological formation modes, Locations, Reserve, Uses, Production, Imports, Exports. Conservation of Minerals and their substitution including coal. National Mineral Policy. Incentives provided by government to Mining sector, Computation & classification of Reserve and Grades.

Unit II

Valuation & depreciation: Valuation methods of valuation by different methods of annuity. Calculation of different annuities, Methods of depreciation and calculation of Depreciation methods of calculations of Redemption values. Main valuation methods of mining Property which under production. Valuation under different methods. Report of valuation of small mining property.

Unit III

Mine Leasing Procedure: Different Acts, Rules related to Scientific Development, Regulation and Conservation of Minerals, major and minor mineral concessions. General Restriction on undertaking mining operation, Maximum area for which Mining lease may be granted, Period for which mining lease may be granted, procedure for obtaining mining lease.

Unit IV

Mining Plan: As per the MCDR, 1988: MCR, 1960. Procedure of arranging finance for small-scale mining through financial institutes, Mine Closure plan.

Reference-

1. Mine Valuation, sparks
2. Mine Economics, R.T. Deshmukh
3. Elements of Mineral exploration, IBM

POLLUTION CONTROL IN MINE

Course Code- Course Objective

L:T:P

- To learn various kind of pollutants and their causes and preventive measures.
- To know the salient features of environmental laws in India.
- To know the various types of occupational diseases in the mine.
- To measure the level of pollution i.e. Noise level, air pollution level etc.

Course outcomes:

Apply knowledge of pollution control for understanding and solving different types of environmental pollution problem in any mine.

Identify, analyze, control and solve environmental pollution problems.

UNIT 1: ENVIRONMENTAL POLLUTION

Introduction and classification of environmental pollution, ecological conservation.

Salient features of the environmental laws in India, Occupational disease.

UNIT 2: AIR POLLUTION

Air pollution due to various gases and suspended particulate materials, causes, consequences, Green House effect, Ozone Depletion, Acid Rain, Preventive Measures against air pollution, dust sampling equipments.

UNIT 3: WATER POLLUTION

Water pollution, its causes and preventive measures, acid-mine drainage, water pollution in mines and mineral beneficiation plants, water treatment & purification schemes in brief.

UNIT 4: LAND POLLUTION

Land pollution: its causes and preventive measures, Land scape pollution and land reclamation, methods of land Reclamation, Mine closure plan.

UNIT 5: NOISE POLLUTION

Pollution due to noise and its consequences, Sources of noise, permitted level of noise, noise produced by different machinery, control and safety measures, measurement of noise level.

Reference Books-

1. Air & Water Acts
2. Forest Conservation acts
3. Legislation in Indian Mines – A Critical appraisal by Rakesh and Prasad
4. Env. Impact of Mining By Down and Stokes

APPLICATION OF IT IN MINING

Under Preparation.....

OPEN ELECTIVE

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Course Code-

L:T:P

Introduction:

Welcome to the curriculum for the Artificial Intelligence and Machine Learning (AI&ML) Specialisation. This specialisation course is taught in Bootcamp mode. Bootcamps are 12 weeks, intense learning sessions designed to prepare you for the practical world – ready for either industry or becoming an entrepreneur. You will be assisted through the course, with development-based assessments to enable progressive learning. In this course, you'll learn how to produce a computer- assisted solution when data is too complex for humans to find answers as they combine both data science and machine learning skills that are needed for today's job market.

Some common examples include; Amazon Alexa - converting spoken audio into language; Google Image Search – uses image recognition to return specific search results; Samsung Smart Fridges – uses data and machine learning to produce intuitions about your behavior. Leading to the successful completion of this bootcamp, you shall be equipped to either do an internship at an organization working in AI or do a project in AI. After the completion of your Diploma, you shall be ready to take up roles like Machine Learning Engineer, Data Scientist, Data Analyst, and more.

This course will teach you Fundamentals of AI, Python and Python libraries, data visualization, machine learning models, maths like linear algebra, data interpretation, deep learning, Version control system, cloud deployment and more. Details of the curriculum is presented in the sections below.

Pre-requisite

Before the start of this specialisation course, you would have completed the following courses;

In the 1st year of study, you would have studied Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Computer, Fundamentals of Electrical and Electronics Engineering, Project Management skills and Multimedia & Animation.

In the 2nd year of study, you would have studied Python Programming, Computer Hardware, Maintenance and Administration, Computer Networks, Database System Concepts and PL/SQL, Data Structures with Python, Operating System and Administration, Object oriented programming and Design with Java, Software Engineering principles and practices.

In this year of study, you shall be applying your previous years learning along with specialised field of study into projects and real-world applications.

Course outcome: A student should be able to

CO1	Explain the concept of AI, its applications, constituents and challenges of ethics in AI.
CO2	Analyze and visualize any given dataset
CO3	Evaluate, optimize, build and test an AI model for a given requirement
CO4	Perform comparative analysis of methods or algorithms for a given requirement
CO5	Select the appropriate tools, production environment and deploy the model.

Detailed Course Content

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	1. AI based movie (Screening)			4	- AI influence in companies viz, Amazon, Microsoft, Google, IBM - Latest developments in AI domain - <u>Google's DeepMind AI Just Taught Itself To Walk - YouTube</u> - <u>Introducing Amazon Go and the world's most advanced shopping technology - YouTube</u> - <u>IBM Watson</u> - Understanding the evolution of AI and HMI (human machine interface) - Discussion on how AI will Impact of daily life, work life, work force, jobs, products and services – T	2		1
	1	1	2	Fundamentals of AI - What is artificial intelligence? - How AI works - Purpose of AI - Types of Artificial Intelligence - Goals of AI - Applications of AI	3		1	- Significance of data in AI - AI Software Development life cycle - Compare traditional software development with AI Software Development - Example – Game rules (Chess) Explore and prepare a report on all popular AI cloud services (ML & DL) offered by vendors - T	2		1

				- Ethics in AI Examples of AI in real world - T							
	5	4,5	3	Why Do We Need a Version Control System? Fundamentals of Git Git installation and setup basic local Git operations ▪ creating a repository, ▪ cloning a repository, ▪ making and recording changes ▪ staging and committing changes, ▪ viewing the history of all the changes ▪ undoing changes	1		3	Git Branching and merging Basic ▪ Creating and switching to new branches ▪ Switching between branches ▪ Merging local branches together			3
	5	4,5	4	GitHub - Basics of distributed git - Account creation and configuration - Create and push to repositories - versioning - Collaboration - Migration	1		3	Create repository – named mini project-1 Push the same to GitHub <u>TOC - Git Essentials: Become a Git and GitHub Ninja Infosys Springboard (onwingspan.com)</u>			3
			5	Developmental Assessment				Assessment Review and corrective action			3
	1	1,5	6	Real industry experience of AI	2		3	Weekly Assignment(1PM-2PM)			
2	1	1	1	Peer Review		4		Machine Learning	2		1

							- Fundamentals - Machine learning types - Machine learning workflow - Machine learning applications - Challenges in ML - Building a model – steps involved - Pipelines ▪ Data engineering ▪ Machine learning ▪ Deployment - What is Data Science? - How Data Science works? - Data Science uses Group discussion - Examples of ML in everyday life / Use of Machine Learning in Daily Life Machine Learning Terminologies - T <u>TOC - Machine Learning Fundamentals Infosys Springboard (onwingspan.com)</u> <u>Prediction – continuous value</u>			
1,5	1,4	2	Introduction to Cloud Computing - Essentials of Cloud Computing - Cloud Deployment Models - Cloud Service Models	2		2	Introduction to Containers Cloud Native application development Explore AI (ML and DL) services across public cloud platforms	1		2

				- Serverless Services - Major Cloud service Providers - Virtualization Explore the cloud service providers and services offered by them - T			Note : teacher has to choose a public cloud platform to perform the following activities - Getting to know cloud platform - Creating an account			
	1,5	4,5	3	- Walking through the administrative console and Cloud SDK - Explore Virtual machines (PaaS, IaaS and SaaS) and storage options - Deploy a simple application on the cloud - AI Platform overview	1	3	Essentials of cloud billing SLA <u>TOC - Essentials of Cloud Computing Infosys Springboard (onwingspan.com)</u> <u>Tutorial - Automatically Create Machine Learning Models - Amazon Web Services</u> <u>Tutorial - Automatically Create Machine Learning Models - Amazon Web Services</u>	1		2
	1	1,3 4	4	Big Data - What is Big Data? - Vs of Big Data - Sources of data - Role of Big Data in AI&ML Python Packages for Machine Learning and Deep Learning - Scientifics computing libraries - Visualization Libraries - Algorithmic libraries Environment setup: install required packages	1	3	Python recap Database connectivity	1		2

				Explore above listed packages						
			5	Developmental Assessment				Assessment Review and corrective action		3
	1,5	2,3,4	6	Build applications using AI cloud services	2		3	Weekly Assignment		
3	1,5	2,3,4	1	Peer review		4		Explore NumPy Module - Array Aggregation Functions - Vectorized Operations - Use Map, Filter, Reduce and Lambda Functions with NumPy - <u>TOC - Pandas and NumPy Tips, Tricks, and Techniques Infosys Springboard (onwingspan.com)</u>		3
	1,5	2,3,4	2	Explore Pandas modules - Aggregation and Grouping - Time Series Operations - Pivot and melt function - Use Map, Filter, Reduce and Lambda Functions with Pandas dataframes - <u>TOC - Unpacking NumPy and Pandas Infosys Springboard (onwingspan.com)</u>	1		3	Contd.		3
	2,5	2,3,4	3	Data visualization with python - Visualization fundamentals - Why visualization	2		2	- Visualizing Amounts - Visualizing distributions		3

				- Coordinate Systems and Axes - Directory of Visualizations Amounts, Distributions, Proportions, x-y Relationships, Uncertainty Basics of python visualization with Matplotlib - Understand the anatomy of a figure - Plot creation - Plotting routines - Basic plot customizations - Saving plots			- Visualizing proportions - Visualizing associations - Visualizing time series Consider a dataset and infer the relations with the help of different plots.			
	2,5	2,3,4	4	- Visualizing trends - Visualizing uncertainty - Visualizing categorical data - visualize proportions - visualize data on multi-plot grid - Composite views for informative summaries of data	1	3	Basics of python visualization with Seaborn <u>The Course Overview - Viewer Page Infosys Springboard (onwingspan.com)</u>			3
			5	CIE 1 – Written and Practice Test			Assessment Review and corrective action			3
	1	4	6	How to create project plan and product backlog for AI project Create Git Repository for following Regression Project - ML / deep learning	2	3	Weekly Assignment			

				Classification Project – ML / deep learning Clustering project – ML / deep learning Natural Language Processing – ML / deep learning							
4	2	2,3,4	1	Peer review Mini Project Activity (2) - Regression - Classification (Individual/ Team of 2) - Define Problem statement (solution to be presented at the semester end) - Create project plan and product backlog - Create git repository for the project - Work progress should be monitored weekly	4		Data engineering pipeline Data Collection - Population and sample - Types of data ▪ Data type (type 1 (cross sectional, time series), type 2 (univariate, multivariate)) ▪ Variable types (categorical, ordinal, ratio, interval) - Data Collection Key terminologies in Statistics – T <u>Mini Project Activity</u> - Data collection for the stated problem	2		1	
	2	1,3	2	Probability - Basic concepts - Conditional and Joint probability - Bayes’ Theorem Probability Distributions - Discrete	2	2	Exploratory data analysis - overview - EDA goals and benefits Univariate data analysis - Characterizing data with descriptive statistics - Univariate distribution plots	1		2	

			- Continuous - Central Limit Theorem <u>Infosys Springboard (onwingspan.com)</u> <u>TOC - Probability Distribution using Python Infosys Springboard (onwingspan.com)</u> Use relevant python packages to compute Central tendency for the parameters Dispersion for the parameters data distribution Visualize above computation with various techniques				- Univariate comparison plots - Univariate composition plots <u>Mini Project Activity</u> Data Exploration and analysis for the stated problem			
2	2,3,4	3	Univariate analysis tests Hypothesis testing Error, Test statistic, type, interpreting test statistics. Understanding p-value	1		3	Multivariate analysis Finding relationship in data - Covariance - Correlation	1		2
2	2,3,4	4	- Multivariate distribution plot - Multivariate comparison plot - Multivariate relationship plot - Multivariate composition plot			4	Linear algebra using python - Scalars - Vectors - Matrices - Tensors - Gradients	1		2

				- TOC - Exploratory Data Analysis with Pandas and Python 3.x Infosys Springboard (onwingspan.com) Mini Project Activity – Status review (Data Exploration and analysis for the stated problem)				- Eigen values and eigen vectors - Norms and Eigen decomposition Use relevant python packages to perform operations over vectors and matrices. TOC - Basics of Linear Algebra using Python Infosys Springboard (onwingspan.com) Interactive Scenario: Introduction to Vector Algebra Using Python (oreilly.com)			
			5	Developmental Assessment				Assessment Review and corrective action			3
	2	2,3,4	6	Statistics and Linear algebra	2		3	Weekly assignment			
5	2,5	2,3,4	1	Peer review Mini Project Activity – Status review		4		Data Preprocessing Importance of data preprocessing Data cleaning - Assess Data quality - Data anomalies - Detect missing values with pandas dataframe functions: .info() and .isna() - Diagnose type of missing values with visual and statistical methods (eg. chi-squared test of independence) Approaches to deal with missing values ▪ Keep the missing value as is	1		2

							▪ Remove data objects with missing values ▪ Remove the attributes with missing values ▪ Estimate and impute missing values			
2,5	2,3,4	2	Practice: Dealing with missing values with different approaches Outliers Detecting outliers ▪ univariate outlier detection ▪ bivariate outlier detection ▪ Time series outlier detection	1		3	Dealing with outliers - Do nothing - Replace with the upper cap or lower cap - Perform a log transformation - Remove data objects with outliers Practice: Dealing with outliers with different approaches <u>TOC - Data Preprocessing Infosys Springboard (onwingspan.com)</u> <u>TOC - Data Cleaning and Transformation Infosys Springboard (onwingspan.com)</u>			3
2,5	2,3,4	3	Data Integration - Overview - data integration challenges - Approaches - Adding attributes - Adding data objects Practice: data integration	1		3	Data reduction - Distinction between data reduction and data redundancy - Objectives - Methods ○ numerosity data reduction ○ dimensionality data reduction	1		2

							Practice: Data reduction with numerosity data reduction method			
	2,5	2,3,4	4	Data transformation Need for data transformation. - Normalization - Standardization Data transformation with - binary coding - ranking transformation - discretization	1	3	Data transformation with - ranking transformation - discretization			3
			5	CIE 2 – Written and Practice Test			Assessment Review and corrective action			3
	2,5	2,3,4	6	Feature engineering	2	3	Weekly Assignment			
6	2,3,5	2,3,4	1	<u>Peer review</u> Mini Project Activity – Status review	4		Data Splitting Importance of data splitting - Training set - Validation set - Testing set Underfitting and overfitting Practice : split training and testing data sets in Python using train_test_split() of sci-kit learn. Explore the options of train_test_split()	1		2

	2,3 ,5	2,3 ,4	2	Machine Learning pipeline: Model training - Supervised Learning: Regression - What is Regression? - Types of regression - Regularization in ML - Real-Life Applications - T - Linear regression Overview - Types - simple linear regression - Multiple linear regression - Polynomial linear regression - Applications of Linear Regression - T	2		2	Understanding Simple linear regression - Regression equation - Assumptions - Gradient descent - Setting up the regression problem Practice: student score based on study hours Problem statement: • Create a model to analyses the relation between CIE and SEE result • Create a model to analyze the relation between crop yield and rain fall rate Build linear regression model using - Stats model - Scikit learn	1		2
	2,3 ,5	2,3 ,4	3	Model Evaluation & testing Evaluate regression model: Evaluation Metric - Coefficient of Determination or R-Squared (R²) - Root Mean Squared Error (RSME) - Optimize regression model - Gradient descent	2		2	Cross-validation Why do we need Cross-Validation? Techniques - Hold out method - Leave One Out Cross-Validation - K-Fold Cross-Validation	1		2

	2,3 ,5	2,3 ,4	4	Multiple Linear Regression - Overview - Assumptions - Normal Equation - Applications Identification and collection of regression dataset - T Perform data exploration, preprocessing and splitting on datasets like - Boston housing price from sci-kit learn datasets - Cricket match result - past data - Performance of a cricket player - past data - Crop yield - past data	2		2	Implementation in python - Build regression model - Evaluate the model - To minimize the cost function			3
			5	Developmental Assessment				Assessment Review and corrective action			3
	2,3 ,5	2,3 ,4	6	Optimization and performance matrices for regression	2		3	Weekly Assignment			
7	2,3 ,5	2,3 ,4	1	Peer Review Mini Project Activity – Status review			4	Explore other regression algorithms - T Rebuild the model with other regression algorithms such as - Random Forest Regressor - Support Vector Regression - Lasso regression			3

							Evaluate and compare the performance of each.			
	2,3 ,5	2,3 ,4	2	Supervised learning – classification What is classification? Types: - Binary classification - Multi-Label Classification - Multi-Class Classification - Imbalanced Classification Classification models Applications - T Practice: Iris dataset from sci-kit learn Perform data exploration, preprocessing and splitting	2	2	Decision trees - What is decision tree? - Understanding Entropy, information gain - How to stop overfitting - Pruning DecisionTreeClassifier - How it works? - Understanding the parameters - Applications	3		
	2,3 ,5	2,3 ,4	3	Build decision tree-based model in python for like Breast Cancer Wisconsin (diagnostic) dataset from sci-kit learn Or any classification dataset from UCI , Kaggle		4	Evaluation Metrics for Classification - confusion matrix, - Accuracy - Precision and Recall - Specificity - F1-score - AUC-ROC ▪ How to compute ▪ How does it work	1		2

							▪ When to use			
	2,3 ,5	2,3 ,4	4	Evaluation Metrics for Classification- contd. Evaluation of decision tree model with different metrics		4	Hyper parameter tuning for DecisionTreeClassifier			3
			5	CIE 3 – Written and Practice Test			Assessment Review and corrective action			3
	2,3 ,5	2,3 ,4	6	Hyper parameter tuning for classification	2	3	Weekly Assignment			
8	2,3 ,5	2,3 ,4	1	Peer review Mini Project Activity – Status review		4	Logistic regression - Overview - Types - How does logistic regression work? - Assumptions - Understanding sigmoid function - Applications Practice: build Logistic regression model in python	1		2
	2,3 ,5	2,3 ,4	2	build Logistic regression model in python Evaluation and optimization of the model	2	2	Support Vector Machine - Introduction to SVM - How does it work? - Applications Practice: Build a SVM Model in python for Fish dataset from Kaggle	2		1
	2,3 ,5	2,3 ,4	3	Build a SVM Model in python		4	Ensemble Learning			3

				How to optimize SVM?				Introduction Basic Ensemble Techniques - Max Voting - Averaging - Weighted Average Advanced Ensemble Techniques - Stacking - Blending - Bagging - Boosting Explore and list the Ensemble Algorithms - T Random Forest - Introduction - How does it work? - Hyper parameters - Applications			
	2,3 ,5	2,3 ,4	4	Build Random Forest-based model in python for Breast Cancer Wisconsin (diagnostic) dataset from sci-kit learn Or dataset from UCI , Kaggle			4	Evaluation and optimization			3
			5	Development Assessment				Assessment Review and corrective action			3
	2,3 ,5	2,3 ,4	6	Comparison of classification algorithms with real world scenario	2		3	Weekly Assignment			

9	3	2,3	1	Peer review Mini Project Activity – Status review	4	Unsupervised learning – - What is unsupervised learning? - Common approaches - Challenges - Clustering Types Applications of unsupervised learning - T K-means – Working of K-means How to Choose the Right Number of Clusters?	2	1
	2,3,5	2,3,4	2	Implementation in python Evaluation Metrics - Inertia - Dunn Index Evaluate the model using mentioned metrics	1	3	Contd.	3
	2,3,5	2,3,4	3	Dimensionality Reduction - Importance of Dimension Reduction in machine learning Common methods to perform Dimension Reduction - T Dimensionality Reduction using PCA in python	2	2	Dimensionality Reduction using PCA in python	3
	5	4,5	4	MLOps - Overview	2	2	- Monitoring - Deployment	3

				- Why MLOps? - ML pipeline - Versioning - Model registry				- Model monitoring			
			5	CIE 4 – Written and Practice Test				Assessment Review and corrective action			3
	4	2,3	6	Compare various clustering techniques	2		3	Weekly Assignment			
10	1	3,4	1	Peer review <u>Mini Project Activity (2)</u> - Regression - Rebuild with deep learning model - Classification - Rebuild with deep learning model - Analyze the performance of ML and DL (Individual/ Team of 2) - Define Problem statement (solution to be presented in the 13th week CIE – 6) - Create project plan and product backlog - Create git repository for the project Work progress should be monitored weekly		4		Deep learning - Limitations of Machine Learning - What is deep learning? - Deep learning models - Deep Learning Applications - Deep learning frameworks Group discussion – T Future -Impact deep learning will likely to have on a variety of industries in the next few years. Environment setup - Local - Cloud <u>TOC - Deep Learning with TensorFlow Infosys</u> <u>Springboard (onwingspan.com)</u>	2		1
	2,3	3,4	2	Introduction to Neural Networks ▪ Understanding	2		2	Introduction to TensorFlow - What is TensorFlow?	1		2

				- Biological Neurons - Artificial neuron /Perceptron - Working of perceptron ▪ Neural network - Architecture - Working of NN - Forward propagation - Back propagation ▪ Activation function - Sigmoid - Tanh - ReLU - LeakyReLU ▪ Cost function - How to measure loss? - How to reduce Loss? - Gradient Descent Get data, and explore Eg. Stroke Prediction Dataset Kaggle or dataset from any other source Prepare data: Dealing with - missing values - Categorical values				- Why TensorFlow? - TensorFlow ecosystem - TensorFlow architecture - Program Elements in TensorFlow Keras - What is Keras? - Keras APIs – three programming models - Sequential Model - Functional API and - Model Subclassing - Keras layers - Custom Keras Layers TOC - Deep Learning with TensorFlow Infosys Springboard (onwingspan.com) TOC - TensorFlow for Beginners Infosys Springboard (onwingspan.com)			
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				- Labeled encoding - One hot coding Prepare data : Feature scaling with StandardScalar() or other method Dropping unnecessary features Data splitting Dealing with imbalanced dataset							
3	2,3,4	3	- Why do we have to flatten the input data? - Understand Keras Dense Layer - Overview - Parameters - Operation - Building Shallow Neural Network with Keras Dense Layer - Building Deep Neural Network with Keras Dense Layers - Create a complete end to end neural network model using Keras Sequential Model and Keras Layer API Eg. MNIST dataset (classify handwritten numerals) or fashion-MNIST dataset or dataset from other source	1		3	Keras optimizers Keras Metrics Keras Losses Create a complete end to end neural network – Contd. <u>TOC - Learning TensorFlow 2.0 Infosys Springboard (onwingspan.com)</u>	1		2	

	3	3,4	4	Keras - Callbacks - Commonly used callbacks Monitor neural network performance with TensorBoard - TensorBoard Basics - TensorBoard Setup Understand Model Behavior During Training Reduce overfitting with Dropout Layer	1		3	How to save trained model Local deployment with TensorFlow ModelServer			3
			5	Development Assessment				Assessment Review and corrective action			3
	2,3	3,4	6	Building deep learning model with TensorFlow and Keras for use cases	2		3	Weekly Assignment			
11	1,5	2,3,4	1	Peer Review Mini Project Activity – Status review			4	Natural Language Processing Understanding natural language processing NLP approaches – rule based, statistical NLP use cases How to use dictionary? Commonly used NLP tools & libraries Setup environment (spaCy or similar nlp package)	2		1
	2,3	2,3,4	2	Text processing tasks (Processing Words)	1			Spell Correction	1		2

				Document Assembler Annotation Tokenization - Sentence tokenization - Word tokenization - Visualize frequency distribution of words - Visualize with word cloud Stop word - Dropping stop words - Dropping punctuations			3	Normalization - Stemming - Lemmatization			
	2,3	3	3	Parts of speech tagging Named Entity Recognition	1		3	Vectorizer N-Gram	1		2
	2,3	2,3,4	4	TF-IDF Build a pipeline for text processing	1		3	Contd.			3
			5	CIE 5 – Written and Practice Test				Assessment Review and corrective action			3
	3	2,3	6	NLP – text summarization	2		3	Weekly Assignment			
12	1	2,3,4	1	Peer review Mini Project Activity – Status review				NLP use case – Sentiment Analysis (SA) What is sentiment analysis? Why is SA important? Business applications for SA How does sentiment analysis work? Transformers	1		2

							Conduct Sentiment analysis to classify movie reviews with			
	1,2,3,4,	2,3,4,6	2	NLP use case – Sentiment Analysis (SA) Contd.		4	- spaCy - TensorFlow and keras			
							Ethics in AI - Importance of AI ethics - Ethical challenges of AI - AI code of ethics Group Discussion: Discussion on the Ethics of AI Ethics of AI: Safeguarding Humanity Professional Education (mit.edu)	1		2
	5	2,3,4	3	Containers Why containers? What is a docker? How docker works? Components of docker - Docker container - Docker client - Docker daemon - Docker image - Docker registry Install docker on desktop and start the docker tool.	2	2	Publish the container in Registry			3

			<u>TOC - Containers & Images Infosys Springboard (onwingspan.com)</u> Docker file Docker image Commands to create docker file. Build docker image with docker file create docker container from docker image Run the docker container <u>TOC - Deploying and Running Docker Containers Infosys Springboard (onwingspan.com)</u> <u>TOC - Docker, Dockerfile, and Docker-Compose (2020 Ready!) Infosys Springboard (onwingspan.com)</u>							
5	3,4	4	Deployment strategies	1		3	Contd.			3
		5	Development Assessment				Assessment Review and corrective action			3
1,3	5	6	Using cloud service for MLOps	2		3	Weekly Assignment			

References

Sl. No	Description
1	Hands-On Artificial Intelligence for Beginners By Patrick D. Smith
2	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, By Aurélien Géron
3	Machine Learning with Python for everyone, Mark E Fenner
4	Hands on Data processing in Python , Joy Jafari
5	Deep Learning with TensorFlow2 and Keras , Antonio Gulli, Amita Kapoor, Sujith Pal
6	Cloud Computing, Concepts, Technology and Architecture by Thomas Erl
7	Khan Academy
8	Fundamentals of Data Visualization, Claus O. Wilke
9	Pro Git ,Scott Chacon, Ben Straub
10	Mathematics for Machine Learning, A. Aldo Faisal, Cheng Soon Ong, and Marc Peter Deisenroth
11	<u>Machine Learning, Pipelines, Deployment and MLOps Tutorial DataCamp</u>
12	<u>MLOps Python Tutorial for Beginners -Get Started with MLOps (projectpro.io)</u>

Cloud Computing and Cyber Security

Under Preparation.....

Internet of Things (IoT)

Pre-requisites

Knowledge of basic programming skills in python, networking concepts and basic electronic components

Course Outcomes

Upon completion of the course, the student shall be able to

CO1	Familiarize with Internet of Things Physical and Logical Design and Levels.
CO2	Understand IoT System Management with NETCONF-YANG
CO3	Understand Internet of Things, its hardware & software components and applications.
CO4	Interpret IoT Application Development
CO5	Discuss Security, Privacy and Governance in IoT
CO6	Explain IIoT and Case studies for IoT Design

Course Contents

UNIT - 1: Introduction to Internet of Things

8 Periods

IoT – Definition, characteristics, Physical design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT functional blocks, IoT communication Models, IoT communication API's IoT enabling Technologies – Wireless sensor networks, Cloud Computing, Big Data Analytics, Communication protocols, embedded systems. IoT Levels and Deployment templates – IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6, Popular IoT platforms, Domain specific IoTs

UNIT - 2: M2M, IoT System Management with NETCONF-YANG

6 Periods

M2M, Difference between IoT and M2M, SDN and NFV for IoT, Need for IoT Systems Management, Simple Network Management Protocol, Network Operator requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG

UNIT - 3: Elements of IoT

8 Periods

Overview of IoT components-basic building blocks of IoT, Hardware Components- IoT

Devices: Raspberry PI, Arduino; Sensors, Actuators, Smart objects and RFID, Software Components-Python Packages of interest for IoT, Networking Protocols

UNIT – 4: IoT Application Development

6 Periods

IoT Design Methodology, Linux on Raspberry PI, Raspberry PI interfaces, Programming Raspberry PI with Python, Data storage on cloud/local server

UNIT - 5: IoT Privacy, Security and Governance

6 Periods

Overview of Governance, Security and Privacy issues, Security, Privacy and Trust in IoT, IoT security life cycle, use of Blockchain in IoT security

UNIT - 6: IIoT and Case Studies on IoT Design

6 Periods

Industrial Internet of Things (IIoT), Differentiate IoT and IIoT, Case Studies-Home Automation, Urban Cities, Environment, Agriculture, Health Care, Transportation.

Reference Books

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
4. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill

Suggested E-learning references

1. <https://internetofthingsagenda.techtarget.com/>
2. <https://dzone.com/iot-developer-tutorials-tools-news-reviews>
3. <https://blog.bosch-si.com/>
4. <https://www.hackster.io/>
5. <https://www.libelium.com/>
6. <https://www.ibm.com/blogs/internet-of-things/>
7. <https://azure.microsoft.com/en-us/blog/topics/internet-of-things/>
8. <https://blog.arduino.cc/>

9. <https://www.raspberrypi.org/blog/>
10. www.lemalabs.com/iot

BLOCK CHAIN TECHNOLOGY

OBJECTIVES:

- To understand the concepts of block chain technology
- To understand the consensus and hyper ledger fabric in block chain technology.

OUTCOMES:

- State the basic concepts of block chain
- Paraphrase the list of consensus and Demonstrate and Interpret working of Hyper ledger Fabric
- Implement SDK composer tool and explain the Digital identity for government

UNIT - I

History: Digital Money to Distributed Ledgers -Design Primitives: Protocols, Security, Consensus, Permissions, Privacy- : Block chain Architecture and Design-Basic crypto primitives: Hash, Signature- Hash chain to Block chain-Basic consensus mechanisms.

UNIT - II

Requirements for the consensus protocols-Proof of Work (PoW)-Scalability aspects of Block chain consensus protocols: Permissioned Block chains-Design goals-Consensus protocols for Permissioned Block chains.

UNIT - III

Decomposing the consensus process-Hyper ledger fabric components-Chain code Design and Implementation: Hyper ledger Fabric II:-Beyond Chain code: fabric SDK and Front End-Hyper ledger composer tool.

UNIT - IV

Block chain in Financial Software and Systems (FSS): -Settlements, -KYC, -Capital markets-Insurance- Block chain in trade/supply chain: Provenance of goods, visibility, trade/supply chain finance, invoice management/discounting.

UNIT - V

Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system / social welfare systems: Block chain Cryptography: Privacy and Security on Block chain.

TEXT BOOKS:

1. Mark Gates, “*Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money*”, Wise Fox Publishing and Mark Gates 2017.
2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, “*Hands-On Block chain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer*”, 2018.
3. Bahga, Vijay Madiseti, “*Block chain Applications: A Hands-On Approach*”, Arshdeep Bahga, Vijay Madiseti publishers 2017.

REFERENCE BOOKS:

1. Andreas Antonopoulos, “*Mastering Bitcoin: Unlocking Digital Crypto currencies*”, O'Reilly Media, Inc. 2014.
2. Melanie Swa, “*Block chain*”, O'Reilly Media 2014.

WEB REFERENCES:

- NPTEL & MOOC courses titled blockchain technology
- blockgeeks.com/guide/what-is-block-chain-technology
- <https://nptel.ac.in/courses/106105184/>

DRONE TECHNOLOGY & ROBOTICS

COURSE OBJECTIVES

The course should enable the students to:

1. Learn concepts of Drone and Drone Technology
2. Impart knowledge of AI and Drone technology for various domains applications
3. To make the students to understand the basic concepts of UAV drone systems.
4. To introduce the stability and control of an aircraft

COURSE OUTCOMES

1. Design, build and program simple autonomous robots.
2. Implement standard signal processing and control algorithms.
3. Ability to design UAV drone system
4. To understand working of different types of engines and its area of applications
5. To understand static and dynamic stability dynamic instability and control concepts

UNIT-I- Robotics, Sensors and Signal processing Robotics:

Robotics and AI, Embedded Systems, Agent-Task-Environment model, Embodied Systems, Synthetic approaches to science Sensors and signal processing Common sensors and their properties, 1D signal processing, Vision

UNIT-II- AI and the Internet of Things:

AI and the Internet of Things: Real World Use-Cases: Automated vacuum cleaners, like that of the iRobot Roomba, Smart thermostat solutions, like that of Nest Labs

UNIT-III- Introduction to Drones:

Introduction to Drones: Introduction to Unmanned Aircraft Systems, History of UAV drones, classification of drones, System Composition, applications

UNIT-IV- Design of UAV Drone Systems:

Design of UAV Drone Systems: Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects-India Specific, Design for Stealth.

UNIT-V- Avionics Hardware of Drones:

Avionics Hardware of Drones: Autopilot, AGL-pressure sensors servos-accelerometer –gyros-actuators-power supply-processor, integration, installation, configuration.

TEXT BOOKS

1. Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc., 1998.

REFERENCE BOOKS

1. The Art of Robotics: An introduction to engineering, F Martin, Addison-Wesley, forthcoming

DATA ANALYTICS

I. RATIONALE

Data Analytics uses statistical and computational methods to analyze data, aiding informed decision-making. Excel dashboards effectively present vital data at a glance, enhancing user interactivity. A Data Analyst collects, cleans, and visualizes Datasets to solve problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Perform Data Analytics in various business domains for improved decision making

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 - Elaborate the fundamental concepts of Data Analytics.

CO2 - Apply appropriate statistical techniques to analyze and interpret complex Datasets.

CO3 - Analyze numerical data by creating pivot table.

CO4 - Represent data in terms of various types of charts.

CO5 - Visualize the data using a Python library.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Course Content	Hours
1	Unit - I Introduction to Data Analytics 1.1 Data Analytics: An Overview, Importance of Data Analytics 1.2 Types of Data Analytics: Descriptive Analysis, Diagnostic Analysis, Predictive Analysis, Prescriptive Analysis, Visual Analytics 1.3 Life cycle of Data Analytics, Quality and Quantity of data, Measurement 1.4 Data Types, Measure of central tendency, Measures of dispersion 1.5 Sampling Funnel, Central Limit Theorem, Confidence Interval, Sampling Variation	
2	Unit - II Statistical Analysis 2.1 Graphical techniques, box plot, skewness and kurtosis, Descriptive Stats 2.2 Correlation and Regression, Data Cleaning 2.3 Imputation Techniques 2.4 Anova and Chi Square 2.5 Scatter Diagram 2.6 Estimation and Hypothesis Testing 2.7 Sampling Distributions, Counting 2.8 Probability, Probability Distributions	
3	Unit - III Data Analytics with Excel 3.1 Excel Dashboard: Tables and Data Grids, Dynamic Filters and Controls, Trend Analysis and Forecasting 3.2 Pivot Tables: Creating a Pivot Table Specifying Pivot Table Data 3.3 Changing a Pivot Tables, Calculation Filtering and Sorting a Pivot Table 3.4 Creating a Pivot Chart, Grouping Items 3.5 Updating a Pivot Table, formatting a Pivot Table using Slicers	

4	Unit - IV Data Visualization 4.1 Creating a Simple Chart, Charting Non-Adjacent Cells 4.2 Creating a Chart Using the Chart Wizard, Modifying Charts, Moving an Embedded Chart, Sizing an Embedded Chart 4.3 Changing the Chart Type, Changing the Way Data is Displayed, Moving the Legend 4.4 Formatting Charts, Adding Chart Items, Formatting All Text, Formatting and Aligning Numbers, Formatting the Plot Area, Formatting Data Markers 4.5 Pie Charts, Creating a Pie Chart Moving the Pie Chart to its Own Sheet Adding Data Labels, Exploding 1.6 a Slice of a Pie Chart	
5	Unit - V Data Visualization using Python 5.1 Overview of Matplotlib and its role in data visualization, Installing and setting up Matplotlib in Python 5.2 Basic plotting with Matplotlib, Line plot, Scatter plots, Bar charts, Histograms, adding titles, labels, and legends to plots 5.3 Changing figure size and aspect ratio, Customizing axes (limits, ticks, and labels) 5.4 Exporting and Saving Visualizations: Saving plots in different formats (PNG, PDF, SVG), Adjusting the resolution and quality of saved plots, creating interactive visualizations using Matplotlib widgets	

SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Jinjer Simon	Excel Data Analysis: Your visual blueprint for analyzing data, charts, and PivotTables	Wiley Publication Edition: 3rd ISBN: 978- 0-470-59160-4
2	A. J. Smalley	Data Analysis with Excel	SAGE Publications Edition: 1st, 2007 ISBN 10: 0070139903 / ISBN 13: 9780070139909
3	Fabio Nelli	Python Data Analytics: With Pandas, NumPy, and Matplotlib	Apress publication ISBN-13 :978-1484239124 ISBN-13978-1484247372
4	Jake VanderPlas	Python Data Science Handbook	Shroff/O'Reilly Publication ISBN-10-9355422555 ISBN-13-978-9355422552
5	Business Analytics with MindTap	Jeffrey D. Camm James J Cochran Michael J. Fry Jeffrey W. Ohlmann	Cengage Learning India Pvt. Ltd. Publication Edition:4th ISBN: 9789360533533

V. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://spreadsheetpoint.com/excel/dashboard-in-excel/	Advance Excel
2	https://www.javatpoint.com/how-to-create-a-dashboard-in-excel	Excel Dashboard
3	https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel	Data Visualization
4	https://www.freecodecamp.org/news/introduction-to-data-visualization-using-matplotlib/	Matplotlib in Python
5	https://archive.nptel.ac.in/courses/106/107/106107220/	Introduction to data analytics