Curriculum

of

Diploma Programme

in

Mining Engineering

State Board of Technical Education (SBTE)
Bihar

Semester – IV

Teaching & Learning Scheme

Board of Study	Course Codes	Course Titles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2447401	**Mine Legislation**	2	1	-	2	5	4
	2447402	**Mine Surveying-2**	3	-	4	2	9	6
	2447403	**Advance Mining Geology**	3	-	4	2	9	6
	2447404	**Mine Machineries**	3	-	4	2	9	6
	2447405	**Mine Environment & Pollution Control**	3	-	4	2	9	6
	2452107	**Basics of Liberal Art (Non-Exam Course)** (FTS, GT, TE, ME)	1	-	-	-	1	1
	2400408	**Employability Skills Development** (Common for All Programmes)	1	-	-	-	1	1
Total			**16**	**1**	**16**	**10**	**43**	**30**

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

Semester - IV

Assessment Scheme

Board of Study	Course Codes	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2447401	**Mine Legislation**	30	70	20	30	-	-	150
	2447402	**Mine Surveying-2**	30	70	20	30	20	30	200
	2447403	**Advance Mining Geology**	30	70	20	30	20	30	200
	2447404	**Mine Machineries**	30	70	20	30	20	30	200
	2447405	**Mine Environment & Pollution Control**	30	70	20	30	20	30	200
	2452107	**Basics of Liberal Art (Non-Exam Course)** (FTS, GT, TE, ME)	25	-	-	-	-	-	25
	2400408	**Employability Skills Development** (Common for All Programmes)	25	-	-	-	-	-	25
Total			**200**	**350**	**100**	**150**	**80**	**120**	**1000**

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

A) Course Code : **2447401 (T2447401/S2447401)**

B) Course Title : Mine Legislation

C) Pre- requisite Course(s) :

D) Rationale :

Diploma holders in Mining Engineering must know the Mines Act, Mine Rules and Mining Regulations for proper regulation of the mine. This course has been developed with the objective of enabling students to acquire knowledge of the latest applicable laws in the mining industry to control possible occurrences of accidents and to comply with the statutory framework on the mining industry. Students will be made aware and educated in this direction through various teaching methods, mine visits, projects and past case studies.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

CO-1 Use the principles of Mining Legislation in Indian mines.

CO-2 Apply knowledge of Mines Act-1952 for the implementation of rules and regulations during their job.

CO-3 Use knowledge of Mine Rules 1955 for the social benefit of mine workers.

CO-4 Implement the regulations to provide a safe working atmosphere to the workers.

CO-5 Apply the statutory concepts of ventilation and illumination in proper functioning of Metalliferous mines according to the Metalliferous Mines Regulations 1961.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Develop-ment of Solutions	**PO-4** Engineer-ing Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Manageme nt	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	3	2	-	-	2		
CO-2	3	2	-	2	1	-	3		
CO-3	3	3	2	2	3	2	2		
CO-4	3	3	-	2	2	3	3		
CO-5	3	-	3	3	-	3	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Mining Engineering	2447401	Mine Legislation	02	01	-	02	05	04

Legend:

Cl: Classroom Instruction (includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1x CI hours) + (0.5x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Codes	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Mining Engineering	2447401	Mine Legislation	30	70	20	30	-	-	150

Legend:

PTA : Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA : Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA : Terminal & Self Learning Assessment (include assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities, etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2447401

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Use relevant rule/ regulations/ bye-laws in a given situation. *TSO 1b.* Formation of Mining board and committee for proper regulation of the mines. *TSO 1c.* Explain Prevention of Illegal Mining with reference to Bihar Minerals rules,2019	**Unit-1.0 General Principles of Mining Law, Development of Mining Legislation** 1.1 Preliminary Definitions. 1.2 Development of Mining laws of India. 1.3 Mining Boards and committees. 1.4 National Mineral Policy. 1.5 Bihar Minerals (Concession, Prevention of Illegal Mining, Transportation & Storage) Rules, 2019	**CO-1**
TSO 2a. Describe members of various committees under The Mine Act 1952. *TSO 2b.* Identify the importance of implementing health and safety provisions. *TSO 2c.* Identify the structure, powers and functions of committees formed under the Act	**Unit 2.0 The Mines Act ,1952** 2.1 Preliminary Definitions 2.2 Various Committees. 2.3 Provisions to health and safety. 2.4 Hours and Limitations of employment. 2.5 Leave with wage and overtime 2.6 Regulation, Rules and Bye-laws 2.7 Amendment upto 2023	**CO-2**
TSO 3a. Identify the importance of initial medical examination and periodical medical examination. *TSO 3b.* Write Provisions related to Workmen's inspector and safety committee. *TSO 3c.* Explain different legal acts related to workmen in mines *TSO 3d.* Enlist the various notice given to mines on violation of rules.	**Unit 3.0 The Mine Rules, 1955** 3.1. Medical Examination of persons employed or to be employed in mines. 3.2 Workmen's inspector and safety committee 3.3 Health and sanitation provisions 3.4 First aid medical appliances. 3.5 Employment of person 3.6 Leave with wages and overtime 3.7 Welfare amenities and welfare officer. 3.8 Registers, Notices & Returns. 3.9 Amendment in Mine Rules, 1955 upto date 2023.	**CO-3**
TSO 4a. Describe the importance of vocational training. *TSO 4b.* Explain the provisions related to rescue and recovery operations. *TSO 4c.* Use the rescue apparatus on occurrence of mine fire. *TSO 4d.* Write the IER rule related to mining field.	**Unit 4.0 The Mine V.T Rules, 1966** **The Mine Rescue Rules 1985, The I.E.R 1956,** 4.1. Preliminary definitions. 4.2 General Vocational Training, Refresher training. 4.3 Training of special category of employees Training Centre and arrangements. 4.4 Rescue Stations and rescue rooms 4.5 Duties and responsibilities of Superintendents. 4.6 Rescue Organization and equipment. 4.7 Provisions of I.E.R related to mining activities.	**CO-4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5a. Describe safe working practices using MMR,1961. *TSO 5b.* Write duties and responsibilities of workmen.	**Unit 5.0 The Metalliferous Mines Regulations, 1961** 5.1 Preliminary definitions. 5.2 examinations and certificates of competency. 5.3 Duties and responsibilities of workmen, competent persons and officials. 5.4 provisions related to plans and sections, ladders, transport of men and mine workings. 5.5 Amendment in MMR,1961 upto date 2023.	**CO-5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

L) Suggested Term Work and Self Learning: S2447401 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

- Prepare a historical report on development of mining laws in India
- Prepare a report on implementation of provisions of mines act 1952 in Indian mines.
- Prepare a report on implementation of mine rules 1955 in Indian mines.
- Draw a layout of lamp room for a mine with 1000 employees.

c. Other Activities:

d. Seminar Topics:

- Importance of Bihar Mineral Rules 2019.
- Hours and Limitations of employment according to Mines Act 1952 in mines.
- Regulation, Rules and Bye-laws.
- Different Notices & Returns used in mines.
- Role of VT center in mines.
- Rescue organization and equipment used therein.
- Provisions of I.E.R related to mining field.

1. Visits: Visit a nearby vocational training and RRRT center and prepare a detailed report on it.

2. Self-learning topics:

- Study the latest circulars issued by DGMS.
- Development of Mines act in Indian mines.
- Difference between Act, Rule and Regulation.
- Study the applicability of provisions of mines act in nearby mine.
- Study the registers, notices and reports maintained in office of any nearby mine.
- Study the causes of accidents in a mine.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	20%	20%	-	-
CO-2	20%	20%	20%	20%	20%	-	-
CO-3	15%	15%	15%	20%	20%	-	-
CO-4	25%	25%	25%	20%	20%	-	-
CO-5	25%	25%	25%	20%	20%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	-	-
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 General Principles of Mining Law, Development of Mining Legislation	6	CO-1	10	3	3	4
Unit-2.0 The Mines Act, 1952	10	CO-2	18	5	5	8
Unit-3.0 The Mine Rules, 1955	12	CO-3	16	4	4	8
Unit-4.0 The Mine V.T Rules, 1966 The Mine Rescue Rules 1985, The I.E.R 1956,	10	CO-4	14	4	4	6
Unit-5.0 The Metalliferous Mines Regulations, 1961	10	CO-5	12	4	4	4
Total	**48**	**-**	**70**	**20**	**20**	**30**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested AssessmentTable for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	The Metalliferous Mine Regulations,1961	DGMS	Lovely Prakashan
2.	The Mine Rules,1955	DGMS	Lovely Prakashan
3.	The Mines Act,1952	DGMS	Lovely Prakashan
4.	The Indian Electricity Rule, 1956	DGMS	Lovely Prakashan
5.	The Mine V.T Rules, 1966 The I.E.R	DGMS	Lovely Prakashan
6.	The Mine Rescue Rules 1985	DGMS	Lovely Prakashan

(b) Online Educational Resources:

1. www.dgms.net
2. www.dgms.gov.in
3. https://www.youtube.com/watch?v=mvwx4MREXu8.
4. https://www.indiacode.nic.in/bitstream/123456789/2168/3/A1952-35.pdf
5. https://indiankanoon.org/doc/70420142/

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

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A) Course Code : 2447402(T2447402/P2447402/S2447402)

B) Course Title : Mine Surveying -2

C) Prerequisite Course(s) :

D) Rationale :

Diploma Holders in Mining Engineering are expected to use various surveying methods applied in mines for preparation of various types of plans and sections used in open cast as well as underground surveys. To meet the requirements of mine surveying this course has been developed to provide knowledge of the use of theodolite, triangulation survey, correlation survey, plan and section preparation and dip and strike problems.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

- **CO-1** Carryout theodolite survey in a given situation.
- **CO-2** Apply the basic principles of Triangulation Survey to locate features and to calculate area of a given site.
- **CO-3** Conduct a correlation survey on a given site.
- **CO-4** Prepare a mine plan and section of given mine features.
- **CO-5** Solve dip, strike and borehole related problems using given data.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Develop-ment of Solutions	**PO-4** Engineer-ing Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Manageme nt	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	3	2	-	-	2		
CO-2	3	2	-	2	-	-	-		
CO-3	3	3	-	2	3	-	-		
CO-4	3	3	-	2	-	-	-		
CO-5	3	-	3	3	-	3	2		

Legend: High (3),Medium (2),Low(1) and No mapping(-)

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Legend:

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Mining Engineering	2447402	Mine Surveying-2	30	70	20	30	20	30	200

Legend:

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PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Terminal & Self Learning Assessment (include assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities, etc.

Note:

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I) Course Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2447402

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Define the various technical terms related to theodolite. *TSO 1b.* Explain the procedure of theodolite survey. *TSO 1c.* Check and perform permanent adjustment of a given theodolite *TSO 1d.* Describe the procedure to measure the direct and deflection angles. *TSO 1e.* Identify and remove the error in theodolite through calibration.	**Unit-1.0 Theodolite Survey** 1.1 Definitions and various technical terms related to theodolite . 1.2 Digital Theodolite, Transit Vernier theodolite, Graduation system of a vernier theodolite 10 sec, 20 sec least count 1.3 Reading of main and vernier scale on horizontal and vertical plate. 1.4 Temporary and Permanent adjustment of a theodolite. 1.5 Methods of measuring horizontal angles and vertical angles –Ordinary , repetition and reiteration method 1.6 Use theodolite for measuring a magnetic bearing, prolong a line, ranging a line 1.7 Measuring direct and deflection angles 1.8 Errors in theodolite work and their removal	**CO-1**
TSO 2a. Explain the procedure to conduct a Triangulation survey. *TSO 2b.* Calculate the coordinates. *TSO 2c.* Describe the errors occurred during surveying. *TSO 2d.* Describe Total station with the help of neat sketch. *TSO 2e.* State parameters for the selection of EDM and relevant equipment.	**Unit-2.0 Triangulation Surveying and EDM** 2.1 Definition; Reconnaissance; Selection of signals and stations; 2.2 Triangulation system with primary, secondary and tertiary orders; Measurement of base line and angles; 2.3 Booking of observations; Auxiliary stations; Satellite stations; 2.4 Computation; Calculation of coordinates; Errors and their distribution and plotting. 2.5 Electronic Distance Measurement (EDM) -Principle of measurement, types , corrections, selection of equipment , total station.	**CO-2**
TSO 3a. Describe the purpose of correlation survey. *TSO 3b.* Select the appropriate method for correlation of surface and underground surveys through - adits, inclines, and shafts. *TSO 3c.* Write the Precautions of correlation survey.	**Unit-3.0 Correlation Survey** 3.1 Purpose of correlation survey. 3.2 Methods of correlation of surface and underground surveys through - adits, inclines, and shafts 3.3 Correlation by magnetic needle; Precautions and accuracy, Surveying for tunnels and open pits, 3.4 Use of Gyro theodolite.	**CO-3**
TSO 4a. Define plan and section. *TSO 4b.* Write the types of plan used in mines. *TSO 4c.* List the various symbol used in mine plan. *TSO 4d.* Use the planimeter to determine the area of an arbitrary two-dimensional shape. *TSO 4e.* Describe the procedure for Enlargement & reduction of plans.	**Unit-4.0 Plans and Section** 4.1 Plans and Sections: General and legal requirements of mine plans; 4.2 Types of plans; Symbols used in mine plans; preparation of plans & sections; 4.3 Plotting of traverse; limits of accuracy digital Planimeter and its uses; 4.4 Enlargement & reduction of plans.	**CO-4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	4.5 Use of ediograph, and pentagraph, Mines Regulations concerning above topics.	
TSO 5a. Write the purpose of bore hole surveying. *TSO 5b.* Derive relation between true, apparent dip and angle between them. *TSO 5c.* Apply the principles of borehole surveying. *TSO 5d.* Solve dip strike problems of given data.	**Unit-5.0 Dip and strike Problem** 5.1 Purposes of bore hole surveying. 5.2 Relation between true dip, apparent dip and angle between them. 5.3 Borehole Surveying: Laser Types, characteristics and mining applications of Laser. 5.4 Clinometer and its use. 5.5 Numerical problem on dip, strike and bore hole surveying.	**CO-5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2447402

Practical/Lab Session Outcomes(LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Select suitable size of theodolite for a given mine site. *LSO 1.2.* Write steps for temporary and permanent adjustment.	1.	Testing and adjustment of given theodolite.	**CO-1**
LSO 2.1. Use of theodolite to measure vertical angle	2.	Measure vertical angles to determine alculate height of tower/headgear.	**CO-1**
LSO 5.1. Apply triangulation survey to measure given mine site.	3.	Measure a base line of given 200 m length and prolong it upto 600m.	**CO-1**
LSO 4.1. Use of Total station to measure co-ordinates.		Measure the distances, co-ordinates and R.L. of given points with reference to given data	**CO-2**
LSO 5.1. Apply Weissbach Triangle method to perform Correlation survey.	5.	Correlation survey by Weissbach Triangle method	**CO-3**
LSO 6.1. Apply the principal of correlation survey.	6.	Correlation survey by single shaft and double shaft or incline.	**CO-3**
LSO 7.1. Use the suitable symbols of various mines features in mine plan ina given situation.	7.	Study and preparation of a mine plan according to mining regulation.	**CO-4**
LSO 8.1. Use of planimeter to measure area of given irregular site.	8.	Digital Planimeter to measure area of irregular site	**CO-4**
LSO 9.1. Use the clinometers to measure the angle from the ground, in a right - angled triangle.	9.	Amount of true dip and direction using given data.	**CO-5**
LSO 10.1. Determine the apparent dip and true dip using given data.	10.	Determine the apparent dip and true dip from the given data.	**CO5**

L) Suggested Term Work and Self Learning: S2447402 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Prepare a traverse survey report of your institution's campus using theodolite.
2. Prepare the Surface plan.
3. Prepare a 3D model to show true dip, apparent dip and strike based on bore hole survey data.

c. Other Activities:

d. Seminar Topics:

- Perform temporary and permanent adjustment of Transit Vernier theodolite at given site.
- Write the errors in theodolite work.
- Use of Total station in Indian mines.
- General and legal requirements for preparing a mine plans.
- Principles of Borehole Surveying.

1. **Visits:** Visit nearby mines and prepare a report on it.

2. **Self-learning topics:**
   - Collect information regarding latest level instruments.
   - Study the latest total station used in Indian mines.
   - Find the application of triangulation survey in field of civil works
   - Find the application of total station in civil works.
   - Study the correlation survey work in nearby mines.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	15%	15%	-	25%	20%	20%
CO-2	20%	10%	10%	25%	25%	10%	20%
CO-3	20%	15%	15%	25%	20%	15%	20%
CO-4	20%	30%	30%	25%	20%	15%	20%
CO-5	20%	30%	30%	25%	10%	40%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Theodolite Survey	10	CO-1	12	3	3	6
Unit-2.0 Triangulation Surveying and EDM	10	CO-2	16	3	5	8
Unit-3.0 Correlation Survey	8	CO-3	14	3	3	8
Unit-4.0 Plans and Section	10	CO-4	14	4	4	6
Unit-5.0 Dip and Strike Problem	10	CO-5	14	2	4	8
Total	**48**	**-**	**70**	**20**	**19**	**31**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested AssessmentTable for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Testing and adjustment of given theodolite.	CO-1	40	50	10
2.	Measure vertical angles to determine alculate height of tower/headgear.	CO-1	40	50	10
3.	Measure a base line of given 200 m length and prolong it upto 600m.	CO-1	30	60	10
4.	Measure the distances, co-ordinates and R.L. of given points with reference to given data	CO-2	30	60	10
5.	Correlation survey by Weissbach Triangle method	CO3	30	60	10
6.	Correlation survey by single shaft and double shaft or incline.	CO-3	30	60	10
7.	Study and preparation of a mine plan according to mining regulation.	CO-4	30	60	10
8.	Digital Planimeter to measure area of irregular site	CO-4	40	50	10
9.	Amount of true dip and direction using given data.	CO-5	40	50	10
10.	Determine the apparent dip and true dip from the given data.	CO-5	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strateges may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology(ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	Theodolite	Telescope: Length 157 mm Imaging Erect Objective Aperture 45 mm Magnification 30X Field of View 1°30' Resolving Power 3" Minimum Focus Distance 1.4 m Stadia Ratio 100 Stadia Constant 0 Angle Measurement Method Absolute Encoding Diameter of the Circle (Vhz) 79mm Minimum Reading 1"/5"/10"/20" (Selectable) Accuracy 2" Detection Method Horizontal : Dual, Vertical : Dual Display Specifications : Screen Type 2 sides, segment LCD in two lines Auto Vertical Compensator System Liquid-electric detection/plate level Range +/- 3' Accuracy 1" Optical Plummet Imaging Erect Magnification 3X Field of View 5° Focusing Range 0.5m ~ 8 Physical Characteristics Operation Environment -20° ~ + 45° Power Supply 6V Rechargeable Ni-MH Battery & AA Battery Size (in mm) 165 x 318 x 157 mm Weight (in g) 4300	1-6
2.	Total Station with stand.	ANGLE MEASUREMENT (b) Angle Accuracy as per DIN 18723 1" (a) Least Count 0.1" TELESCOPE (a) Telescope Magnification 30X (b) Field view 1°30'(2.7 m at 100m) (c) Minimum Focussing Distance 1.7 m DISTANCE MEASUREMENT WITH PRISM (a) Using Long Range EDM 5000 m with single prism (b) Accuracy 1 mm + 2 ppm (c) Least Count .1 mm DIGITAL LEVEL Graphical display on screen with display resolution of 1" PLUMMET (a) Optical/Laser Plummet Inbuilt Laser/Optical Plummet from the Instrument. DRIVES (a) Horizontal & Vertical Drives Should have Endless movements with friction drives. DISPLAY Resolution Should have Full QVGA 340*240 pixels resolution identical display on both sides Illumination Capability to illuminate display for day and night operation DATA OUTPUTS Should be capable of outputting the data In all standard formats including DXF and other customized formats directly from the total station. SURVEY DATA Graphical Display of the surveyed points, Lines & Areas with Codes & Symbols KEY BOARD Type Alphanumeric keyboard on instrument on both sides UPLOAD OPTIONS DXF, shape files Battery -Lithium Ion Batteries Operation Time Should be minimum of 6-8 hours Charging Time Less than 1 hour 21 WEIGHT Less than 6 Kg	1-6
3.	Digital Planimeter	Measuring by 6-digit pulse count enables to measure 100 times larger accumulative area than ordinary planimeters, Accuracy- Up to 2"/hr (40 mm/hr)	7, 8
4.	Clinometer	Item Dimensions LxWxH 7.6 x 5.1 x 7.6 Centimeters, memory stick-1.	9-10

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Surveying vol-I and II	B.C. Punimia	Laxmi Publications
2.	Mine surveying and leveling vol-1, 2, 3	S. Ghatak	Coal field publishers. 7th ed.
3.	Surveying and levelling volume 1	T.P Kanetkar	Pune vidyarthi grih prakashan
4.	Surveying and levelling volume 2	T.P Kanetkar	Pune vidyarthi grih prakashan
5.	Advanced Surveying	B. Ghosh	Tata mcgraw hill 1st 1987

(b) Online Educational Resources:

1. https://www.teachmint.com/tfile/study_material/mininggyangate2022/minesurveying/1)introduction(survey)pdf/a9d78e1b-b0ef-4ba7-9887-1e4669a5bde9
2. https://www.youtube.com/watch?v=pGreWWpDIwg
3. https://www.gim-international.com/content/article/surveying-in-the-mining-sector
4. https://www.youtube.com/watch?v=37P5YVOjpE4
5. https://www.youtube.com/watch?v=vXAr0-aEnZk
6. https://nptel.ac.in/courses/105107122

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

Lab Manuals

******

A) Course Code **: 2447403(T2447403/P2447403/S2447403)**

B) Course Title **:** Advance Mining Geology

C) Pre- requisite Course(s) **:**

D) Rationale **:**

Diploma holders in Mining Engineering are expected to work in the mining sector for development of mines and estimation of ore reserves to achieve optimum production. This course enables students to learn how to identify different types of deposits of coal and other metals that are technically, economically viable for mining operations. Students will be introduced to various methods of exploration of mineral deposits in India, their mode of occurrence, common ore deposits; Various fossil fuel reserves i.e. petroleum and coal; It is very essential for a mining student to go through the technical aspect of deposits in the earth before their extraction to deal with the problems associated with mining extraction methods.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

CO-1 Apply the principles of stratigraphy to determine the origin and distribution of ore deposits.
CO-2 Examine the formation and control of ore reserves for further decisions related to mining.
CO-3 Select mineable ore and mineral with their occurrence & distribution in India.
CO-4 Analyze the formation of coal and petroleum resources in India.
CO-5 Use appropriate prospecting method(s) to search suitable ore deposit.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Develop-ment of Solutions	**PO-4** Engineer-ing Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Managemen t	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	3	2	-	-	2		
CO-2	3	2	-	2	2	-	-		
CO-3	3	3	-	2	3	2	2		
CO-4	3	3	2	2	-	-	-		
CO-5	3	-	3	3	-	3	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Mining Engineering	2447403	Advance Mining Geology	03	-	04	02	09	06

Legend:

Cl: Classroom Instruction (includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1x CI hours) + (0.5x LI hours) + (0.5xNotional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Codes	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Mining Engineering	2447403	Advance Mining Geology	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Terminal & Self Learning Assessment (include assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities, etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2447403

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain Principles of stratigraphy. *TSO 1b.* Write brief report on Geological Time scale. *TSO 1c.* Explain geographical distribution of rock formation in India. *TSO 1d.* List different types of minerals found in India with suitable data *TSO 1e.* Describe Gondwana system of rock formation. *TSO 1f.* Describe mode of occurrence and use of fossils.	**Unit-1.0 Indian Stratigraphy** 1.1 Definitions, Principles of stratigraphy, Principle of correlation, Geological units, 1.2 Geological Time scale, 1.3 Physiographic division of India general geological information. i. Peninsular India, ii. Indo-gangetic plan iii. Archaean system – iv. Cuddapah system – vindhyan system 1.4 Gondwana system - A brief account of the gondwana rocks, Fossil contents and economic, Importance of Gondwana rocks. 1.5 Fossils – Index fossils, Mode of occurrence and preservation, Fosssilisation and use of fossils.	**CO-1**
TSO 2a. Define ore and mineral. *TSO 2b.* State the classification of ore deposit. *TSO 2c.* Describe the formation of hydrothermal ore deposits. *TSO 2d.* Explain the process of placer deposit. *TSO 2e.* Explain control of ore deposition.	**Unit-2.0 Ore Deposit** 2.1 Definition of ore, mineral, Gangue and Tenor of ores, 2.2 Classification of ore deposits- 2.2.1 Magmatic ore deposit 2.2.2 Pegmatic ore deposits, 2.2.3 Hydrothermal ore deposits 2.2.4 Mechanical concentration deposits (Placer deposits) 2.2.5 Oxidation and super gene sulphide enrichment ore deposits, 2.3 Control of ore deposition – Structural controls, Physical and chemical controls.	**CO-2**
TSO 3a. Identify the different ores of minerals. *TSO 3b.* Explain different type of ores found in India . *TSO 3c.* Prepare the industrial use of various ore in detail. *TSO 3d.* Use the Mohs scale to measure the hardness of given rock sample.	**Unit-3.0 Ore Deposits of India** 3.1 A brief account of the origin, occurrence and distribution of ores in India –Iron ore, Manganese ore, Copper Ore, Lead and Zinc Ores, Aluminium ore, Chromite. 3.2 Metallogenic epochs. 3.3 Mohs scale.	**CO-3**
TSO 4a. Explain the theories of coal formation. *TSO 4b.* Enlist the types of coal. *TSO 4c.* Identify the banded constituents of bituminous coal. *TSO 4d.* Explain the favorable geological structures	**Unit-4.0 Fossil Fuels** 4.1 **Coal**- definition, Origin of coal – In situ theory, Drift theory, 4.1.1 Formation of coal, Classification of coal – Peat, Lignite, Bituminous & its banded	**CO-4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
for petroleum oil pool. *TSO 4e.* Enlist the petroleum deposit in India.	constituents and Anthracite, 4.1.2 Chemical properties of coal, 4.1.3 Occurrence of coal in India with special reference to C.G. 4.2 **Petroleum -**Origin of petroleum, Oil traps, types of oil traps, Petroleum deposits of India.	
TSO 5a. Define prospecting. *TSO 5b.* Describe the different prospecting methods. *TSO 5c.* Select appropriate method of prospecting at given situation. *TSO 5d.* Write the application of GPS and GIS in mining field.	**Unit-5.0 Field work and Prospecting** 5.1 Field Equipments, Method of field work. 5.2 Prospecting- Purpose, methods-Airborne and Ground prospecting methods. 5.3 Geochemical survey for oil and gas. 5.4 Application of DGPS, GPS, GIS. in Mining fields.	**CO-5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2447403

Practical/Lab Session Outcomes(LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use the various symbol to prepare a geographical map for ore deposits. *LSO 1.2.* Prepare a geographical map showing mineral deposits in Bihar/ nearby locations.	1.	Identify the location of mineral / ore based on the importance of given location with their mineral / ore deposit.	**CO-1**
LSO 2.1. Identify fossil of given hand specimen. *LSO 2.2.* Write the process of fossilification with neat sketch.	2.	Identify the different fossils in the given hand specimen.	**CO-1**
LSO 3.1. Select the relevant physical characteristics of given hand specimen as per application.	3.	Identify ore minerals in the given hand specimen based on its origin, occurrence and uses.	**CO-1**
LSO 4.1. Select the suitable mineral(s) based on required physical characteristics.	4.	Prepare the list of important ores tenor of minerals based on Indian availability & economic.	**CO-2**
LSO 5.1. Use the mohs scale to measure the hardness of mineral specimen. *LSO 5.2.* Identify the mineral with lowest hardness from the given sample.	5.	Arrange the given set of mineral samples in ascending order on the basis of their hardness.	**CO-3**
LSO 6.1. Prepare a map of ore deposits in India. *LSO 6.2.* Use the symbols of different ore deposits.	6.	Locate different important ore deposit mines on Indian maps.	**CO-3**
LSO 7.1. Identify the grade of coal at given sample.	7.	Collect coal samples from dump yards of different mines to analyze the quality.	**CO-4**
LSO 8.1. Collect data of petroleum deposits in India.	8.	Draw a map to locate onshore and offshore petroleum and natural gas deposits	**CO-4**
LSO 9.1. Apply the suitable prospecting methods to search the ore body.	9.	Sketch and describe a electrical resistivity prospecting method.	**CO-5**
LSO 10.1. Apply the principles of GPS in mining field.	10.	Sketch and describe the use of DGPS in surface mining.	**CO-5**

L) **Suggested Term Work and Self Learning: S2447403** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Prepare a map of physiographic division of India.
2. Prepare a map of the structure of Himalayas and discuss the age of formation of Himalayas.
3. Prepare a map of showing magmatic and supergene enrichment deposits found in India.
4. collect different samples of minerals from nearby mines and arrange them in increasing order according to moh's scale of hardness.
5. Prepare a report on prospective coal areas in Bihar.
6. Prepare a sectional view of given bore hole data to estimate reserve.

c. Other Activities:

d. Seminar Topics:

- Prepare a brief account of the Archean rocks of Singhbhum, Bihar. Discuss their economic importance.
- Classification of the Dharwar rocks of south India.
- The processes of formation of mineral deposits in India.
- List of some metallic and non metallic ore minerals found in Bihar.
- Major Captive coal mines of Bihar.
- Why Bombay high is so famous in India?
- Application of DGPS and GIS in mining field.

1. **Visits:** Visit nearby underground metal mines. Prepare report of visit with special comments of origin, occurrence of deposit and prospecting method therein.

2. **Self-learning topics:**

   - Arrange in chronological order of different formation of rocks as per geological time scale and mention their period/ age.
   - Study of path finder/ geobotanical/geochemical guide(gossan/cap rock)of ore mineral.
   - Study the types of ore found in nearby mines and their mode utilization in those mines.
   - Brief study on ore and mineral deposit in Bihar.
   - Study of hardness of minerals of nearby mines.
   - Collect information regarding different grade of bituminous coal found in Bihar.
   - Study of alternative sources of energy emerging to replace coal and petroleum in future.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	20%	20%	20%	20%	20%
CO-2	20%	20%	20%	20%	20%	20%	20%
CO-3	20%	20%	20%	20%	20%	20%	20%
CO-4	20%	20%	20%	20%	20%	20%	20%
CO-5	20%	20%	20%	20%	20%	20%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Indian Stratigraphy	10	CO-1	15	6	5	4
Unit-2.0 Ore Deposit	10	CO-2	15	4	5	6
Unit-3.0 Ore Deposits of India	8	CO-3	10	3	4	3
Unit-4.0 Fossil Fuels	10	CO-4	15	4	5	6
Unit-5.0 Field work and Prospecting	10	CO-5	15	3	6	6
Total	**48**	**-**	**70**	**20**	**25**	**25**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Identify the location of mineral / ore based on the importance of given location with their mineral / ore deposit.	CO-1	40	50	10
2.	Identify the different fossils in the given hand specimen.	CO-1	40	50	10
3.	Identify ore minerals in the given hand specimen based on its origin, occurrence and uses.	CO-2	40	50	10
4.	Prepare the list of important ores tenor of minerals based on Indian availability & economic.	CO-2	40	50	10
5.	Arrange the given set of mineral samples in ascending order on the basis of their hardness.	CO-3	30	60	10
6.	Locate different important ore deposit mines on Indian maps.	CO-3	50	40	10
7.	Collect coal samples from dump yards of different mines to analyze the quality.	CO-4	40	50	10
8.	Draw a map to locate onshore and offshore petroleum and natural gas deposits	CO-4	40	50	10
9.	Sketch and describe a electrical resistivity prospecting method.	CO-5	50	40	10
10.	Sketch and describe the use of DGPS in surface mining.	CO-5	50	40	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment
Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology(ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	3D map of ore deposit	Showing ore deposits in India	1
2.	Hand specimen	Different fossils	2,3
3.	Hand specimen of ore deposits	Iron ore, Manganese ore, Copper Ore, Lead and Zink Ores, Aluminium ore etc.	3-5
4.	Indian Map	Showing ore deposits	6
5.	Coal sample	Various grade of coal sample.	7
6.	3D map of petroleum deposit in India	Showing Petroleum and natural gas deposit in India.	9
7.	DGPS	Surveying in OC mines.	10

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Principles of Engineering geology.	K. M. Bangar	Standard Publishers and Distributors. 2nd , 2009
2.	Engineering and general geology	Prabin singh	S.K. Kataria and sons, latest
3.	The Principles of petrology	G.W. Tyrell	Aitbs Publishers and Distributors. 2013
4.	Geology of India and Burma	M.S. Krishnan	CBS 6th edition (1 January 2017)
5.	Ore deposits of India	Gokhlae & Ray	Thomson Press
6.	India's Mineral Resources	S. Krishnaswamy	Oxford & IBH, 1979, 2nd edition

(b) Online Educational Resources:

1. https://nptel.ac.in/courses/105104216
2. https://www.youtube.com/watch?v=_dOpehNbCRk
3. https://www.youtube.com/watch?v=xvl1LTm3684
4. https://www.slideshare.net/hzharraz/lecture-2-mining-geology
5. https://www.slideshare.net/hzharraz/topic-1concepts-of-an-ore-deposit

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. 3D map of ore deposits in India
2. 3d maps of Physiographic division of India.
3. Lab Manuals.

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A) Course Code : **2447404(T2447404/P2447404/S2447404)**

B) Course Title : Mine Machineries

C) Pre- requisite Course(s) :

D) Rationale :

Mining Diploma Engineer is responsible for supervising the mining operation at the mine site using suitable mining machines to achieve high productivity. Many types of machinery are being used in mines for drilling, extraction, loading, transportation and other mining operations; thus knowledge of operation, maintenance and safety features of machines is very essential for a Mining Diploma Engineer for proper management. Therefore, this course has been developed. This course is also helpful in selection of machinery at the initial stage in any mining project with justification, suitability and efficiency of the machines according to the nature of mineralization, depth of occurrence type of mining and local geological condition.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

CO-1 Use appropriate wire rope as per given working conditions.
CO-2 Operate winding system in underground mines following appropriate safety measures.
CO-3 Select suitable type of coal face machineries used in bord and pillar and longwall mining method.
CO-4 Operate different types of communication system properly used in mines.
CO-5 Select appropriate mine pumps under according to given situation.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	3	2	-	-	2		
CO-2	3	2	-	2	3	3	2		
CO-3	3	3	2	2	3	-	3		
CO-4	3	3	2	2	2	2	-		
CO-5	3	-	3	3	-	3	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Mining Engineering	2447404	Mine Machineries	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1x CI hours) + (0.5x LI hours) + (0.5xNotional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Codes	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Mining Engineering	2447404	Mine Machineries	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Terminal & Self Learning Assessment (include assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities, etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2447404

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Classify wire rope on the basis of construction and applications. *TSO 1b.* Describe various testing methods of wire ropes. *TSO 1c.* Perform the procedure of rope capping at mine site. *TSO 1d.* Enlist the step involved in rope splicing. *TSO 1e.* Explain the operation of rope splicing and safety measures.	**Unit-1.0 Wire Rope** 1.1 Classification of wire ropes- based on construction, laying and use. Their construction and use 1.2 Testing of wire ropes, strength of wire ropes, factor of safety, rope troubles. 1.3 Capping and recapping of ropes, Rope splicing of haulage ropes. 1.4 Care and maintenance of wire ropes, its use and storage. 1.5 Numerical calculation.	**CO-1**
TSO 2a. Identify different types of winding systems used in mines. *TSO 2b.* Draw a flow chart showing Maintenance schedule of winding system of a mine. *TSO 2c.* Describe the process of assembling various units of different winding system. *TSO 2d.* Apply various safety measures in winding system.	**Unit-2.0 Winding** 2.1 Factors governing height of the head gear-dead load live load and wind pressure, Head gear arrangement, 2.2 Types of winding system- drum winding and friction winding. 2.3 Shaft fittings- signals, rigid & flexible rope guides, catchplate, keps, tilting plateform, cage receivers, winding drums, drives. 2.4 Fitting of Winding engines – Braking system on winders. Over winding & over speed prevention, safety hook, depth indicator, automatic contrivance, friction sheave, 2.5 Suspension gear, cages and skip and its fittings, multilevel. 2.6 Power torque diagram and its calculation. 2.7 Statutory provisions regarding winding.	**CO-2**
TSO 3a. Enlist the coal face machinery used in Bord and Pillar mining. *TSO 3b.* State the use of SDL face machinery. *TSO 3c.* Write brief report on machinery used in Longwall Mining method. *TSO 3d.* Explain working principles of shearer in longwall mining. *TSO 3e.* Describe safety measures observed during working in longwall face.	**Unit-3.0 Coal Face Mechanization** **3.1 Bord and Pillar face machinery**- Electric and compressed air operated coal drill, UDM, CCM, Powers loaders- L.H.D. and S.D.L, mine tub, CM and shuttle car. Their Constructional feature, operation, use and preventive maintenance. **3.2 Longwall face machinery-** Coal winning machine (Shearer, Coal Plough), AFC, Stage loader, Feeder braker, Powered support and its types, Power pack. Their Constructional feature, operation, use and preventive maintenance.	**CO-3, CO-4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 4a. Explain various signaling system used in mines. *TSO 4b.* Describe safety features of GEB used in UG mines. *TSO 4c.* Differentiate flame proof and intrinsic safe apparatus used in UG mines. *TSO 4d.* Write maximum permissible voltage for various electric equipments used in mine.	**Unit-4.0 Mine Communication and GEB** 4.1 Mine Communication Signalling , telephone and wireless communication. 4.2 Gate end box-Purpose of re-mote control, General Principle of working of gate end box, Use of GEB in mine. 4.3 Flame proof and intrinsic safe apparatus. 4.4 Maximum permissible voltage for mine equipments.	**CO-3, CO-4**
TSO 5a. Classify the different mine pumps used in mines. *TSO 5b.* Write the steps of installation of mine pump at given location. *TSO 5c.* Describe the selection criteria of mine pumps. *TSO 5d.* Carryout safety precautions during use of turbine pump at mine site.	**Unit-5.0 Mine Pumps** 5.1 Types-Rotary (Turbine and Centrifugal), Reciprocating and Rotary pump. 5.2 Series and parallel operations of pumps. 5.3 Selection criteria, Installation, construction, fittings and attachment, operation and characteristics of mine pumps. 5.4 D`arcy`s formula, and numerical calculation.	**CO-4, CO-5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2447404

Practical/Lab Session Outcomes(LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Select suitable wire rope for replacement of old rope.	1.	Enlist the step involved during process of changing of winding rope and its requirement as per regulation.	**CO-1**
LSO 2.1. Perform rope capping operation at given wire rope using relevant principles of rope capping.	2.	Perform rope capping operation at given wire rope.	**CO-1**
LSO 3.1. Demonstrate the procedure of rope splicing following safety measures.	3.	Demonstrate procedure of rope splicing.	**CO-1**
LSO 4.1. Select suitable type of winding drum under given condition.	4.	Draw a layout about the winding drum used in 300 meter deep mines.	**CO-2**
LSO 5.1. Install fitting and attachment in suspension gear and rope guide suspension arrangements.	5.	Prepare a plan for installation of suspension gear and rope guide suspension arrangements.	**CO-2**
LSO 6.1. Select appropriate size of CM and shuttle car to fulfill the mine output under given conditions.	6.	Prepare a layout of mechanized coal face with respect to application of CM &shuttle.	**CO-3**
LSO 7.1. Measure penetration rate using suitable drill machine in a given condition.	7.	Measurement of rate of penetration by jack hammer.	**CO-3**
LSO 8.1. Install the shearer at longwall face following safe practices.	8.	Prepare a layout of SERD and DERD shearer using in 100 m longwall face.	**CO-3**
LSO 9.1. Operate the given GEB.	9.	Plan for installation and operation of Gate End Box(GEB) in a mine.	**CO-4**
LSO 10.1. Calculate rate of delivery and water head at given data of turbine pump	10.	Rate of delivery of centrifugal pump used in mines.	**CO-5**

L) **Suggested Term Work and Self Learning: S2447404** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Prepare a model for capping and recapping of wire ropes.
2. Prepare a model of head gear frame showing all details.
3. Prepare a model of SDL used in UG coal mine.
4. Prepare a model of SERD Shearer.
5. Importance of GEB in UG mines.
6. Prepare a flowchart for installation of mine pump.

c. Other Activities:

d. Seminar Topics:

- Wire rope used in winding gear arrangement.
- Use of wire rope in haulage.
- Safety features in skip and cage.
- Suspension gear arrangement and its fittings.
- Differentiate SDL and LHD machine.
- Communication system used in nearby UG coal mines.
- Use of different types of pump in mines.

1. **Visits:** Visit nearby mines and study the various face machinery, transport machinery and working of the winding system used therein, and prepare a detailed report on it.

2. **Self-learning topics:**

- Collect unused samples of wire ropes and perform the capping, recapping and splicing on it.
- Study the operation of headgear pulley.
- Study the working of some India's largest winding system.
- Collect photographs of winding installation from different mines.
- Collect maintenance schedule of drill, LHD, SDL by visiting nearby mines.
- Collect maintenance schedule of AFC and SRD/DRD from nearby visited mine.
- Enumerate the problems observed during mine visit and propose possible solution for that.
- Study of GEB used in nearby mines.
- Study the water pump used in college.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	20%	20%	20%	20%	20%
CO-2	20%	20%	20%	25%	20%	20%	20%
CO-3	30%	30%	30%	25%	30%	30%	30%
CO-4	15%	15%	15%	15%	15%	15%	15%
CO-5	15%	15%	15%	15%	15%	15%	15%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Wire Rope	10	CO-1	14	4	5	5
Unit-2.0 Winding	10	CO-2	16	4	6	6
Unit-3.0 Coal Face Mechanization	12	CO-3	18	5	5	8
Unit-4.0 Mine Communication and GEB	8	CO-4	10	4	2	4
Unit-5.0 Mine Pumps	8	CO-5	12	3	4	5
Total	**48**	**-**	**70**	**20**	**22**	**28**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Enlist the step involved during process of changing of winding rope and its requirement as per regulation.	CO-1	40	50	10
2.	Perform rope capping operation at given wire rope.	CO-1	40	50	10
3.	Demonstrate procedure of rope splicing.	CO-1	30	60	10
4.	Draw a layout about the winding drum used in 300 meter deep mines.	CO-2	40	50	10
5.	Prepare a plan for installation of suspension gear and rope guide suspension arrangements.	CO-2	30	60	10
6.	Prepare a layout of mechanized coal face with respect to application of CM &shuttle.	CO-3	30	60	10
7.	Measurement of rate of penetration by jack hammer.	CO-3	30	60	10
8.	Prepare a layout of SERD and DERD shearer using in 100 m longwall face.	CO-3	40	50	10
9.	Plan for installation and operation of Gate End Box(GEB) in a mine.	CO-4	40	50	10
10.	Rate of delivery of centrifugal pump used in mines.	CO-5	30	60	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment
Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	Rope samples.	Lang's lay type, locked coil type, stranded type and other relevant ropes used in mines.	1-3
2.	Model of head gear arrangement.	Working model	4-5
3.	Model of CM & shuttle car.	Model	9
4.	Model of shearer	Double ended and single ended ranging drum shearer.	8

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Mine Transport	N.T. Karelin	Orient longman, 1967
2.	Mining and Working vol-2	S. Ghatak	Khanna Publishing House, Delhi ISBN: 9789386173768
3.	Elements of Mining Technology vol-3	D.J. Deshmukh	Lovely Prakashan
4.	Science and Art of Mining Digest	C.M.P.D.I. Pub	C.M.P.D.I. Pub,2011
5.	Mining Digest	L.C. Kaku	Lovely Prakashan

(b) Online Educational Resources:

1. https://archive.nptel.ac.in/courses/123/105/123105005/
2. https://www.slideshare.net/ajeetkm/mine-machinery-wire-ropes
3. https://mineportal.in/assets/uploads/user-notes/df4684fd22721f7396ace865dbf2bf3f/file-166550869228278.pdf
4. https://www.youtube.com/watch?v=6cRoVCJUxkI
5. https://www.youtube.com/watch?v=tI2L2ZTPTXA&t=814s
6. https://www.kghmzanam.com/images/Foldery/KGHM_ZANAMs_Undergound_Mining_Machine_catalogue.pdf

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Lab Manuals.
2. Visit reports.
3. Mining machinery manufacturer company catalogue.

******

A) Course Code **: 2447405(T2447405/P2447405/S2447405)**

B) Course Title : Mine Environment & Pollution Control

C) Pre- requisite Course(s) **:**

D) Rationale **:**

Mining operation should be such that there is no disturbing the ecosystem and maintaining normal environmental condition within the mine so that target production will be achieved along with safety of mines and people residing in the nearby areas. Underground mining methods are considered more hazardous due to its procedure of winning under extremely difficult conditions inviting chances of infringement of safety. The purpose of this course to develop insight for mine environment and pollution control and apply related knowledge in working in mining.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

CO-1 Control the formation of dust in mine environment.

CO-2 Apply the concepts of environmental engineering for prevention and control of air and water pollution.

CO-3 Select appropriate noise control devices under given a condition.

CO-4 Prepare Environmental Impact Assessment plan under a given condition.

CO-5 Implement the laws and regulations relevant to the environment conservation in mine workings.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Develop-ment of Solutions	**PO-4** Engineer-ing Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Manageme nt	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	3	3	2	2	2	2		
CO-2	3	2	2	2	2	1	-		
CO-3	3	3	-	3	3	2	-		
CO-4	3	3	-	2	1	-	-		
CO-5	2	-	3	3	-	3	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Mining Engineering	2447405	Mine Environment & Pollution Control	03	-	04	02	09	06

Legend:

Cl: Classroom Instruction (includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1x Cl hours) + (0.5x LI hours) + (0.5xNotionalhours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Codes	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Mining Engineering	2447405	Mine Environment & Pollution Control	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Terminal & Self Learning Assessment (include assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities, etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2447405

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. State physiological effects of mine dust. *TSO 1b.* Explain cause and preventive measures of formation of dust. *TSO 1c.* Explain working principles and constructional features of given dust sampling equipment. *TSO 1d.* Identify and take measures for prevention of occupational diseases due to dust.	**Unit-1.0 Mine Dust** 1.1 Concept and classification of mine dust. 1.2 Causes of formation, Physiological effects, measurement of dust concentration, size of dust particles. 1.3 Sampling of air borne dust, prevention and suppression of dust, Threshold Limit Value (TLV) 1.4 Dust sampling method and its equipment. 1.5 Occupational diseases due to dust.	**CO-1**
TSO 2a. Identify causes and consequences of air and water pollution. *TSO 2b.* Apply basic techniques to prevent and control air pollution in the given situation. *TSO 2c.* Describe the ambient air quality standards in India. *TSO 2d.* Compare the BOD and COD of mine water sample. *TSO 2e.* Apply techniques to minimize acid mine drainage.	**Unit-2.0 Air and Water Pollution** 2.1 **Air pollution –** Causes, consequences and preventive measures, suspended particulate matter**,** Ambient air quality standards in India. 2.2 **Water Pollution-** Causes and preventive measures, Water treatment plants, Bio Chemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solid, (TSS), Acid mine drainage and its control.	**CO-2**
TSO 3a. Identify causes and consequences of noise pollution. *TSO 3b.* Apply the safety measures used for the abatement of noise. *TSO 3c.* Use various instruments suitable for measuring ground vibration safely and effectively.	**Unit-3.0 Noise Pollution** 3.1 Pollution due to noise and its consequences, Noise produced by different machinery. 3.2 Control and safety measurement of noise levels. 3.3 Ground vibration: Causes, Prevention and Measurement of ground vibration.	**CO-3**
TSO 4a. Apply the technique to minimize the impact of air, water, noise pollution on nearby mines area. *TSO 4b.* Explain the procedure of environmental impact assessment. *TSO 4c.* Use relevant IS codes developed by Bureau of Indian Standards applicable to mines. *TSO 4d.* Prepare a suitable EMP to minimize air, noise and water pollution.	**Unit-4.0 Environmental Impact Assessment** 4.1 Overview of Environmental impact and its Assessment- Base line data collection, compilation, interpretation and analysis, various types of approaches, buffer zones. 4.2 Impact on climatic conditions and sources-heat, humidity, wind, rainfall, dust. Impact on soil, water, air, noise level, flora, land use pattern and socio- economic survey. 4.3 IS codes/ standards of air, soil, water and noise pollution their control, other IS codes & standards applicable to mines.	**CO-4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	4.4 Environmental management plan based on impact assessment. 4.5 Environment Management Plan and its implementation	
TSO 5a. Explain the organizational structure of central and state pollution control board. *TSO 5b.* Describe the provisions of environment protection act 1986 related to mining operation. *TSO 5c.* Use The Air (Prevention and control of pollution) Act for the abatement of air pollution due to mining activities.	**Unit-5.0 Law and Rules Related to Environment** 5.1 Central and State pollution control board. 5.2 Air quality index (AQI), 5.3 Environment Protection Act and Rule 1986. (Provisions applicable related to Mining operation only) 5.4 Water Conservation Act of 2009. 5.5 Indian Forest Act 1927.(provision related to mining) 5.6 The Air (Prevention and control of Pollution) Act 1981.	**CO-5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2447405

Practical/Lab Session Outcomes(LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Operate the hand held dust extractor device for measurement of dust concentration	1.	Measurement of dust by portable hand held dust extractor	CO-1
LSO 2.1. Use the dust sampling instruments in a given situation.	2.	Various dust sampling instruments.	CO-1
LSO 3.1. Describe the procedure of dust particles measurement.	3.	Measurement of dust particles produced by blast hole drills.	CO-1
LSO 4.1. Determine the pH value of given water sample using the litmus paper.	4.	pH values of water samples discharged from mines.	CO-2
LSO 5.1. Measure the amount of SPM in a given mine air sample.	5.	Suspended Particulate Matter (SPM) in a given sample of air.	CO-2
LSO 6.1. Determine the vibrations using the suitable vibration measuring device.	6.	Determination of vibrations produced by machineries.	CO-3
LSO 7.1. Measure the noise level of different mining machineries following the appropriate procedure using relevant equipment with maximum limit.	7.	Noise level of different mining machineries	CO-3
LSO 7.2. Use the sound level meter for measuring the noise level of mining machineries.	7.	Noise level of different mining machineries	CO-3
LSO 8.1. Prepare a detailed flowchart of Environment Impact Assessment (EIA) plan in a given situation.	8.	Environment Impact Assessment (EIA)	CO-4
LSO 9.1. Measure the Air Quality Index (AQI) using suitable equipment and procedure.	9.	Air Quality Index (AQI)	CO-5

L) **Suggested Term Work and Self Learning: S2447405** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Prepare a model of hand held dust sampler.
2. Prepare a model of water treatment plant.
3. Prepare a model of various dust sampling devices used in mines.
4. Prepare a flow chart of BOD and COD calculation.
5. Prepare a report on mine closure.

c. Other Activities

d. Seminar Topics:

- Causes and preventive measures of occupational diseases and its effect on human body.
- Ambient air quality standards in India.
- Application of GPS and GIS in mining field.
- Importance of EIA and EMP in mining field.

1. Visits: Visit a nearby mine where dust sampler being used and prepare a report comprises of its major specifications / features, working and applications.

2. Self-learning topics:

- Study the dust measuring method adopted for finding dust concentration in nearby mine and by weather monitoring department of your area.
- Study the reports submitted with regard to air pollution by nearby mines.
- Effects of air pollution and preventive measures used for its control in nearby mines.
- Prepare a banner/ animations/photograph etc. related to issue of air pollution.
- Write the safety measures adopted for the abatement of noise.
- Study about the standards of air quality index maintained in nearby mine.

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	20%	20%	30%	20%	20%
CO-2	25%	25%	30%	30%	20%	20%	20%
CO-3	20%	20%	20%	30%	30%	20%	20%
CO-4	20%	20%	10%	-	-	20%	20%
CO-5	20%	20%	20%	20%	20%	20%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment:

Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Mine Dust	8	CO-1	12	3	3	6
Unit-2.0 Air and Water Pollution	12	CO-2	18	5	5	8
Unit-3.0 Noise Pollution	8	CO-3	12	4	4	4
Unit-4.0 Environment Impact Assessment.	10	CO-4	14	4	4	6
Unit-5.0 Law and Rules Related to Environment	10	CO-5	14	4	4	6
Total	**48**	**-**	**70**	**20**	**20**	**30**

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested AssessmentTable for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Measurement of dust by portable hand held dust extractor	CO1	30	60	10
2.	Various dust sampling instruments.	CO1	40	50	10
3.	Measurement of dust particles produced by blast hole drills.	CO1	30	60	10
4.	pH values of water samples discharged from mines.	CO2	30	60	10
5.	Suspended Particulate Matter (SPM) in a given sample of air.	CO2	30	60	10
6.	Determination of vibrations produced by machineries.	CO3	30	60	10
7.	Noise level of different mining machineries	CO3	30	60	10
8.	Environment Impact Assessment (EIA)	CO4	40	50	10
9.	Air Quality Index (AQI)	CO5	40	50	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment
Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology(ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	Hand held dust extractor		1
2.	Litmus Paper	For pH value measurement of mine sample.	4
3.	Sound level meter.	Low battery indicator, backlight Auto manual shutdown, 10mm (0.4") lcd display Optional accessories - htc rs-232 cable with software, rs-232 usb cable Standard accessories - hard carrying case, wind ball, screw driver, manual Dimension - instrument- 236 x 63 x 26mm	7
4.	Air Quality Meter PCE-CMM 10	Measuring range CO2400 ... 5000 ppm Resolution 1 ppm Accuracy ± (5% + 50 ppm) between 400 ... 2000 ppm and an atmospheric pressure of 1013 mbar Sensor NDIR principle ABC Automatic baseline correction Audio alarm Buzzer Visual alarm Red backlight Display 3 inch LC display battery indicator Four-level display display frequency 3 seconds	9

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Environmental Mangaement of Mining operation	Prof.B.B.Dhar	Ashish Publishing House, 1990
2.	Mine Environment and Ventilation	G.B. Mishra	Oxford University Press , Illustrated reprint, 1986
3.	Elements of Mining Technology-II	D. J. Deshmukh	Denette publication
4.	Impact of mining on environment	R.K. Trivedi	South Asia Books (1 December 1990)

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
5.	Mining, Challenges of the 21st Century	Ajoy K. Ghose, B. B. Dhar	APH Publishing, 2000
6.	Water Conservation Act of 2009.	GOI	GOI,2009
7.	Indian Forest Act 1927	GOI	GOI
8.	The Air (Prevention and control of Pollution) Act 1981.	GOI	GOI
9.	Mining and Environment	Prof.B.B.Dhar	APH Publishing House.

(b) Online Educational Resources:

1. https://archive.nptel.ac.in/courses/123/106/123106002/
2. https://www.slideshare.net/safdar5647/dust-in-mine
3. https://www.ripublication.com/ijeem_spl/ijeemv4n3_14.pdf
4. https://en.wikipedia.org/wiki/Environmental_effects_of_mining
5. https://www.indiacode.nic.in/bitstream/123456789/9462/1/air_act-1981.pdf

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Lab Manuals
2. Joy mining catalogue.

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A) Course Code : **2452107(T2452107)**

B) Course Title : Basics of Liberal Art (Non-Exam Course) (FTS, GT, TE, ME)

C) Pre- requisite Course(s) :

D) Rationale :

The Liberal Art education aims to provide students with a foundational understanding of various aspects of liberal arts, including literature, history, philosophy, and social sciences for holistic approach towards education. The skills and knowledge gained after studying liberal arts can advance their chances in succeeding in selected career. This course of Basics of Liberal Art is designed for diploma graduates to develop certain liberal arts such as critical thinking skills, promote liberal art awareness, and foster creativity.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

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

CO-1 Demonstrate knowledge of key concepts and theories in literature, history, philosophy, and social sciences.

CO-2 Apply critical thinking skills to evaluate and assess information from diverse sources.

CO-3 Use creative thinking to perform disruptive engineering tasks.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	-	-	-	-	3	1	3		
CO-2	-	-	1	-	3	1	3		
CO-3	-	-	1	-	3	11	3		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Title	Scheme of Study (Hours/Week)				
	Classroom Instruction (CI)		Notional Hours (TW+ SL)	Total Hours (CI+TW)	Total Credits (C)
	L	**T**			
Basics of Liberal Art	01	-	-	01	01

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

I) Theory Session Outcomes (TSOs) and Units: T2452107

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Define the concept of liberal arts and its significance. *TSO 1b.* Identify the different disciplines encompassed by liberal arts. *TSO 1c.* Discuss the historical development and evolution of liberal arts.	**Unit-1.0 Introduction to Liberal Arts** 1.1 Definition and significance of liberal arts 1.2 Historical development and evolution of liberal arts 1.3 Overview of interdisciplinary approaches in liberal arts 1.4 Liberal arts education and its benefit	**CO1**
TSO 2a. Analyze information and arguments is essential for success in liberal arts. *TSO 2b.* Analyze assumptions and identify biases *TSO 2c.* Draw logical conclusions from the evidence.	**Unit-2.0 Critical Thinking** 2.1 The Role of Critical Thinking in Liberal Arts Education 2.2 Arguments in Liberal Arts Disciplines, Information Assumptions, biases 2.3 Critical Thinking and Interpretation, logical conclusions from the evidence 2.4 Media Literacy and Critical Thinking in the Digital Age	**CO1, CO2**
TSO 3a. Devise original ideas and interpretations in give situation *TSO 3b.* Use new and unconventional approaches to problem-solving. *TSO 3c.* Use both primary and secondary sources effectively.	**Unit-3.0 Creativity** 3.1 Creative Thinking Skills in Education 3.2 Primary and Secondary Sources in Research for Academic Studies 3.3 Critical Thinking in Research: A Focus on Higher Education 3.4 Innovative Approaches to Analysis in Different Academic Fields	**CO1, CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.5 Collaborative Research in Academic Settings 3.6 Feel free to let me know if you would like further information or if you have any other specific requests! 3.7 FDM based 3D printing process details. 3.8 Conduct research, Sources of information. 3.9 Primary and secondary data sources.	

Note: One major TSO may require more than one Theory session/Period.

J) Suggested Term Work/ Activities and Self Learning: Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Perform 3D printing of plastic casing of inhaler used by Asthma patients and estimate the cost.
2. Download 5 videos on 3D printing of different components, watch them and write a report to detail out the steps involved, 3D Printer used, 3D Printing software used, material used, complexity involved, printing time, post processing steps used.
3. Print two pieces of same components using ABS and PLA and compare their strength, surface roughness, weight, cost.
4. Download two 3D printing free software and try to check their compatibility with your lab printer.

c. Other Activities:

1. Seminar Topics:
   - Commercially available 3D printers and software.
   - Strength of 3D printed Plastic components as compared to Die cast Plastic components.
   - Properties of PLA and ABS 3D printing materials.
   - Reverse engineering application of 3D Printing.

2. Visits: Visit nearby tool room/industry with 3D Printing facilities. Prepare report of visit with special comments of 3D printing technique used, material used, single component/batch production/mass production and cost of printed component.

3. Self-learning topics:
   - 3D printing of flexible plastic components.
   - 3D printing of micro/mini components.
   - Conversion of CAD file formats into IGES.
   - 3D scanning process.

K) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

L) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

M) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Liberal Arts and Sciences: Thinking Critically, Creatively, and Ethically	Ed. D., Christopher a Ulloa Chaves	Trafford Publishing, 2014 ISBN: 1490736999, 9781490736990
2.	Art of Creative Thinking	Rod Judkins	Hachette Book Publishing 2015 ISBN: 9781444794489
3.	Introduction to Creativity and Innovation for Engineers	Stuart Walesh	Pearson, 2017 ISBN: 9781292159287

(b) Online Educational Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me115/preview

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. 3D Printing Projects DK Children; Illustrated edition, 2017
2. The 3D Printing Handbook: Technologies, design and applications Ben Redwood, Filemon Schöffer, Brian Garret, 3D Hubs; 1st edition, 2017
3. 3D Printer Users' Guide

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A) Course Code : **2400408(T2400408)**

B) Course Title : Employability Skills Development (Common for all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Education may only be enough to qualify for a job, but employability skills are the major criteria to be considered for a job role. Employability skills are building blocks of any career and they equip one to carry out roles in the company to the best of their ability. Employers usually check these employability skills before hiring. These sets of job-readiness skills are behaviors that are necessary for every job and are essential attitudes that enable students to grow in their careers. Employers value employability skills because they regard these as indications of how their employees will get along with other team members and customers, and how efficiently they will be able to handle the job performance and career success. Employers like to hire a technical expert who also displays well-rounded employability skills.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

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

CO-1 Build resume and showcase portfolio for placement activity.

CO-2 Face interviews and participate effectively in Group Discussions.

CO-3 Apply engineering tools in work situations and societal processes.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Developmentof Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	3	-	-	2		
CO-2	3	-	-	-	2	2	3		
CO-3	3	-	-	3	3	2	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2400408	Employability Skills Development	01	-	-	-	01	01

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2400408	Employability Skills Development	25	--	-	--	--	--	25

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) Course Curriculum Detailing:

Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2400408

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Perform SWOT analysis and reflect. *TSO 1b.* Develop skills in carrier planning & goal setting *TSO 1c.* Build a Resume using Internet formats. *TSO 1d.* Develop and Design portfolios. *TSO 1e.* Maintain good grooming attire. *TSO 1f.* Introduce oneself to others. *TSO 1g.* Develop a personal website.	**Unit-1. Goal Setting** 1.1 Career planning, SWOT 1.2 Resume using Internet formats. 1.3 Showcase portfolios. 1.4 Personal grooming. 1.5 Self-Introduction. 1.6 Website Development.	**CO1**
TSO 2a. Face interviews and E- Interviews confidently *TSO 2b.* Participate in group discussions. *TSO 2c.* Use Social media for personal enrichment &Netiquette *TSO 2d.* Manage self for higher growth. *TSO 2e.* Use body language for effective communication *TSO 2f.* Manage Emotions for personal growth	**Unit-2. Capacity Development** 2.1 Interview Skills 2.2 Group Discussion – Do's & don'ts, leadership, Teamwork, how to interrupt, synthesis, and analysis of topics. 2.3 Social Media for Personal Enrichment 2.4 Body language 2.5 Self-Management. 2.6 Emotional Intelligence	**CO2**
TSO 3a Develop & Maintain Social Contacts. TSO 3b Engage in Social Service projects. TSO-3c Collaborate for mutual advantage. TSO 3d Apply QC-Tools in work situations. *TSO 2g.* TSO 3e Practice Lean Manufacturing Techniques for Production and Operations	**Unit-3. Utilizing Potential** 3.1 Social Networking 3.2 Social Engagements, Volunteering 3.3 Collaboration& Team-work. 3.4 QC-Tools – Check sheets, Fishbone Diagram, Histogram, Pareto chart, Control-chart, Scatter Diagram, Stratification, 3.5 Lean Manufacturing, Kanban, Kaizen, Five S, Poka-yoke, Quality Circle	**CO3**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: - (Not Applicable)

L) Suggested Term Work and Self Learning: Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

1 Build a resume for Placement Activity.

2 Prepare letters for job applications.

b. Micro Projects:

1. Prepare collage for personal grooming.
2. Develop a showcase portfolio.
3. Prepare a collage of different gestures and postures of Body Language.
4. Apply Five-S in a work situation.
5. Arrange Mock Interviews, appear, and video record. Reflect on your performance.
6. Organize Group discussions on current topics and video record. Reflect on your performance

c. Other Activities:

1. Seminar Topics:
   - Emotional Intelligence.
   - 21st Century Skills.
   - Multitasking

2. Visits: Visit nearby Job Fairs, Career Guidance Fairs, etc.

3. Self-learning topics:
   - Use of social media.
   - Self-introduction.
   - Self-grooming.
   - QC Tools.
   - Lean Manufacturing,
   - Emotional Intelligence.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	30%	-	50%	-	-	-	-
CO-2	40%	-	25%	50%	-	-	-
CO-3	30%	-	25%	50%	100%	-	-
Total Marks	**25**	**-**	**10**	**10**	**5**	**-**	**-**
			25				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: (Not Applicable)

O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications
1.	Group Discussion Tables and chairs	Round Table with seating arrangement for 15 person
2..	Mock Interviews infrastructure	2 parallel mock interview set up with recording facility.
3.	Ear phones	Compatible with mobile phones
4	Headphones	Compatible with laptop/desk top
5	Blue tooth	Compatible with mobile phones.
7.	CC TV Camera	Compatible to record presentations and addresses.
8.	Podium	For presentations on stage.
9.	Public address system	For public meetings.
10.	Full Glass Mirrors	For monitoring Body Language

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Employability Skills Skills for Employability	Dr. M. Sen Gupta	Innovation Publication Pvt Ltd, 2020 ISBN: 978-81-933819-1-5
2.	Employability Skills	Dr. Nishith Rajaram Dubey, Anupam Singh	Indra Publishing House, 2023 ISBN - 978-93-93577-68-9
3.	Organizational Behavior	A. K. Chitale, Rajendra Prasad Mohanty and Dr Nishith Dubey	PHI Learning Pvt Ltd ISBN 978-81-203-4696-3
4.	Managerial Skills	Dr Nishith Dubey & Prof Gitanjali Shrivastava	Shiva Prakashan, Indore, India,2010, ISBN 81-7677-100-7,
5.	Body Language	Allan Pease	Pease International PTY. Ltd Australia

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
6.	Production and Operations Management Goods & Services approach	Dr S.V Deshmukh, Dr A. K. Chitale and Dr Nishith Dubey	Archers & Elevators publishing house, Bangalore, ISBN 9789386501197
7.	Emotional Intelligence	Daniel Goleman	Word Press.Com, 9789382563792
8.	How to win friends and influence people	Dale Carnegie	Srishti Publishers & Distributors, Delhi, India

(b) Online Educational Resources:

1. 4-Year Plan For Career Success: https://eng.umd.edu/sites/clark.umd.edu/files/4%20Year%20Plan%20For%20Career%20Success_Categorized_1.pdf

2. CAREER DEVELOPMENT GUIDE https://www.engineersaustralia.org.au/sites/default/files/content-files/2016-12/career_development_guide_may_2014.pdf

3. Tips for successful career planning tips://www.aryacollege.in/tips-for-successful-career-planning-in-2021/

4. Career Planning – Complete Guidehttps://www.mygreatlearning.com/blog/what-is-career-planning/

5. Build Resume: https://www.themuse.com/advice/how-to-make-a-resume-examples

6. Build Resume https://resumegenius.com/blog/resume-help/how-to-write-a-resume

7. Body Language: https://ubiquity.acm.org/article.cfm?id=3447263

8.Group Discussions: https://brightspeaking.com/en/how-to-effectively-participate-in-a-group-discussion/

9.Carrier planning & goal setting: https://www.hays.com.au/career-advice/career-development/setting-career-goals

10. Carrier planning & goal setting: https://www.thebalancemoney.com/step-by-step-guide-to-setting-career-goals-2059883

11. Collaboration & teamwork: https://www.indeed.com/career-advice/career-development/teamwork-and-collaboration

12. Interview skills: https://www.youtube.com/watch?v=lKCTS9dY4h4

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(c) Others:

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