A) Course Code : 2039371(039)
B) Course Title : Elements of Mining Technology
C) Pre- requisite Course Code and Title :
D) Rationale :

A mining engineer is responsible for exploring the economically viable mineral using mining operations in different hydro-geological conditions. Mine operations include mine planning, drilling, blasting, excavation and transportation of ores. Mining engineering is the application of combined knowledge of various branches of engineering and technology in extracting the mineral from the earth and making it useful. The purpose of "Elements of Mining Technology" is to provide understanding of fundamentals of mining and its terminology so as to gain access into further knowledge and skills related to mining engineering and technology. This course broadly include: -

1. Basic mining terminology.
2. Mode of entry into a mine.
3. Method of shaft sinking.
4. Method of drilling/boring.
5. Method of mining

E) Course Outcomes :

The students after going through the course will be able to:

CO-1 Apply the basic mining terminology with reference to given context.

CO-2 Select suitable mode of entry into a mine as per given conditions.

CO-3 Select suitable method of shaft sinking in a given condition.

CO-4 Identify and select suitable method of drilling/boring in a given situation.

CO-5 Identify suitable method of mining in a given situation.

F) SCHEME OF STUDIES AND EXAMINATION :

Course Code	Periods/ Week (In Hours)			Scheme of Examination						Credit L+T+(P/2)
	L	T	P	Theory			Practical		Total Marks	
				ESE	CT	TA	ESE	TA		
2039371 (039)	2	1	2	70	20	30	40	60	220	4

G) DISTRIBUTION OF HOURS AND MARKS:-

S.No	Chapter Name	Hours	Marks
1	Introduction	10	15
2	Modes of entry	10	15
3	Shaft sinking	10	15
4	Drilling/Boring	06	10
5	Methods of Mining	12	15
Total		**48**	**70**

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), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Apply the basic mining terminology with reference to given context.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1 Use mining terminology with reference to coal and metal mining. SO1.2 Use historical detail of mines of India for drawing mineral maps of a given geographical area.	LE1.1 Prepare map of India to show distribution of coal and different minerals. LE1.2 Prepare map of Chhattisgarh to show distribution of coal and different minerals	**Unit-1.0 Introduction** 1.1 Basic mining terminology related to- Underground (UG) metal and coal mining, Opencast (OC) metal and coal and other methods of mining. 1.2 History of underground and opencast coal mining and other methods of mining. 1.3 History of underground and opencast metal mining and other methods of mining. 1.4 Mineral distribution of in India. 1.5 Mineral Wealth of Chhattisgarh.	• Prepare a monograph on different types of minerals mined in India along with their usage. • Prepare map of India to show distribution of coal and different minerals.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Collect relevant photographs or draw a simple sketch of given mining terms.
ii. Write historical development of coal mining in India.
iii. Write historical development of metal mining in India.
iv. Write the historical development of other methods of mining in India.

b. Mini Project:

i. Make a list of tools, equipment and accessories along with their photographs observed during the visit of a mine. Also write usage of the equipment/ tools/accessories.

CO-2 Select suitable mode of entry into a mine as per given condition.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 2.1 Identify different mode of entry into mines. SO 2.2 Draw layout of a suitable mode of entry for the given conditions. SO 2.3 Compare different mode of entries used in mines.	LE2.1 To sketch and describe different fittings used in shaft, incline and Adit. LE2.2 Calculate the feasibility of mine entry for a given conditions and criterion.	**Unit-2.0 Mode of entry** 2.1 Different types of mode of entry(Shaft, Incline and Adit) 2.2 Site selection for different modes of entries. 2.3 Factors governing shape and size of different modes of entry. 2.4 Suitability and Comparison between different modes of entries. 2.5 Drivage of incline and adit.	• Write a handout on types of mode of entries used in mines in different countries along with suitable photographs.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Write the criteria to be considered for selecting site for drivage of an incline, shaft and adit.
ii. Write the factors governing the shape and size of shaft.
iii. Compare different mode of mine entries.

b. Mini Project:

i. Prepare a model of Shaft/Adit/Incline showing relevant safety features.

c. Other Activities (Specify):

i. Visit nearby mine and draw sketch of the incline/shaft/adit along with relevant installations and fittings.

CO-3 Select suitable method of shaft sinking in a given condition.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 3.1 Identify relevant criteria for sinking shaft in a given condition. SO 3.2 List sequence of operations to be performed for drivage of a shaft. SO 3.3 Identify precautionary measures to be observed for safe drivage of a shaft.	LE3.1 Sketch and describe temporary and permanent lining. LE3.2 Sketch and describe marking of a center of shaft.	**Unit-3.0 Shaft Sinking** 3.1 Sinking of shaft in different types of strata. 3.2 Marking of center of shaft. 3.3 Temporary and permanent lining, scaffolding. 3.4 Firing shots in sinking shaft. 3.5 Shaft fittings. 3.6 Precautionary aspects to be observed during shaft sinking. 3.7 Special methods of shaft sinking.	• Collect cases related to accidents in shafts and write brief on each case.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Write the factors to be considered during selection of site for shaft sinking in the given condition.

ii. Describe the procedure of firing shots in a sinking shaft along with safety measures to be observed.

iii. Prepare a report related to shaft project being done or had been done in a nearby mine.

b. Mini Project:

i. Prepare a model of a shaft showing relevant shaft fittings and linings.

c. Other Activities (Specify):

i. Visit a nearby mine having a shaft. Observe and list safety devices fitted there.

CO-4 Select suitable method of drilling/boring in a given condition.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Identify the specific drill bit applicable under a given condition. SO4.2 Draw a layout of Surface arrangements for drilling/boring.	LE4.1 Sketch and describe different types of drill bits and drill rod. LE4.2 Sketch and describe a drilling machine used in surface mines. LE4.3 List criterion for choosing a drill bit for the given condition.	**Unit-4.0 Drilling/ boring** 4.1 Drilling/boring in different types of strata, Types of drill and drill bits, drilling accessories, drillability of rock. 4.2 Surface arrangement for Drilling/boring 4.3 Safety aspects to be observed during drilling/boring.	• Collect videos of different types of drilling and boring operations for different strata. Explain each video with specific details.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Identify various parameters of rock drillability based on given conditions.
ii. Compare Diamond/rotary/percussive drilling based on given criterion.

b. Mini Project:

i. Draw model of surface arrangement of drilling/boring.
ii. Collect data related to drilling operations of nearby mines and prepare a report with the result

CO-5 Identify suitable method of mining in a given situation.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Choose a suitable method of mining in a given condition. SO5.2 List the different surface and underground method of mining.	LE5.1 Prepare a classification chart for different methods of mining showing details of mining methods.	**Unit-5.0 Method of mining** 5.1 Classification of methods of mining. a. Opencast mining b. Underground mining- i. U/G Metal Mining Different stoping methods ii. U/G Coal Mining Bord and Pillar Mining Longwall Mining 5.2 Various parameters for Selection of suitable methods of	• Conduct a literature survey and develop a handout on special methods of mining. • Identify various parameters for application of different methods of mining. .

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
		mining 5.3 Special methods of mining i.e. Placer, dredging, hydraulic, strip, Gassification,auger and leaching.	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

i. Compare Opencast and underground mining methods.
ii. List various criteria for selection of underground coal mining methods.
iii. List various criteria for selection of underground metal mining methods.
iv. List various criteria for selection of opencast mining methods.
v. Prepare a classification chart for different methods of mining showing details of mining methods.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) Suggested Specification Table For ESE of Laboratory Instruction:

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work(Marks)		
		Performance		Viva-Voce
		PRA	PDA	
1.	Prepare map of India to show distribution of coal and different minerals.	15	15	30
2.	Prepare map of Chhattisgarh to show distribution of coal and different minerals.	15	15	30
3.	To sketch and describe different fittings used in shaft, incline and adit.	15	15	30
4.	Calculate the feasibility of mine entry for a given conditions and criterion.	15	15	30
5.	Sketch and describe temporary and permanent lining.	15	15	30
6.	Sketch and describe marking of center of shaft.	15	15	30
7.	Sketch and describe different types of drill bits and drill rod.	15	15	30
8.	Sketch and describe drilling machine used in surface mines.	15	15	30
9.	List various criteria for choosing a drill bit for the given conditions.	15	15	30
10.	Prepare a classification chart for different	15	15	30

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work(Marks)		
		Performance		Viva-Voce
		PRA	PDA	
	methods of mining showing details of mining methods.			

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practical.

Legend : PRA: Process Assessment, PDA : Product Assessment

Note : Only one experiment has to performed at the end semester examination of **40 Marks** as per assessment scheme.

J) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

K) Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Elements of Mining Technology	D J Deshmukh Vol. 1	Denett &co.	
2	Principals and practices of modern coal mining.	R. D. Singh	New age international	2005
3	Winning and working coal vol 1	S.Ghatak		
4.	Introductory Mining Engineering	Howard L. Hartman, Jan M Mutmansky	Wiley & Sons	Aug 2002
5.	Underground Mining Methods	William A Hustrulid& Richard L Bullock	SME Publication	2001

(b) Open source software and website address :

1. http://www.edumine.com/
2. http://nptel.ac.in/course.php
3. http://octavesim.com/
4. https://swayam.gov.in/courses/public

L) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Apply the basic mining terminology with reference to given context.	3	3	3	2	1	1	3	3	3	3	-	-
CO-2 Select suitable mode of entry into a mine as per given situation.	3	3	3	3	2	1	3	3	3	3	-	-
CO-3 Select suitable method of shaft sinking in a given situation	3	3	3	3	2	1	3	3	3	3	-	-
CO-4 Select suitable method of drilling/boring in a given situation.	3	3	3	3	2	1	3	3	3	3	-	-
CO-5 Identify suitable method of mining in a given situation.	3	3	3	1	1	1	3	3	3	3	-	-

Legend: 1 – Low, 2 – Medium, 3 – High

M) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-1 Apply the basic mining terminology with reference to given context.	SO1.1 SO1.2	LE1.1 LE1.2	Unit-1.0 Introduction 1.1, 1.2, 1.3, 1.4, 1.5	As mentioned in relevant page numbers
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-2 Select suitable mode of entry into a mine as per given situation.	SO2.1 SO2.2 SO2.3	LE2.1 LE2.2	Unit-2.0 Mode of entry 2.1, 2.2, 2.3, 2.4, 2.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-3 Select suitable method of shaft sinking in a given situation.	SO3.1 SO3.2 SO3.3	LE3.1 LE3.2	Unit-3.0 Shaft Sinking 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-4 Select suitable method of drilling/boring in a given situation.	SO4.1 SO4.2	LE4.1 LE4.2 LE4.3	Unit-4.0 Drilling/ boring 4.1 4.2 4.3	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-5 Identify suitable method of mining in a given situation.	SO5.1 SO5.2	LE5.1	Unit-5.0 Method of mining 5.1 5.2 5.3	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

A) Course Code : **2039372(039)**

B) Course Title : **Mine transportation**

C) Pre- requisite Course Code and Title :

D) Rationale :

Excavated raw minerals have to be transported to beneficiation plant or processing unit to make it marketable and usable. Mine transportation involves moving bulk of minerals using different transportation sources such as rope haulage, conveyors and ropeways. Proper selection of transportation mechanism depends upon various factors such as minerals to be hauled, terrain, distance and economic value of the mineral. Therefore, it requires systematic planning, scientific approach and safety measures for taking such decisions.

This paper deals with various types of transportation systems of mineral from its origin to the beneficiation plant or processing unit including their preventive maintenance.

E) Course Outcomes :

CO-1 Apply Knowledge of mine machinery for installation, problem solving and maintenance of rope haulage in mines.

CO-2 Apply Knowledge of mine machinery for installation, problem solving and maintenance of belt conveyors in mines.

CO-3 Apply Knowledge of mine machinery for installation, problem solving and maintenance of chain conveyors in mines.

CO-4 Apply Knowledge of mine machinery for installation, problem solving and maintenance of aerial ropeway in mines.

CO-5 Apply Knowledge of mine machinery for installation, problem solving and maintenance of Underground mine locomotives.

F) SCHEME OF STUDIES AND EXAMINATION :

Course Code	Periods/ Week (In Hours)			Scheme of Examination						Credit L+T+(P/2)
	L	T	P	Theory			Practical		Total Marks	
				ESE	CT	TA	ESE	TA		
2039372 (039)	2	1	0	70	20	30	-	-	120	3

G) DISTRIBUTION OF HOURS AND MARKS:-

S.No	Chapter Name	Hours	Marks
1	Rope haulage	10	15
2	Belt conveyor	10	15
3	Chain conveyor	10	15
4	Aerial ropeway	08	10
5	Underground Mine Locomotives	10	15
Total		**48**	**70**

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), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Apply Knowledge of mine machinery for installation, problem solving and maintenance of rope haulage in mine.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Use knowledge of installation and maintenance of different types of rope haulage in the given situation. SO1.2 Elaborate different types of rope haulage used in mines.		**Unit1.0 Rope Haulage** 1.1 Direct rope haulage. 1.2 Tugger haulage 1.3 Endless rope haulage 1.4 Main and tail rope haulage. 1.5 Safety devices used in rope haulage system, manhole.	• Illustrate different types of layout of rope haulages used in mines. • Enlist preventive maintenance of different types of haulages.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Describe construction and use of rope haulage systems.
ii. Illustrate different types of layout of rope haulages used in mines.
iii. Enlist preventive maintenance of different types of haulages.

b. Mini Project:

i. To construct a model of given type of rope haulage and showing its safety devices.

c. Other Activities (Specify):

i. Group study of transport system using in a nearby mine.

CO-2 Apply Knowledge of mine machinery for installation, problem solving and maintenance of belt conveyors in mines.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Use knowledge of installation and maintenance of belt conveyors in the given situation. SO2.2 Calculate amount of minerals to be transported based on given parameters.		**Unit2.0 Belt Conveyors-** 2.1 Belt conveyor-types, construction ,installation, handling and maintenance, 2.2 Belt conveyor Tensioning devices and holdback, carrying capacity of conveyor. 2.3 Merits and demerits of using belt conveyor in mines.	• Illustrate different types of layout of belt conveyor used in mines. • Enlist preventive maintenance of belt conveyors. • Calculate quantity of mineral to be transported based on given parameters.

SW-2 Suggested Sessional Work (SW) :

a. Assignments:

i. Describe construction and working of different types of belt conveyor.
ii. Illustrate different types of layout of belt conveyor used in mines.
iii. Enlist preventive maintenance of belt conveyors.
iv. Calculate amount of minerals to be transported based on given parameters.

b. Mini Project:

i. Collect relevant data related to belt conveyor used in nearby mines.
ii. Analyze the data with reference to efficiency of belt conveyor in comparison to other mode of transportation.

c. Other Activities (Specify):

i. Prepare a working model of a belt conveyor.

CO- 3 Apply Knowledge of mine machinery for installation, problem solving and maintenance of chain conveyors in mines.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Use knowledge of installation and maintenance of different types of chain		**Unit3.0 Chain conveyor-** 3.1 Types of chain conveyors. 3.2Construction, installation,	• Enlist preventive maintenance of chain conveyors

Session Outcomes	Laboratory Instruction	Class room Instruction	Self Learning
conveyor in the given situation. SO3.2 Calculate amount of minerals to be transported based on given parameters. SO3.3 Compare the applicability of chain conveyor with belt conveyors in the given situation.		operation and maintenance 3.3 Shifting of chain conveyor, 3.4 Merits and demerits of chain conveyor. 3.5 Comparison between belt and chain conveyor.	• Calculate amount of minerals to be transported based on given parameters.

SW-3 Suggested Sessional Work (SW) :

a. Assignments:

i. Describe construction and working of different types of chain conveyor
ii. Compare between belt and chain conveyor system of transportation.
iii. Enlist preventive maintenance of chain conveyors
iv. Calculate amount of minerals to be transported based on given parameters.

b. Mini Project:

i. Prepare a working model of chain conveyor.

CO-4 Apply Knowledge of mine machinery for installation, problem solving and maintenance of aerial ropeway in mines.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Elaborate construction and working of different types of aerial ropeway. SO4.2 Use knowledge of installation and maintenance of different types of aerial ropeways in the given situation.		**Unit4.0 Aerial ropeway-** 4.1 Various conditions for use of aerial ropeway. 4.2 Different Types of aerial ropeways used in mines along with their safety features. 4.3 Construction, installation and maintenance of Mono and Bi-cable ropeway.	• Illustrate different types of layout of aerial ropeways used in mines • Enlist preventive maintenance of aerial ropeways • Calculate quantity of mineral to be transported based on given parameters.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

i. Sketch and describe construction, installation and application of monocable aerial ropeway along with their safety features.
ii. Sketch and describe construction, installation and application of Bicable aerial ropeway along with their safety features
iii. Enlist preventive maintenance of aerial ropeways.
iv. Calculate quantity of mineral to be transported based on given parameters.

CO- 5 Apply Knowledge of mine machinery for installation, problem solving and maintenance of other underground mine locomotives.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Elaborate the construction and working of locomotive haulage. SO5.2 Compare the use of SDL, LHD and shuttle cars with other systems of transportation in the given situation.		**Unit5.0 Underground Mine Locomotives** SDL, LHD, Shuttle car, Locomotive haulage- Battery and diesel, flame traps & exhaust conditioner box, man riding system,	• Access and analyse the application of different locomotive haulages based on different economic factors. • Illustrate the safety features used in man riding system in mines. • Study the history of use of locomotive in mines and write a story on that.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others) , LI : Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

i. Demonstrate working feature of diesel locomotive.
ii. Explain different types man riding system.
iii. Access and analyse the application of different locomotive haulages based on different economic factors.
iv. Illustrate the safety features used in man riding system in mines.

b. Mini Project:

i. Visit nearby mines and prepare the list of different types of transportation system used in mines and compare them on parameters such as load carrying capacity, safety features, cost of machine, cost of operation and maintenance.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

J) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	Elements of mining technology Vol 3	D.J. DESHMUKH	Denett& Co	19th edition 2016
2	Mine pumps and haulages	S.GHATAK	Lovely prakashan	3rd edition 1996
3	Mine transport	KARLINE		
4	Underground mining methods : Engineering fundamentals and international case studies.	William A Hustrulid and Richard R Bullock	SME Publication	May 2001
5	SME Mining Reference Handbook	Raymond L Lowrie	SME Publication	December 2002
6	Mining Equipment and System : Theory and Practice of Exploitation and Reliability	Jacek M Czaplicki	CRC Press	December 2009
7	Extracting the Science : A Century of Mining Research	Jurgen F Brune	SME Publication	2010

(b) Open source software and website address :

1. http://www.edumine.com/courses/online-courses/
2. http://nptel.ac.in/course.php
3. http://octavesim.com/
4. https://swayam.gov.in/courses/public

K) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Apply Knowledge of mine machinery for installation, problem solving and maintenance of rope haulage in mines.	3	3	3	3	2	2	3	3	3	3	-	-
CO-2 Apply Knowledge of mine machinery for installation, problem solving and maintenance of belt conveyors in mines.	3	3	3	3	2	2	3	3	3	3	-	-
CO-3 Apply Knowledge of mine machinery for installation, problem solving and maintenance of chain conveyors in mines.	3	3	3	3	2	2	3	3	3	3	-	-
CO-4 Apply Knowledge of mine machinery for installation, problem solving and maintenance of aerial ropeway in mines.	3	3	3	3	2	2	3	3	3	3	-	-
CO-5 Apply Knowledge of mine machinery for installation, problem solving and maintenance of Underground mine locomotives.	3	3	3	3	2	2	3	3	3	3	-	-

Legend: 1 – Low, 2 – Medium, 3 – High

L) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-1 Apply Knowledge of mine machinery for installation, problem solving and maintenance of rope haulage in mines.	SO1.1 SO1.2	LE1.1 LE1.2 LE1.3	Unit 1.0 Rope Haulage 1.2, 1.3, 1.4, 1.5	As mentioned in relevant page numbers
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-2 Apply Knowledge of mine machinery for installation, problem solving and maintenance of belt conveyors in mines.	SO2.1 SO2.2	LE2.1 LE2.2 LE2.3	Unit 2.0 Belt Conveyors 2.1 2.2 2.3	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-3 Apply Knowledge of mine machinery for installation, problem solving and maintenance of chain conveyors in mines.	SO3.1 SO3.2 SO3.3	LE3.1	Unit 3.0 Chain conveyor 3.1, 3.2, 3.3, 3.4, 3.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-4 Apply Knowledge of mine machinery for installation, problem solving and maintenance of aerial ropeway in mines.	SO4.1 SO4.2	LE4.1 LE4.2	Unit 4.0 Aerial ropeway 4.1 4.2 4.3	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-5 Apply Knowledge of mine machinery for installation, problem solving and maintenance of Underground mine locomotives.	SO5.1 SO5.2	LE5.1	Unit 5.0 Underground Mine Locomotives	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

A) Course Code : 2039373(039)
B) Course Title : Applied Geology
C) Pre- requisite Course Code and Title :
D) Rationale :

Mining engineering is the application of combined knowledge of various branches of engineering and technology in extracting the mineral from the earth or from the underground. As such the geology becomes the first step of mining education. It is essential to know and identify mineral and ore, their modes of occurrences in the earth crust and the formation and deposits of various rocks.

As such the subject Applied Geology is introduced in the third semester of three year diploma course in mining engineering. Purpose of introducing the subject of "Applied Geology" is to make a student aware of basic ideas of topics essential to develop understanding the initial stages involved in mining of minerals. The subject deals with the following topics which are the basic for a mining diploma education, in first stage.

A systematic approach is designed in sequential order to acquire knowledge of:-

1. Physical Geology
2. Mineralogy
3. Petrology
4. Structural Geology

E) Course Outcomes:

CO-1 Apply the basic knowledge of physical geology with reference to given context.

CO-2 Solve simple engineering problems related to mineralogical chemistry of rocks.

CO-3 Solve engineering problems related to origin, texture and structure of rock.

CO-4 Solve engineering problems related with applied and field geology.

F) **SCHEME OF STUDIES AND EXAMINATION :**

Course Code	Periods/ Week (In Hours)			Scheme of Examination						Credit L+T+(P/2)
	L	T	P	Theory			Practical		Total Marks	
				ESE	CT	TA	ESE	TA		
2039373 (039)	2	1	2	70	20	30	40	60	220	4

G) DISTRIBUTION OF HOURS AND MARKS:-

S.No	Chapter Name	Hours	Marks
1	Physical geology	12	20
2	Mineralogy	12	20
3	Petrology	12	15
4	Structural geology	12	15
Total		**48**	**70**

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), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

Convert unit of the given physical quantity from one unit system to other.

CO-1 Apply the basic knowledge of physical geology with reference to given context.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1 Explain given geological terms with suitable examples and illustrations. SO1.2 Draw specific features related to geological work of wind and river. SO1.3 Measure the intensity of earthquake. SO1.4 Explain the environmental effects of geological weathering, post earthquake and post volcanoes.	LE1.1 Sketch and describe the features of solar system. LE1.2 Sketch and identify different types of geomorphological models such as volcanoes earthquake etc. LE1.3 Measure the intensity of earthquake (Richter scale).	**Unit1.0 Physical Geology** 1.1 Solar system, Origin of Earth with various hypotheses. 1.2 Various methods to determination of age of the earth. 1.3 Interior of the Earth-Crust, Mental and Core. 1.4 Elementry knowledge of weathering ,work of wind and work of rivers in formation of geological structures. 1.5 Earthquakes, , Earthquake waves, Earthquake Scale 1.6 Volcanoes, types of volcanoes, volcanic products, volcanic cones, distribution of volcanoes.	• Collect the data of post flood activity, desert, volcano and earthquake related to mankind.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Describe absolute age determination of earth by radioactivity method.
ii. Discussion on uniparental and biparental hypotheses on origin of earth.

b. Mini Project:

i. Make a model of interior of earth.

c. Other Activities (Specify):

i. Visit a nearby location with exposed geological features and take photograph and Write brief details on it.
ii. Visit a nearby location of course of river pattern.

CO-2 Solve simple engineering problems related to mineralogical chemistry of rocks.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Collect samples and identify with its characteristics physical properties of mineral. SO2.2 Identify the presence of mineral in the collected rock sample.	LE2.1 Identification of rock forming minerals in hand specimen with their diagnostic properties with the help of goniometer, streak plate, knife, glass plate, magnifying glass, magnet.	**Unit2.0 Mineralogy** 2.1 Definition, Diagnostic Physical properties of minerals – crystal form, Colour, Streak, Luster, hardness, Cleavage, Fracture. Identification of common minerals- Orthoclase feldspar Plagioclase feldspar, Augite, fluorite, graphite Hornblende, Biotite, Galena, Muscovite, Olivine, Quartz, Asbestos, Calcite, Dolomite, Corundum, Gypsum, Talc etc. 2.2 Uses of mineral identification instrument like goniometer, streak plate, knife, glass plate, magnifying glass, magnet.	• Collect various mineral samples from the surrounding and identify them. • Identify different minerals showing same streak • Collect different types of cleavages sample.

SW-2 Suggested Sessional Work (SW) :

a. Assignments:

i. Write the properties of mineral showing same colour
ii. Write the economical values of collected samples.

b. Mini Project:

i. Visit a nearby mines area identify minerals and rocks with their diagnostic properties and collect samples with mark

ii. Prepare a brief report on mode of formation of minerals.

c. Other Activities (Specify):

i. Collect metallic and non metallic samples.

CO-3 Solve engineering problems related to origin, texture and structure of rock.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Collect samples and identify the rocks with petrological property. SO3.2 Identify the igneous and sedimentary structure. SO3.3 Identify the top and bottom criteria.	LE3.1 Identify the different type of rocks with their structure. LE3.2 Identify the igneous rock with texture and structure. LE3.3 Identify the sedimentary rock with texture and structure. LE3.4 Identify the metamorphic rock with texture and structure. LE3.5 Identify the concordant and disconcordant form.	**Unit3.0 Petrology** 3.1 Classification of Rocks 3.2 Igneous rocks- Acid and basic rocks, Textures and structure of Igneous rocks- Tabular Classification of igneous rock. Forms and structures of igneous bodies Petrological properties of Common Igneous rocks – Granite, Syenite, Gabbro, Basalt, Trachyte and Rhyolite. 3.3 Sedimentary rocks - definition , Classification, and formation. Sedimentary structures. 3.4 Sedimentary rocks- Conglomerate Sandstone, Shale, lime stone, clay and Breaccia. 3.5 Metamorphic rock – Definition, Agents and kind of metamorphic rock. Metamorphism Texture and Structure of Metamorphic rocks– Slaty, Schistose, Gheissose and Granulose . 3.6 Common Metamorphic rocks	• Classify the igneous metamorphic and sedimentary rocks. (on the basis of chemical composition, crystallizatio n, origin and texture)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
		– Slate, Schist, Gneiss, Quartzite and Marble.	

SW-3 Suggested Sessional Work (SW) :

a. Assignments:

i. Compare different rock with their textural properties.

ii. Find out microstructure in metamorphic and igneous rock such as granulose maculose schistose gneissic, corona lit-par-lit structure, vesicular structure.

b. Mini Project:

i. Visit a nearby area with exposed outcrops such as dam, canal, rail and mining area. Also prepare a report with dip-strike and bearing of structure.

CO-4 Solve engineering problems related with structural geology.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Classification of fold on the basis of axial plane. SO4.2 Identify the different type of fault on the basis of throw of hanging wall, foot wall and angle of fault plan.	LE4.1 Measure the amount and direction of dip and strike of structural model with the help of clinometers compass LE4.2 Draw and sketch different types of fold. LE4.3 Draw and sketch different types of fault. LE4.4 Draw and sketch different types of Unconformity.	**Unit4.0 Structural Geology** 4.1 Dip and Strike, Apparent dip and True dip. 4.2 Folds- definition, Elements of fold, types of fold, Identification of fold in map and field. 4.3 Fault – definition, Fault Terminology, elements of fault. Classification and type of faults. Identification of fault in map and field. 4.4 Unconformities- definition, Types. Identification of Unconformity in map and field. 4.5 Joints- Classification- Strike joints, Dip joints, Oblique joints, Bedding joints, Mural Joints, Sheet Joints and columnar joints.	• Write down the complete geological history of given geological section map.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

i. Write difference between fault and unconformity in geological map and field.
ii. Find out the true dip and apparent dip of a exposure/structural model.

b. Mini Project:

i. Draw profile, section map, thickness of bed and amount of dip. Give complete succession.
ii. Draw completion of outcrop map with three reference points. Find out dip and strike direction

I) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work(Marks)		
		Performance		Viva-Voce
		PRA	PDA	
1.	Sketch and draw features of solar system	15	15	30
2.	Sketch and identify of different types of geomorphological models such as volcanoes earthquake etc.	15	15	30
3.	Measure the intensity of earthquake (Richter scale)	15	15	30
4.	Identification of rock forming minerals in hand specimen with their diagnostic properties with the help of goniometer, streak plate, knife, glass plate, magnifying glass, magnet.	15	15	30
5.	Identify the different type of rocks with their structure.	15	15	30
6.	Identify the igneous rock with texture and structure.	15	15	30
7.	Identify the sedimentary rock with texture and structure.	15	15	30
8.	Identify the metamorphic rock with texture and structure.	15	15	30
9.	Identify the concordant and disconcordant form.	15	15	30
10.	Measure the amount and direction of dip and strike of structural model with the help of clinometers compass	15	15	30
11.	Draw and sketch different types of fold.	15	15	30
12.	Draw and sketch different types of fault	15	15	30
13.	Draw and sketch different types of Unconformity.	15	15	30

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practical.

Legend : PRA: Process Assessment, PDA : Product Assessment

Note : Only one experiment has to performed at the end semester examination of **40 Marks** as per assessment scheme.

J) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

K) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	Applied Geology	K M Bangar	Standard publishers distributors	2nd, 2009
2	Introduction to geology	V.S. Joji	I.K. International Publishing House	2017
3	Engineering and general geology	Prabin singh	S.K. Kataria and sons	2013

(b) Open source software and website address : N/A

L) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Richter scale	Standard	3
2	Hardness kits(Mohr scale)	Mohr scale.	4
3	Goniometer	As standard	4

M) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Apply the basic knowledge of physical geology with reference to given context.	3	2	2	2	2	2	2	3	3	3	-	-
CO-2 Solve simple engineering problems related to mineralogical chemistry of rocks.	3	2	2	2	2	2	2	3	3	3	-	-
CO-3 Solve engineering problems related to origin, texture and structure of rock.	3	2	2	2	2	2	2	3	3	3	-	-
CO-4 Solve engineering problems related with structural geology.	3	2	2	2	2	2	2	3	3	3	-	-

Legend: 1 – Low, 2 – Medium, 3 – High

N) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-1 Apply the basic knowledge of physical geology with reference to given context.	SO1.1 SO1.2 SO1.3 SO1.4	LE1.1 LE1.2 LE1.3	Unit1.0 Physical Geology 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8	As mentioned in relevant page numbers
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-2 Solve simple engineering problems related to mineralogical chemistry of rocks.	SO2.1 SO2.2	LE2.1	Unit2.0 Mineralogy 2.1 2.2 2.3	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-3 Solve engineering problems related to origin, texture and structure of rock.	SO3.1 SO3.2 SO3.3	LE3.1 LE3.2 LE3.3 LE3.4 LE3.5	Unit3.0 Petrology 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-4 Solve engineering problems related with structural geology.	SO4.1 SO4.2	LE4.1 LE4.2 LE4.3 LE4.4	Unit4.0 Structural Geology 4.1, 4.2, 4.3, 4.4, 4.5	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

A) Course Code : 2039374(039)
B) Course Title : Elements of Mine Surveying
C) Pre- requisite Course Code and Title :
D) Rationale :

Technical observations commence with scientific glances necessity skills of majoring various objects. A newly admitted student of this special stream needs to be taught the various objectives and methods of measuring land forms. This subject of "Elements of Mine Surveying" included in the curriculum to enable students to acquire knowledge of:-

a. Introduction
b. Chain Surveying
c. Compass Surveying
d. Dial Traversing
e. Computation of Area and Volume.

E) Course Outcomes :

CO-1 Apply basic principle of surveying for access to mine deposits.
CO-2 Conduct chain surveying at given situation.
CO-3 Conduct compass surveying at given situation.
CO-4 Conduct dial surveying at given situation.
CO-5 By applying the principle of surveying compute area and volume of given shape and size.

F) SCHEME OF STUDIES AND EXAMINATION :

Course Code	Periods/ Week (In Hours)			Scheme of Examination						Credit L+T+(P/2)
	L	T	P	Theory			Practical		Total Marks	
				ESE	CT	TA	ESE	TA		
2039374 (039)	2	1	2	70	20	30	40	60	220	4

G) DISTRIBUTION OF HOURS AND MARKS:-

S.No	Chapter Name	Hours	Marks
1	Introduction.	10	15
2	Chain Surveying	10	15
3	Compass Surveying	10	15
4	Dial Traversing	08	10
5	Computation of Area and Volume	10	15
Total		**48**	**70**

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), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.
Convert unit of the given physical quantity from one unit system to other.

CO-1 Apply basic principle of surveying for access to mine deposits.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self -Learning (SL)
SO1.1 Classify survey on basis of purpose of survey and instrument used SO1.2 Check the estimated distances and angles with the measured distances and angles.		**Unit1.0 Introduction** 1.1 Definition and Objects of surveying 1.2 Classification of survey 1.3 Principle of surveying 1.4 Linear measurement 1.5 Angular measurements 1.6 Measurement of distances a. Direct method b. Computation method.	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Describe the methods of linear and angular measurements.
ii. Write down the principle of surveying and classification of survey.

CO-2 Conduct chain surveying at given situation.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Draw clear sketch of a given type of chain/tape showing its constructional detail of a given chain/tape SO2.2 List various instruments used in chain surveying.	LE2.1 Sketch and describe various types of chain and tape use in chain survey. LE2.2 Ranging and chaining of a line about 50 meter in length LE2.3 Traversing of a given area by chain and tape. LE2.4 Plot a survey work with a suitable	**Unit2.0 Chain Surveying** 2.1 Purpose and principle of chain surveying. 2.2 Equipment used in chain surveying-chain, tape, ranging rods, pegs, cross staff, optical square. 2.3 Different operations in chain surveying-Direct and indirect ranging, chaining on flat and sloping	• Comparison of constructional detail of different types of chain and tape. • Observe the effect of error due to damage of chain and tape. • Observe the

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.3 Traverse a given area by chain and tape. SO2.4 Plot survey work with a given scale by scale and protector method.	scale conducted by yourself.	ground, perpendicular and oblique offsetting. 2.4 Conducting chain survey recording field data plotting the survey work using conventional sign. 2.5 Obstacles and errors in chain surveying. 2.6 Corrections, test, and adjustment of chain.	difference in length by measuring a line with a chain and a tape.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Describe various types of chain and tape.
ii. Describe the procedure of traversing by chain and tape.

b. Other Activities (Specify):

i. Check the accuracy of a given chain with the help of a standard tape.
ii. Measure the error found in a given chain and adjust it by doing necessary corrections.

CO-3 Conduct compass surveying at given situation.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Draw the Sectional view of a surveyor and prismatic compass showing its constructional details. SO3.2 Measure bearings of given lines and compute included angle and check the result. SO3.3 Traverse an area with surveyor/prismatic compass by given method.	LE3.1 Measurement of magnetic bearing and calculation of included angles LE3.2 Measurement of included angle with the help of a prismatic compass. LE3.3 Traversing of given areas by prismatic compass by applying alternate station method and double foresight method and its plotting. LE3.4 Calculate the effect of local	**Unit3.0 Compass Surveying** 3.1 Purpose of compass surveying. 3.2 Construction of surveyors and prismatic compass. 3.3 Comparison between surveyors and prismatic compass. 3.4 Concept of (i) meridian- true, magnetic and arbitrary meridians. (ii) bearing-true, magnetic and arbitrary, magnetic dip and declination. 3.5 System of measuring the bearings- whole circle bearing, reduced bearing (Q.B.) Problems on	• Measure the magnetic dip and magnetic declination at a given place and time • Observe the variations in magnetic meridian on a particular place according to change in time.

	attraction and apply corrections.	conversion of bearings. 3.6 Fore bearing and back bearing of a line 3.7 Concept of a traverse-open and closed traverse. 3.8 Local attraction, causes, detection, error and applying correction. 3.9 Checks for an open and closed traverse. 3.10 Calculation of included angle from bearing and vice-versa. 3.11 Error, precaution and adjustment in compass surveying.	

SW-3 Suggested Sessional Work (SW) :

a. Assignments:

i. Compare Prismatic and Surveyor compass.

ii. Describe alternate station method and double foresight method of compass surveying.

b. Mini Project:

i. Traverse an area by prismatic compass and a miner dial, plot and compare results of both the survey work

c. Other Activities (Specify):

i. Study of Survey map of India/CG.

CO-4 Conduct dial surveying at given situation.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Calculate Least count of a given instrument. SO4.2 Measure included angle, deflection angle and calculate bearing of given lines. SO4.3 Traverse a given area with a dial by a given method.	LE4.1 Calculate least count of a given venier dial. LE4.2 Measure bearings of given lines and calculate included angle between them. LE4.3 Traversing with a miners dial by different methods (alternate station method/double foresight method/ loose	**Unit4.0 Dial Traversing** 4.1 Introduction and description of ordinary and telescopic vernier dial, calculation of least count of vernier dial. 4.2 Temporary and permanent adjustments 4.3 Taking bearing and observation with dial. 4.4 Method of dial Traversing-Loose and fast needle of traversing. 4.4 Measurement of	• Checking of accuracy of given dial and its permanent adjustments. • Performance of permanent adjustments.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.4 Perform temporary and permanent adjustment of a dial.	needle and fast needle) LE4.4 Measurement of deflection angle and calculation of bearings.	included and deflection angles. 4.5 Transfer of survey station from floor to roof and roof to floor. 4.6 Setting out underground road ways with the help of dial 4.7 Marking of center line of a gallery. 4. 8 Plotting by scale and protector. 4.9 Test for miners dial	

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

i. Describe various types of dial traversing method (loose and fast needle)
ii. Describe method of Setting out underground road ways with the help of dial.

b. Mini Project:

i. Marking of Center line of given gallery of given length.
ii. Shifting of roof stations to floor and floor stations to roof.

c. Other Activities (Specify):

i. Calculate the least count of instruments having various graduation systems.
ii. Plot a given survey work by scale and protector.

CO-5 By applying the principle of surveying compute area and volume of given shape and size.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Compute area of a given shape and size. SO5.2 Compute volume of a given shape and size.	LE5.1 Compute area of regular and irregular shapes by Simpsons Rule and by Bowditch Rule. LE5.2 Compute volume of regular and irregular shapes by Simpsons Rule and by Bowditch Rule.	**Unit5.0 Computation of Area and Volume** 5.1 Computation of area of regular and irregular shapes by Simpsons Rule and by Bowditch Rule. 5.2 Computation of volume of regular and irregular shapes by Simpsons Rule and by Bowditch Rule.	• Calculate area and volume of regular and irregular shape given to you.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Calculate area of a given regular figure.
ii. Calculate area of a given irregular figure.
iii. Calculate volume of a given regular figure.
iv. Calculate volume of a given irregular figure.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
1	Sketch and describe various types of chain and tape use in chain survey.	15	15	30
2	Ranging and chaining of a line about 50 meter in length	15	15	30
3	Traversing of a given area by chain and tape	15	15	30
4	Plot a survey work with a suitable scale conducted by your self.	15	15	30
5	Measurement of magnetic bearing and calculation of included angles	05	05	10
6	Measurement of included angle with the help of a prismatic compass.	05	05	10
7	Traversing of a given areas by prismatic compass by applying alternate station method and double foresight method and its plotting.	05	05	10
8	Calculate the effect of local attraction and applying corrections	05	05	10
9	Calculate least count of a given verniredail.	05	05	10
10	Measure bearings of given lines and calculate included angle between them.	05	05	10
11	Traversing with a miners dial by different methods (alternate station method/double foresight method/ loose needle and fast needle)	05	05	10
12	Measurement of deflection angle and calculation of bearings	05	05	10
13	Compute area of regular and irregular shapes by Simpsons Rule and by Bowditch Rule.	05	05	10
14	Compute volume of regular and irregular shapes by Simpsons Rule and by Bowditch Rule.	05	05	10

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments/practices.

Legend : PRA: Process Assessment, PDA : Product Assessment

Note : Only one experiment has to performed at the end semester examination of **40 Marks** as per assessment scheme

J) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

K) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1	Surveying, Vol-I	B.C. Punamia	Laxmi Publication	1 june 2016
2	Mine Surveying, Vol-I & II	S. Ghatak	Coal field Publication	
3	Surveying & Leveling, Vol-I	Kanetkar& Kulkarni	Pune Vidhyarthi Griha prakashan Pune	
4.	Fundamental of surveying	S.K. Roy	PHI Learning Pvt. Ltd. New Delhi	2nd Edition, 2010

(b) Open source software and website address:

1. nptel.ac.in/courses/105104101/
2. http://www.edumine.com/
3. http://nptel.ac.in/course.php
4. http://octavesim.com/
5. https://swayam.gov.in/courses/public

(c) Others:

1. https://www.youtube.com/watch?v=chhuq_t40rY&list=PL20A0651466E8A776

L) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Chain and Tape	20m, 30m & 50m chain. 30m,50m, 100m tape	1,2,3,4
2	Ranging Rod	Metallic type -2m,3m.	All
3	Staff and Peg		All
4	Prismatic compass	10 cm. dia.	5,6,7,8,9,10,13,14
5	Surveyor Compass	Dia30cm	9,13,14
6	Miner's Dail	diameter	11,12,13,14

M) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1 Apply basic principle of surveying for access to mine deposits.	3	3	3	2	2	2	3	3	3	3	-	-
CO-2 Conduct chain surveying at given situation.	3	3	3	2	2	2	3	3	3	3	-	-
CO-3 Conduct compass surveying at given situation.	3	3	3	2	2	2	3	3	3	3	-	-
CO-4 Conduct dial surveying at given situation.	3	3	3	2	2	2	3	3	3	3	-	-
CO-5 By applying the principle of surveying compute area and volume of given shape and size.	3	3	3	2	2	2	3	3	3	3	-	-

Legend: 1 – Low, 2 – Medium, 3 – High

N) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-1 Apply basic principle of surveying for access to mine deposits.	SO1.1 SO1.2		Unit1.0 Introduction 1.1, 1.2, 1.3, 1.4, 1.5, 1.6	As mentioned in relevant page numbers
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-2 Conduct chain surveying at given situation.	SO2.1 SO2.2 SO2.3 SO2.4	LE2.1 LE2.2 LE2.3 LE2.4	Unit2.0 Chain Surveying 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-3 Conduct compass surveying at given situation.	SO3.1 SO3.2 SO3.3	LE3.1 LE3.2 LE3.3 LE3.4	Unit-3.0 Compass Surveying 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-4 Conduct dial surveying at given situation.	SO4.1 SO4.2 SO4.3 SO4.4	LE4.1 LE4.2 LE4.3 LE4.4	Unit-4.0 Dial Traversing 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-5 By applying the principle of surveying compute area and volume of given shape and size.	SO5.1 SO5.2	LE5.1 LE5.2	Unit-5.0 Computation of Area and Volume 5.1 5.2	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

A) Course Code : 2039375(039)
B) Course Title : Mine Ventilation (Lab)
C) Pre- requisite Course Code and Title :
D) Rationale

Mining engineers' role is to provide a comfortable, safe and healthy working environment as prescribed in Mines Act, Rules and Regulations and as specified from time to time by the competent authority. This paper deals with the scientific parameters required to create safe, comfortable and healthy working conditions with the application of knowledge of mine environment, mine gases, maintenance of temperature and humidity, principles of natural and mechanical ventilation in mines, etc. Therefore, it requires application of systematic planning, scientific approach and safety measures to create comfortable, safe and healthy working environment.

E) Course Outcomes:

CO-1 Apply knowledge of mine environment to maintain safe and comfortable working conditions in mines.

CO-2 Use the knowledge of heat and humidity in mines to create comfortable working conditions.

CO-3 Use different terms of mine ventilation to conceive the concepts of safe and comfortable conditions.

CO-4 Use the knowledge of mine ventilation to create safe, healthy and comfortable working conditions.

CO-5 Use principles of mine lighting to ensure adequate illuminations in mines.

F) SCHEME OF STUDIES AND EXAMINATION:

Course Code	Periods/ Week (In Hours)			Scheme of Examination						Credit L+T+(P/2)
	L	T	P	Theory			Practical		Total Marks	
				ESE	CT	TA	ESE	TA		
2039375 (039)	3	1	2	70	20	30	40	60	220	5

G) DISTRIBUTION OF HOURS AND MARKS:

S.No	Unit Titles	Hours	Total Marks
1	Mine atmosphere	13	15
2	Heat and Humidity	12	10
3	Basics of Mine Ventilation	13	15
4	Mine Ventilation System	13	15
5	Mine lighting and Illumination	13	15
Total		**64**	**70**

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), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Apply knowledge of mine environment to maintain safe and comfortable working conditions in mines.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Explain different types of mine gases, their origin, composition, effects, occurrence and detection in mines. SO1.2 Explain gas laws and their application in different situation in mines. SO1.3 Elaborate the principle, procedure and mechanism of methane drainage under given condition in mines.	LE1.1 Detect different gases in mine atmosphere using suitable equipment and prepare a chart of composition of mine atmosphere. LE1.2 Draw layouts of different procedure of methane drainage.	**Unit1.0 Mine Atmosphere** 1.1 Pollution of mine atmosphere. 1.2 Mine gases (CO, CO_2, CH_4 Etc.), composition, physical and chemical properties of mine air. 1.3 Origin and occurrence of mine gases. 1.4 The gas laws. 1.5 Effects and detection of mine gases. 1.6 Methane drainage. 1.7 Monitoring system of mine Environment. 1.8 Analysis of mine air. 1.9 Flame safety lamps-GL-7, GL-5, GL-60	• Identify the equipment used for detection of gases like carbon-mono-oxide, methane, carbon di oxide, nitrogen oxides etc. • Carryout the analysis of mine atmosphere in different mines and compare the result. • Study the physiological effects of various mine gases.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Identify the equipment used for detection of gases like carbon-mono-oxide, methane, carbon di oxide, nitrogen oxides etc.

ii. Carryout the analysis of mine atmosphere in different mines and compare the result.

iii. Study the physiological effects of various mine gases.

b. Other Activities (Specify):

i. Relate the above studies with the industrial visit of mines and prepare a report with the above data.

CO-2 Use the knowledge of heat and humidity in mines to create comfortable working conditions.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Identify the sources of heat and humidity and their effects in mine atmosphere. SO2.2 Calculate the cooling power of mine air in the given situation SO2.3 Use knowledge of installation and operating mechanism of air conditioning plants and spot coolers in mines.	LE2.1 To measure the heat and humidity in mine atmosphere using suitable equipment. LE2.2 To draw layouts of different air conditioning systems based on given condition.	**Unit2.0 Heat and Humidity** 2.1 Heat and Humidity in mine atmosphere and their effects 2.2 Cooling power of mine air 2.3 Assessment of comfort condition. 2.4 Air conditioning of mines, surface, underground and divided installations 2.5 Spot coolers.	• To collect information about sources of heat and humidity in mines and their physiological effects in human life.

SW-2 Suggested Sessional Work (SW) :

a. Assignments:

i. To collect information about sources of heat and humidity in mines and their physiological effect on human life.

ii. To find measures which can be applied to mitigate the harmful effects of heat and humidity on human and mine life.

b. Mini Project:

i. Prepare a model on Spot cooler.

c. Other Activities (Specify):

i. List different types of instruments used for measuring heat and humidity in mines.

CO-3 Use different terms of mine ventilation to conceive the concepts of safe and comfortable conditions.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain the need and importance of object and standard of ventilation and related regulations SO3.2 Measure pressure, quantity and velocity required for air flow in mines with the application of law of air flow. SO3.3 Calculate equivalent resistance and equivalent orifice based on given parameters.	LE3.1 Measure quantity and velocity of air and atmospheric pressure using suitable equipment. LE3.2 Monitor air quality using suitable dust measuring devices by measuring size and concentration of dust particles.	**Unit3.0 Basics of Mine Ventilation** 3.1 Object of ventilation, introduction of natural and artificial ventilation and standards of ventilation. 3.2 Degree of gassiness of mines, 3.3 Measurement of air quantity, pressure and velocity. 3.4 Law of air flow in mines, flow of air in ducts and mine roadways, resistance of airways, chezys and atkinsons equation. 3.5 Equivalent resistance and equivalent orifice of mine, 3.6 Regulation related with above topics. 3.7 Dust monitoring.	• To collect the data related to the gas emission from different mines and classify them on the basis of degree of gassiness. • Collect ventilation data from different mines and evaluate comfortable conditions of working at work places under given conditions.

SW-3 Suggested Sessional Work (SW) :

a. Assignments:

i. To collect the data related to the gas emission from different mines and classify them on the basis of degree of gassiness

ii. Collect ventilation data from different mines and evaluate comfortable conditions of working at work places under given conditions.

b. Other Activities (Specify):

i. Visit a nearby mine having natural ventilation system.

CO-4 Use the knowledge of mine ventilation for creating safe, healthy and comfortable working conditions.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain the mechanism of natural ventilation and measure the natural ventilation pressure under different situation. SO4.2 Use knowledge of constructional features and characteristic curves for selection of suitable mechanical ventilation under given conditions. SO4.3 Calculate pressure and velocity produced under different mechanical ventilation system based on given parameters	LE4.1 Draw layout of distribution of air current for ventilation under given conditions LE4.2 Sketch and describe auxiliary and booster fans. LE4.3 Make a layout for the installation of various accessories used in ventilation like door, airlock, regulator, stopping, air crossing and brattice cloth under given conditions.	**Unit4.0 Mine ventilation System** 4.1 Natural ventilation and its measurement. 4.2 Thermodynamics of natural ventilation, 4.3 Distribution of air and its control. 4.5 Ascensional and descensional ventilation. 4.6 Mechanical ventilation, different types of fans used in mines, Characteristic curves of fan, relation between pressure quantity and power of fan, fan drift, their construction feature, auxiliary and booster fan, splitting of air current, advantage of splitting, reversal of air current, leakage of air 4.4 Accessories of ventilation used in mines –Door, Airlock, regulator, stopping, air crossing, brattice partitions. 4.7 Numerical calculation	• Prepare model for different mechanical ventilation system. • Collect information and data related to accidents occurred due to inadequate ventilation in mines. • Study the effectiveness of use of auxiliary and booster fans in near by mines.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

i. Collect information and data related to accidents occurred due to inadequate ventilation in mines
ii. Study the effectiveness of use of auxiliary and booster fans in nearby mines.

b. Mini Project:

i. Prepare a model to show different ventilation accessories.

c. Other Activities (Specify):

i. Prepare model for different mechanical ventilation system.

CO-5 Use principles of mine lighting to ensure adequate illumination in mines.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Explain various technical terms and parameters related to mine lighting and illumination. SO5.2 Explain the constructional features and operating procedures of various types of lamps used in mines. SO5.3 Explain statutory provisions related to underground and surface lighting in mines.	LE5.1 Sketch and describe after assembling and dissembling of flame safety lamp. LE5.2 Draw layouts of lamp room organization.	**Unit5.0 Mine lighting and illumination** 5.1 Technical terms in lighting and photometry. 5.2 Lighting source in mines, cap lamp, constructional features of lamps, 5.3 Surface and Underground lighting as per statutory norms. 5.4 Flameproof and intrinsically safe lighting. 5.5 Lamp room layout, lamp room organization, care and maintenance of cap lamps.	• Study statutory norms for underground and surface lighting in mines. • Study the use, care and maintenance of cap lamps. • Study the risk associated with the use of non-intrinsically safe equipment.

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others) , LI : Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

i. Study statutory norms for underground and surface lighting in mines.
ii. Study the use, care and maintenance of cap lamps.
iii. Study the risks associated with the use of non- intrinsically safe equipment.

b.` Mini Project:

i. Prepare a model to show 50 nos. capacity cap lamp room.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

I) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
1	Detect different gases in mine atmosphere using suitable equipment and prepare a chart of composition of mine atmosphere.	15	15	30
2	Draw layouts of different procedure of methane drainage.	15	15	30
3	To measure the heat and humidity in mine atmosphere using suitable equipment	15	15	30
4	To draw layouts of different air conditioning systems based on given condition.	15	15	30
5	Measure quantity and velocity of air and atmospheric pressure using suitable equipment.	15	15	30
6	Monitor air quality using suitable dust measuring devices by measuring size and concentration of dust particles	15	15	30
7	Draw layout of distribution of air current for ventilation under given conditions	15	15	30
8	Sketch and describe auxiliary and booster fans.	15	15	30
9	Make a layout for the installation of various accessories used in ventilation like door, airlock, regulator, stopping, air crossing and brattice cloth under given conditions	15	15	30
10	Sketch and describe after assembling and dissembling of flame safety lamp.	15	15	30
11	Draw layouts of lamp room organization.	15	15	30

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend : PRA: Process Assessment, PDA : Product Assessment

Note : Only one experiment has to performed at the end semester examination of **40 Marks** as per assessment scheme

J) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

K) Suggested Learning Resources:

(a) Books :

S. No.	Titles	Author	Publisher	Edition & Year
1.	Mine Ventilation and air conditioning	Howard L. Hartman, Jan M. Mutmansky, Raja V. Ramani, Y. J. Wang	Willy Eastern Publication, New Delhi	Nov. 1997
2.	Mine Ventilation- Two volumes	D.C. Panigrahi	CRC Press	2001
3.	Practical Mine Ventilation (digitized edition)	James R Robinson	University of California Press	2009
4.	Mine environment and ventilation	G. B. Mishra	Oxford University Press	1986
5.	Advanced Mine Ventilation- Respirable coal dust, combustible gas and mine fire control	Pramod Thakur	Woodhead Publishing	2018

(b) Open source software and website address :

1. Practice of mine ventilation engineering @ https://www.srk.com/en/publication/na-practice-mine-ventilation-engineering
2. https://en.wikipedia.org/wiki/Underground_mine_ventilation
3. http://www.edumine.com/courses/topics/mine-ventilation/
4. https://www.na.srk.com/en/na-short-course-mine-ventilation-basics-and-advanced-concepts
5. https://mining.mines.edu/mining-ventilation-laboratory/

L) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	D-6 Methanometer	MSA, measurement range from 0 to 5% by volume, nickel cadmium batteries.	1
2	P.S. detector		1
3	Multi gas detector	MSA ALTAIR 4X sensor, rugged IP 67 housing.	1
4	Whirling Hygrometer		3
5	Rotating vane Anemometer	Anemometer have for vanes, low friction ball or roller bearing, sensitivity 50-100fpm, accuracy 80-90%, air velocity measuring range .25 to 50 m/s.	5
6	Pitot Static Tube		5
7	Gravimetric dust sampler		6
8	Flame safety lamp	GL-5 ,GL-7, GL-60	10

M) Mapping of POs & PSOs with COs:

Course Outcomes (COs)		Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
		PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2
CO-1	Apply knowledge of mine environment to maintain safe and comfortable working conditions in mines.	3	3	3	3	3	2	3	3	3	3	-	-
CO-2	Use the knowledge of heat and humidity in mines to create comfortable working conditions.	3	3	3	3	3	2	3	3	3	3	-	-
CO-3	Use different terms of mine ventilation to conceive the concepts of safe and comfortable conditions.	3	3	3	3	3	2	3	3	3	3	-	-
CO-4	Use the knowledge of mine ventilation to create safe, healthy and comfortable working conditions.	3	3	3	3	3	2	3	3	3	3	-	-
CO-5	Use principles of mine lighting to ensure adequate illuminations in mines.	3	3	3	3	3	2	3	3	3	3	-	-

Legend: 1 – Low, 2 – Medium, 3 – High

N) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-1 Apply knowledge of mine environment to maintain safe and comfortable working conditions in mines.	SO1.1 SO1.2 SO1.3	LE1.1 LE1.2	Unit-1.0 Mine Atmosphere 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9	As mentioned in relevant page numbers
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-2 Use the knowledge of heat and humidity in mines to create comfortable working conditions.	SO2.1 SO2.2 SO2.3	LE2.1 LE2.2	Unit-2.0 Heat and Humidity 2.1, 2.2, 2.3, 2.4, 2.5	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-3 Use different terms of mine ventilation to conceive the concepts of safe and comfortable conditions.	SO3.1 SO3.2 SO3.3	LE3.1 LE3.2	Unit-3.0 Basics of Mine Ventilation 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-4 Use the knowledge of mine ventilation to create safe, healthy and comfortable working conditions.	SO4.1 SO4.2 SO4.3	LE4.1 LE4.2 LE4.3	Unit-4.0 Mine ventilation System 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7	
PO-1,2,3,4,5,6, 7,8,9,10 PSO-	CO-5 Use principles of mine lighting to ensure adequate illuminations in mines.	SO5.1 SO5.2 SO5.3	LE5.1 LE5.2	Unit-5.0 Mine lighting and Illumination 5.1, 5.2, 5.3, 5.4, 5.5	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

Name of program: Diploma in Engineering **Semester: III**
Branch : Mining Engineering **Code: NIL**
Subject : Health and Yoga **Total Tutorial Periods: NIL**
No. Of Periods : 2 Periods/Week

Course Objectives:

1 To provide understanding the importance of health.
2 To provide insight into the hygiene aspect & quality of life.
3 To study the concepts of various medical therapy.
4 To practice the various yogasans.
5 To provide knowledge about common diseases and its cure through yagasans and pranayam.
6 To develop concentration through various methods.

UNIT- I **HEALTH & HYGIENE:** Concept of health, Physical health and mental health and wellbeing and how to achieve these, longevity and how to achieve it, concept and common rules of hygiene, cleanliness and its relation with hygiene; Overeating and underrating, amount of food intake required, intermittent fasting; adequate physical labour, sleep; consumption of junk fast food vs nutritious food; fruits, vegetables cereals and qualities of each of these.

UNIT-II **INTRODUCTORY KNOWLEDGE OF COMMON STREAMS OF MEDICINAL CURE:** History, development, basic concepts, modes of operation of Alopathy, Ayurved, Homoeopathy, Biochemic, Unani, Siddha, Accurpressure, Accupunture, Naturopathy, Yogic and Herbal system of medicines, Introduction of Anatomy and Physiology concerned.

UNIT- III **YOGASANS:** Meaning and concept of Yoga, Yogasans and its mode of operation, How to perform Yogasans, Common Yogasans with their benefits, such as, Padahastasan, Sarvangasan, Dhanurasan, Chakrasan, Bhujangasan, Paschimottasan, Gomukhasan, Mayurasan, Matsyasan, Matsyendrasan, Pawanmuktasan, Vajrasan, Shalabhasan, Sinhasan, Shashankasan, Surya Namaskar, Halasan, Janushirasan, Utshep Mudra.

UNIT-IV **YOGASANS FOR COMMON DISEASES:** From Yogic Materia Medica with symptoms, causes, asans and herbal treatment.

- **Modern silent killers:** High blood pressure, diabetes and cancer, causes and cure; Common health problems due to stomache disorders, such as, indigestion, acidity, dycentry, piles and fissures, artheritis, its causes, prevention and cure.
- **Asans for relaxation:** Shavasan, Makarasan, Matsyakridasan, Shashankasan.
- **Asans to increase memory and blood supply to brain:** Shirsh padasan, Shashankasan.
- **Asans for eye sight:** Tratak, Neti Kriya .
- **Pranayam:** Definition and types: Nadi Shodhan, Bhastrik, Shitakari, Bhramari useful for students.

UNIT-V **CONCENTRATION:** Concentration Of Mind And How To Achieve It. Tratak (त्राटक), Concentration On Breath, Japa (जप), Ajapajap (अजपाजप), Internal silence(, Visualization In Mental Sky (, Concentration On Point Of Light(, Concentration On Feeling (, Concentration On Figure (

Text Books:

Health, Hygiene & Yoga, Dr P B Deshmukh, Gyan Book Pvt Ltd. New Delhi.

Reference Books:

(1) Yogic Materia Medica
(2) Asan, Pranayam and Bandh