

Maharashtra State Board Of Technical Education, Mumbai																									
Learning and Assessment Scheme for Post S.S.C Diploma Courses																									
Programme Name						: Diploma In Mining & Mine Surveying / Mining Engineering																			
Programme Code						: MS / MZ										With Effect From Academic Year						: 2023-24			
Duration Of Programme						: 3 Year										Duration						: 32 WEEKS			
Year						: Second						NCrF Entry Level : 3.5						Scheme						: K	
Sr No	Course Title	Abbreviation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme						Credits	Assessment Scheme												
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week	Paper Duration (hrs.)		Theory				Based on LL & TL				Based on Self Learning	Total Marks			
						CL	TL	LL					Practical												
													FA-TH	SA-TH	Total	FA-PR		SA-PR		SLA					
																Max	Max	Max	Min	Max			Min	Max	Min
(All Compulsory)																									
1	APPLIED MECHANICS	AMC	AEC	332301	1	2	-	2	-	4	4	3	30	70	100	40	25	10	25@	10	-	-	150		
2	BASIC SURVEYING	BSU	SEC	332302	1	2	-	2	-	4	4	3	30	70	100	40	25	10	25#	10	-	-	150		
3	ECONOMIC AND FIELD GEOLOGY	EFG	DSC	332303	1	2	-	2	1	5	5	3	30	70	100	40	25	10	25#	10	50	20	200		
4	MINE VENTILATION	MVE	DSC	332304	-	3	-	2	-	5	5	3	30	70	100	40	25	10	25#	10	-	-	150		
5	MINING TECHNOLOGY	MTE	DSC	332305	1	2	-	2	-	4	4	1.5	30	70*#	100	40	25	10	25#	10	-	-	150		
6	ROCK MECHANICS	RME	DSC	332306	-	3	-	2	-	5	5	3	30	70	100	40	25	10	25#	10	-	-	150		
7	UNDERGROUND COAL MINING	UCM	DSC	332307	1	3	-	2	-	5	5	3	30	70	100	40	25	10	25#	10	-	-	150		
8	ESSENCE OF INDIAN CONSTITUTION	ICO	VEC	332001	-	1	-	-	1	2	2	-	-	-	-	-	-	-	-	-	50	20	50		
9	INDUSTRIAL TRAINING / PROJECT 1	ITP	INP	332002	-	-	-	2	4	6	6	-	-	-	-	-	50	20	50#	20	100	40	200		
Total					5	18		16	6		40		210	490	700		225		225		200		1350		

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						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)			Notional Learning Hrs /Week	Theory	Based on LL & TL				Based on Self Learning				
						CL	TL	LL						Practical				SLA				
														FA-TH	SA-TH	Total		FA-PR		SA-PR		
														Max	Max	Max	Min	Max	Min	Max	Min	
Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment Legends : @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination Note : 1. FA-TH represents average of two class tests of 30 marks each conducted during the semester. 2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester. 3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work. 4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks 5. 1 credit is equivalent to 30 Notional hrs. 6. * Self learning hours shall not be reflected in the Time Table. 7. * Self learning includes micro project / assignment / other activities. 8. Industrial training shall be completed in summer vacation after First year. Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)																						

APPLIED MECHANICS**Course Code : 332301**

Programme Name/s : Mining & Mine Surveying/ Mining Engineering
Programme Code : MS/ MZ
Year : Second
Course Title : APPLIED MECHANICS
Course Code : 332301

I. RATIONALE

The analysis of forces acting on various structural and machine elements using principles of mechanics gives useful data for detailing and design of structure and machine. The analysis of forces helps to prevent arises of defects, errors and subsequent failures in such elements under action of forces. This course is designed for diploma aspirants to acquire and apply the basic and discipline knowledge to solve practical problems regarding design and automation components in the field of various engineering disciplines such as mining their allied disciplines.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply the principles of engineering mechanics to analyze, design and automation the prototypes and equipment's of mining industry

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Select the suitable machine under given in mining condition.
- CO2 - Analyze the given force system to calculate resultant force in mining.
- CO3 - Determine unknown force(s) of given load combinations in the given situation.
- CO4 - Apply the laws of friction in the given situation.
- CO5 - Determine the centroid/center of gravity of the given structural elements of having specific shape and size.
- CO6 - Determine various material parameters under various load conditions.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week	SLH	NLH	Paper Duration	Theory				Based on LL & TL				Based on SL						
												Practical										
								CL		TL	LL	FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
Max	Max	Max	Min	Max	Max	Max	Min	Max	Min	Max	Min	Max	Min									
332301	APPLIED MECHANICS	AMC	AEC	2	-	2	-	4	4	3	30	70	100	40	25	10	25@	10	-	-	150	

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Identify the type of machine based on efficiency of machine. TLO 1.2 Calculate effort required and load lifted by the given simple lifting machine. TLO 1.3 Verify law machine for given loading. TLO 1.4 Determine effort required along with efficiency for given machine with varying velocity ratio.	Unit - I Simple Lifting Machine 1.1 Concept of simple lifting machine, load, effort, mechanical advantage, velocity ratio, efficiency of machines, reversible and non-reversible/self locking machines. (IKS*: Hand axe as wedge, Lever in battle, Inclined Plane for loading, Pulleys to lift water in irrigation) 1.2 Concept of ideal machine and its conditions, machine friction, ideal effort, ideal load, effort lost in friction and load lost in friction, maximum mechanical advantage and maximum efficiency. 1.3 Nature of graphs: Load vs. effort, load vs. ideal effort, load vs. MA, load vs. efficiency, Law of machine and its uses. 1.4 Velocity ratios of inclined plane, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block, two sheave pulley block, three sheave pulley block	Lecture Using Chalk-Board Video Demonstrations Presentations Case Study

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Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Describe the characteristics of force. TLO 2.2 Calculate the moment of given forces in a force system. TLO 2.3 Suggest the suitable law for the analysis of given force system. TLO 2.4 Determine the components of given force. TLO 2.5 Calculate the resultant force of given force system analytically. TLO 2.6 Calculate the resultant force of given force system graphically.	Unit - II Analysis of Forces 2.1 Introduction of Mechanics: Engineering Mechanics, Statics, Dynamics, Kinetics, Kinematics, concept of rigid body, Force: definition, unit, graphical representation, Bow's notation, characteristics, Types of force system 2.2 Moment of force: Definition, unit, sign conventions, couple and its properties. 2.3 Law related to forces: Law of transmissibility of force, Law of polygon of forces, Varignon's theorem of moments, Law of moment, Law of parallelogram of forces. (IKS*:Weighing scale in Mohenjodaro, Harappa 2.4 Resolution of coplanar forces: orthogonal and non orthogonal components of a force. 2.5 Composition of coplanar forces using analytical method. Resultant of collinear, concurrent and nonconcurrent force system. 2.6 Composition of coplanar forces using graphical method. Resultant of concurrent force system and parallel force system consisting of maximum four forces only	Lecture Using Chalk-Board Video Demonstrations Demonstration Collaborative learning Presentations Hands-on
3	TLO 3.1 Draw the Free Body Diagram for given loading in given situation. TLO 3.2 Determine the equilibrant of the given concurrent force system. TLO 3.3 Use Lami's theorem to determine the unknown forces causing equilibrium for given practical situation. TLO 3.4 Identify the type of beam in a given structure. TLO 3.5 Determine reactions in the given type of beam analytically.	Unit - III Equilibrium of Forces 3.1 Equilibrium and its conditions. 3.2 Equilibrant and relation with resultant, Equilibrant of concurrent force system. 3.3 Lami's Theorem and its applications, Concept of Free body diagram, (Problems unknown not more than two.) 3.4 Types of supports: fixed, simple, hinged, roller and fixed, Types of beams: cantilever, simply supported, overhanging, continuous and fixed. Types of loads: vertical and inclined point load, uniformly distributed load. 3.5 Determination of Beam reactions using analytical method for cantilever simply supported and overhanging beam subjected to vertical load, inclined load and uniformly distributed load (combination of any two types).	Lecture Using Chalk-Board Video Demonstrations Demonstration Presentations Site/Industry Visit Hands-on Case Study

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Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Determine friction force along with coefficient of friction for the given condition. TLO 4.2 Describe the conditions for friction for the give situation. TLO 4.3 Determine friction force in the given situation. TLO 4.4 Draw free body diagram for showing forces acting on a ladder under given condition.	Unit - IV Friction of Forces 4.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, and their relationship. 4.2 Equilibrium of bodies on level surface subjected to force parallel to plane and inclined to plane. 4.3 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. 4.4 Forces acting on ladder (only free body diagram, no numerical).	Lecture Using Chalk-Board Video Demonstrations Demonstration Presentations Case Study Hands-on Site/Industry Visit
5	TLO 5.1 Determine the centroid of given plane figure. TLO 5.2 Determine the centroid of given composite figure. TLO 5.3 Determine center of gravity of given solid. TLO 5.4 Determine Centre of gravity of the given composite solid.	Unit - V Centroid and Centre of Gravity 5.1 Centroid of geometrical plane figures: square, rectangle, triangle, circle, semi-circle, quarter circle (IKS*: Archery arrowheads in Ramayana, Arch in archeological structures such as Mahal, Gol Gumbaz). 5.2 Centroid of composite figures such as I, L, C, T, Z sections (not more than three simple figures). 5.3 Centre of Gravity of simple solids: cube, cuboid, cylinder, cone, sphere and hemisphere (no hollow solids). 5.4 Centre of Gravity of composite solids composed of not more than two simple solids.	Lecture Using Chalk-Board Demonstration Video Demonstrations Model Demonstration Hands-on Case Study
6	TLO 6.1 Describe given terms and compute their values. TLO 6.2 Calculate Material Properties Under given load condition. TLO 6.3 Compute stresses and load shared by given composite sections subject to direct load. TLO 6.4 Calculate the change in dimensions and volume of the body subjected to uniaxial, biaxial and tri-axial loads/stresses of given materials. TLO 6.5 Calculate design constants for given conditions. TLO 6.6 Describe relation between given modulus.	Unit - VI Simple Stress, Strain and Elastic constants 6.1 Stress, strain, elasticity. Rigid, elastic and plastic bodies. Deformation of elastic body under various forces. 6.2 Type of stresses-normal and tangential, normal tensile and compressive stresses, standard stress strain curve for mild steel bar under tension test, Hook's law, elastic limit, modulus of elasticity, factor of safety, yield and working stresses. 6.3 Stress and strain in composite section under axial loading. 6.4 Longitudinal and Lateral strain, Poisson's ratio, biaxial and triaxial stresses, volumetric strain, change in volume, Bulk modulus. 6.5 Shear stress and strain, modulus of rigidity, complementary shear stress and induced tension and compression due to it. 6.6 Relation between modulus of elasticity, modulus of rigidity and bulk modulus.	Lecture Using Chalk-Board Video Demonstrations Cooperative Learning Model Demonstration Hands-on

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
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MSBTE Approval Dt. 01/10/2024

Semester - 2, K Scheme

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Verify law of machine under the given condition. LLO 1.2 Verify law of moment of forces. LLO 1.3 Understand the centroid of structural component.	1	Collect the photographic information of Indian Knowledge System (IKS) given in various units.	6	CO1 CO2 CO5
LLO 2.1 Verify law of machine under the given condition.	2	*Determine mechanical advantage and velocity ratio of differential axle and wheel for different load and efforts.	2	CO1
LLO 3.1 Verify law of machine under the given condition.	3	Determine mechanical advantage and velocity ratio of worm and worm wheel for different load and efforts.	2	CO1
LLO 4.1 Verify law of machine under the given condition.	4	Determine mechanical advantage and velocity ratio of single purchase crab winch for different load and efforts.	2	CO1
LLO 5.1 Verify law of machine under the given condition.	5	Determine mechanical advantage and velocity ratio of double purchase crab winch for different load and efforts.	2	CO1
LLO 6.1 Verify law of machine under the given condition.	6	*Determine mechanical advantage and velocity ratio of simple screw jack for different load and efforts.	2	CO1
LLO 7.1 Verify law of machine under the given condition.	7	Determine mechanical advantage and velocity ratio of Weston's differential pulley block for different load and efforts.	2	CO1
LLO 8.1 Verify law of machine under the given condition.	8	Determine mechanical advantage and velocity ratio of geared pulley block for different load and efforts.	2	CO1
LLO 9.1 Verify law of machine under the given condition.	9	Determine mechanical advantage and velocity ratio of two sheave pulley block for different load and efforts.	2	CO1
LLO 10.1 Verify law of machine under the given condition.	10	Determine mechanical advantage and velocity ratio of three sheave pulley block for different load and efforts.	2	CO1
LLO 11.1 Analyse the resultant force of given force system.	11	*Verify law of polygon of forces using Universal force table for given forces.	2	CO2
LLO 12.1 Analyse the resultant force of given force system.	12	*Verify law of moment of forces using law of moment apparatus for given forces.	2	CO2
LLO 13.1 Analyse the resultant force of given force system.	13	Verify Varignon's theorem of moments of forces using law of moment apparatus for given forces.	2	CO2
LLO 14.1 Analyse the resultant force of given force system.	14	Determine graphically the resultant force of given concurrent force system.	2	CO2
LLO 15.1 Analyse the given force system acting on structural element.	15	Determine graphically the resultant force of given parallel force system.	2	CO2
LLO 16.1 Verify laws of friction related to forces.	16	*Verify the Lamis theorem using Universal force table apparatus for given forces.	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 17.1 Verify laws of friction related to forces.	17	*Determine support reactions of simply supported beam using parallel force or beam reaction apparatus for given vertical forces.	2	CO3
LLO 18.1 Apply the concept of friction for given objects.	18	*Determine coefficient of friction using friction apparatus for given block on horizontal plane.	2	CO4
LLO 19.1 Verify laws of friction related to forces.	19	Determine coefficient of friction using friction apparatus for given block on inclined plane.	2	CO4
LLO 20.1 Apply the concept of centroid for given objects.	20	Apply the concept of centroid for given objects.	4	CO5
LLO 21.1 To find the sliding coefficient of friction between the belt and pulley LLO 21.2 Apply Universal Testing Machine for different types of test.	21	Operate Universal Testing Machine for different types of test.	2	CO6
LLO 22.1 understand the elongation of steel by using Extensometer.	22	Measure the elongation of steel by using Extensometer.	2	CO6
LLO 23.1 Apply Compression testing machine for compression test.	23	Operate Compression testing machine for compression test.	2	CO6
Note : Out of above suggestive LLOs - • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes.				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- *Solve the examples on calculation of values of MA, VR, η , P_i , P_f , W_i , W_f etc. for given type of machine. *Solve the examples on calculation of centroid of simple/composite plane figures from given problem statement or figure. *Solve the examples on calculation of centroid of simple/composite plane figures from given problem statement or figure. *Solve the examples on calculation of centroid of simple/composite solid bodies from given problem statement or figure. *Solve the examples on calculation of coefficient of friction, normal reaction, force required to pull the block for given case of frictional bodies (horizontal or inclined plane). *Solve the examples on calculation of unknown forces using Lami's theorem from given problem statement or figure. *Solve the examples on calculation of support reactions of given beam from given problem statement or figure. *Solve the examples on calculation of orthogonal or non orthogonal components of a force. *Solve the examples on calculation of resultant of a force for given force system from given problem statement or figure. *Solve the examples on calculation of moments of a force from given problem statement or figure.

Micro project

- *Prepare a chart showing comparison of centroid and center of gravity for square-cube, rectangle- cylinder, triangle-cone, circle-sphere, semicircle-hemisphere. *Prepare chart of types of forces showing real-life examples. *Prepare chart or flow of laws related to engineering mechanics like law of moment, law of machine, law of

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parallelogram of forces, Varignon's theorem of moments etc.. *Collect photographs of specific simple lifting machine and relate these machines with the machines being studied and prepare models of simple lifting machines using tools in "MECHANO" and "MECHANIX" *Prepare chart showing all types of beams having types of support (roller, hinged, fixed) with sketches and corresponding photographs of real life examples. *Prepare models of types of beam subjected to all loads (point load, udl, uvl, moment, couple) with sketches and corresponding photographs of real life examples. *Prepare photographic chart showing real life examples of uses of friction on horizontal (walking, writing, etc.) and inclined plane (slider in gardens, loading of heavy material in trucks etc.).

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Simple axle and wheel (wall mounted unit with the wheel of 40 cm diameter and axles are in steps of 20 cm and 10 cm reducing diameter .	1
2	Law of moment's apparatus consisting of a stainless steel graduated beam 12.5 mm square in section, 1m long, pivoted at centre.	10,11
3	Beam Reaction apparatus (The apparatus is with two circular dial type 10 kg.)	15
4	Friction apparatus for motion along horizontal and inclined plane (base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees. pan. Two weight boxes (each of 5 gm, 10 gm, 2-20 gm, 2-50 gm, 2-100 gm weight)	16,17
5	Models of geometrical figures.	18
6	Differential axle and wheel (wall mounted unit with the wheel of 40 cm diameter and axles are in steps of 20 cm and 10 cm reducing diameter .	2
7	Pulley and flat belt and V belt	21
8	Worm and worm wheel (wall mounted unit with threaded spindle, load drum, effort wheel; with necessary slotted weights, hanger and thread)	3
9	Single Purchase Crab winch (Table mounted heavy cast iron body. The effort wheel is of C.I. material of 25 cm diameter mounted on a shaft of about 40mm dia. On the same shaft a geared wheel of 15 cm dia.	4
10	Double Purchase Crab winch (Having assembly same as above but with double set of gearing arrangement.)	5
11	Simple screw Jack (Table mounted metallic body , screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	6
12	Weston's Differential pulley block (consisting of two pulleys; one bigger and other smaller.	7

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
13	Weston's Differential worm geared pulley block (Consists of a metallic (preferably steel) cogged wheel of about 20 cm along with a protruded load drum of 10 cm dia. to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weights)	8
14	Universal Force Table (Consists of a circular 40 cm dia. Aluminum disc, graduated into 360 degrees.) with all accessories.	9,14

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Simple Lifting Machine	CO1	10	2	2	6	10
2	II	Analysis of Forces	CO2	14	2	4	8	14
3	III	Equilibrium of Forces	CO3	10	2	8	4	14
4	IV	Friction of Forces	CO4	8	2	4	6	12
5	V	Centroid and Centre of Gravity	CO5	10	2	4	6	12
6	VI	Simple Stress, Strain and Elastic constants	CO6	8	2	2	4	8
Grand Total				60	12	24	34	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Term work (Lab Manual), Self-Learning (Assignment) Question and Answers in class room, quiz and group discussion. Note: Each practical will be assessed considering-60% weightage to process related and 40 % weightage to product related

Summative Assessment (Assessment of Learning)

- Practical Examination, Oral Examination, Pen and Paper Test.

XI. SUGGESTED COS - POS MATRIX FORM

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	PSO-3
CO1	1	1	1	2	1	-	1			
CO2	1	1	1	2	1	-	1			

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CO3	2	2	1	2	1	-	1			
CO4	2	2	2	2	1	-	1			
CO5	2	2	1	2	1	-	1			
CO6	1	2	1	2	1	-	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	S. Ramamrutham	Engineering Mechanics	Dhanpat Rai Publishing Co. 2016 ISBN-13: 978- 9352164271
2	R. S. Khurmi, N.Khurmi	Engineering Mechanics	S.Chand & Co. New Delhi 2018 ISBN: 978-9352833962
3	S. S. Bhavikatti	Engineering Mechanics	New Age International Private Limited, Edition 5, ISBN: 978-9388818698, New Delhi
4	D. S. Bedi, M. P. Poonia	Engineering Mechanics	Khanna Publishing ISBN-13:978-9386173263, New Delhi
5	Dr. R. K. Bansal	Engineering Mechanics	Laxmi Publications, Darya ganj, Delhi, Edition 6, ISBN 13: 9788131804094

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.engineersrail.com/simple-lifting-machine/	Introduction of simple lifting machine
2	https://www.youtube.com/watch?v=kNypk8GReqM	Law of machine and types of machines useful in industry.
3	https://www.youtube.com/watch?v=6u_rjLjv-MY&list=PLOSWwFV98r	Introduction of force system with examples
4	https://www.youtube.com/watch?v=RrVuSbCZH8c	Verification of Lamis theorem in laboratory
5	https://www.youtube.com/watch?v=tM5hsUiNpGA	Calculation of beam reactions for various types of beams
6	https://www.youtube.com/watch?v=RGT1g_lu440	Calculation of coefficient of friction for horizontal and inclined plane
7	https://www.youtube.com/watch?v=wFjLNSfPXAI	Centroid of plane/composite figures, C.G. of plane/composite solids
8	https://www.youtube.com/watch?v=v6VTMwxx4oA	Centroid of composite figures.

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

BASIC SURVEYING**Course Code : 332302****Programme Name/s : Mining & Mine Surveying/ Mining Engineering****Programme Code : MS/ MZ****Year : Second****Course Title : BASIC SURVEYING****Course Code : 332302****I. RATIONALE**

Surveying is generally used to make land maps and boundaries. The development of engineering survey is the basic foundation to ensure the quality of the project, because it can provide accurate data for the subsequent construction. Surveying is involved in everything right from accurately drawing boundaries between private and public land, to inspecting bridges and other critical infrastructure. Without surveying, the placement, security, and safety of projects cannot be assured. Therefore, the students are required to develop such competency to carry out the given type of survey using relevant equipment's so as to prepare the plan to interpret the information to take the appropriate decisions. This course will help the students in achieving in above mentioned goal.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Prepare plans and Contour maps using Surveying Equipment's and Techniques.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Suggest relevant type of survey required for the given situation.
- CO2 - Undertake cross staff and compass survey for the given field.
- CO3 - Undertake survey using Theodolite for preparing a plan of the given terrain.
- CO4 - Determine Reduced Level to prepare Contour maps for the given type of terrain.
- CO5 - Prepare the plan using Plane Table Surveying to locate relevant details.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks	
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL				
				CL	TL	LL					Practical				Based on SL								
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA				
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min				
332302	BASIC SURVEYING	BSU	SEC	2	-	2	-	4	4	3	30	70	100	40	25	10	25#	10	-	-	150		

BASIC SURVEYING**Course Code : 332302****Total IKS Hrs for Sem. : 1 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the given basic principles of surveying. TLO 1.2 Classify the survey based on purpose, instruments used and nature of field. TLO 1.3 Use the conventional sign and symbols for preparing the plan of a given land.	Unit - I Overview and Classification of Surveying 1.1 Surveying: Introduction, Purpose, use and Principles. 1.2 Types of surveying- Primary and Secondary classification, Plane, Geodetic, Cadastral, Hydrographic, Photogrammetry Aerial, Layout survey, Control survey, Topographical survey, Route survey, Reconnaissance survey. 1.3 Conventional sign and symbols	Demonstration Lecture Using Chalk-Board Video Demonstrations Presentations Hands-on

BASIC SURVEYING**Course Code : 332302**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Describe the procedure of finding the distance between two given inter-visible and invisible survey stations. TLO 2.2 Explain the given Survey line and survey station used in survey. TLO 2.3 Explain the methods of ranging. TLO 2.4 Calculate the area of open field using chain and cross staff survey. TLO 2.5 Define Geographic/True Magnetic and Arbitrary Meridians and Bearings, Meridian and Bearing. TLO 2.6 Convert the Whole circle bearing to reduced bearing system and vice versa. TLO 2.7 Calculate internal and external angle from bearing of line. TLO 2.8 Determine the correct bearing from given Data. TLO 2.9 Apply Bowditch's rule to complete the traverse of given land.	Unit - II Cross Staff and Compass Surveying 2.1 Linear Measurement Instruments: Metric Chain, Tapes, Arrow, Ranging rod, Open cross staff (IKS). 2.2 Chain survey Station, Base line, Check line, Tie line, Offset, Tie station, Types of offsets: Perpendicular and Oblique. 2.3 Ranging: Direct and Indirect Ranging. 2.4 Area Calculations of field by cross staff (Numerical problems). 2.5 Compass Traversing: open, closed. 2.6 Technical Terms: Geographic/True Magnetic and Arbitrary Meridians and Bearings, Meridian and Bearing. 2.7 Whole Circle Bearing System and Reduced Bearing System . Numericals on conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing. 2.8 Calculation of internal and external angles from bearings at a station. 2.9 Components of Prismatic Compass and their Functions (No sketch) Temporary adjustments and observing bearings. 2.10 Local attraction, Methods of correction of observed bearings-Correction at station and correction to included angles. 2.11 Methods of plotting a traverse and closing error, Graphical adjustment of closing error.	Demonstration Presentations Lecture Using Chalk-Board Video Demonstrations Hands-on

BASIC SURVEYING**Course Code : 332302**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain the given components of a transit Theodolite. TLO 3.2 Explain the relationship between the given fundamental axis of theodolite along with typical characteristics. TLO 3.3 Describe the procedure to measure the horizontal Angle using Theodolite for the given situation. TLO 3.4 Describe the procedure to measure vertical angles using Theodolite for the given situation. TLO 3.5 Compute Latitude, Departure, Consecutive co ordinates. Independent coordinates from the data given. TLO 3.6 Determine the type of traverse by undertaking relevant check in the given situation. TLO 3.7 Calculate the bearing from given angles. TLO 3.8 Apply Bowditch's rule along with Transit rule to balance the traverse for a given data. TLO 3.9 Prepare Gale's Traverse table for the given data.	Unit - III Theodolite Surveying 3.1 Types and uses of Theodolite; Component parts of transit Theodolite and their functions, Reading the Vernier of transit Theodolite. 3.2 Technical terms- Swinging, Transiting, Face left, Face right. 3.3 Fundamental axes of transit Theodolite and their relationship. 3.4 Temporary adjustment of transit Theodolite. 3.5 Measurement of horizontal angle Direct and Repetition method, Errors eliminated by method of repetition. 3.6 Measurement of vertical Angle. 3.7 Theodolite traversing by included angle method and deflection angle method. 3.8 Checks for open and closed traverse, Calculations of bearing from angles. 3.9 Traverse computation-Latitude, Departure, Consecutive coordinates, independent coordinates, Balancing the traverse by Bowditch's rule and Transit rule, Gale's Traverse table computation.	Demonstration Flipped Classroom Lecture Using Chalk-Board Hands-on Site/Industry Visit Collaborative learning Presentations

BASIC SURVEYING**Course Code : 332302**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain the terms Level surfaces, level line, Horizontal and vertical surfaces, Datum, Bench Marks- GTS, Permanent, Arbitrary and Temporary, Reduced Level, Line of collimation, Back sight, Fore sight, intermediate sight, Change point, Height of instruments. TLO 4.2 Explain the Construction of given levelling equipment with its salient features. TLO 4.3 Explain the temporary adjustments of dumpy level. TLO 4.4 Calculate Reduced Level of the given station using relevant method of surveying. TLO 4.5 Justify the relevant types of levelling with examples. TLO 4.6 Interpret the contour maps for the given type of topography. TLO 4.7 Describe the characteristics of contours for the given terrain.	Unit - IV Levelling and Contouring 4.1 Terminologies: Level surfaces, level line, Horizontal and vertical surfaces, Datum, Bench Marks- GTS, Permanent, Arbitrary and Temporary, Reduced Level, Line of collimation, Back sight, Fore sight, intermediate sight, Change point, Height of instruments. 4.2 types of levels: Dumpy, Auto level, Digital level, Fundamental axis of Dumpy Level . Temporary adjustments of Level. 4.3 Types of Levelling Staffs: Self-reading staff and Target staff. 4.4 Reduced level by Plane of collimation method and Rise/ Fall Method. 4.5 Find the R. L. by H.I. method with necessary checks (Numerical problems). 4.6 Find the R.L by Rise and Fall method with necessary checks. (Numerical problems). 4.7 Types of Leveling : Simple, Differential, Fly, Profile and Reciprocal Levelling. 4.8 Contour, contour interval, horizontal equivalent. 4.9 Contour maps: Characteristics and uses of Contour maps. 4.10 Methods of Locating Contour: Direct and Indirect.	Demonstration Video Demonstrations Lecture Using Chalk-Board Presentations Cooperative Learning Hands-on
5	TLO 5.1 Explain the functions and use of the given type of accessories of a plane table. TLO 5.2 Describe the method of orienting the plane table in a given situation. TLO 5.3 Select the relevant method of plane tabling for a given situation.	Unit - V Plane Table Surveying 5.1 Principle of plane table survey. 5.2 Accessories of plane table and their use, Telescopic alidade. 5.3 Setting of plane table; Orientation of plane table - Back sighting and Magnetic meridian method. 5.4 Methods of plane table surveys : Radiation, Intersection and Traversing. 5.5 Merits and demerits of plane table survey.	Demonstration Presentations Lecture Using Chalk-Board Hands-on Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Find the distance between two given inter-visible points.	1	*Measure the distance between two inter-visible survey stations using chain, tape and ranging rods.	2	CO2

BASIC SURVEYING**Course Code : 332302**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Undertake chain and cross staff survey for the given plot.	2	*Determine area of open field using chain and cross staff survey.	2	CO2
LLO 3.1 Calculate area of irregular plot from given plan of plot.	3	Determine area of irregular field using Digital Planimeter .	2	CO2
LLO 4.1 Determine bearing using Prismatic Compass.	4	*Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass.	2	CO2
LLO 5.1 Prepare traverse using Prismatic Compass.	5	*Measure Fore Bearing and back bearing of a closed traverse of 5 to 6 sides and correct the bearings and included angles.	4	CO2
LLO 6.1 Use transit theodolite to measure Horizontal angle by Direct Method.	6	Measure Horizontal angle by using Transit Theodolite by Direct Method.	2	CO3
LLO 7.1 Use transit theodolite to measure Horizontal angle by method of Repetition.	7	Measure Horizontal angle by using Transit Theodolite by method of Repetition .	4	CO3
LLO 8.1 Use transit theodolite to measure Vertical angle .	8	Measure vertical angle using Transit Theodolite.	4	CO3
LLO 9.1 Prepare traverse using Transit Theodolite.	9	*Use transit theodolite to carry out Survey Project for closed traverse for minimum 5 sides (Compulsory).	6	CO2 CO3
LLO 10.1 Undertake differential leveling by Height of instrument method using dumpy level/Auto Level and leveling staff.	10	*Determine Reduced Level by Height of Instrument Method.	4	CO4
LLO 11.1 Undertake differential leveling by Rise and fall method using dumpy level/Auto Level and leveling staff.	11	*Determine Reduced Level by Rise and Fall Method	4	CO4
LLO 12.1 Undertake fly leveling with double check using dumpy level/ Auto level and leveling staff	12	*Perform Fly Levelling to check levelling work.	2	CO4
LLO 13.1 Perform Road profile and cross section of given terrain.	13	*Profile leveling and cross-sectioning for a road length of 300 m with cross-section at 20 m interval. (Compulsory).	6	CO4
LLO 14.1 Undertake differential levelling operation for agriculture land .	14	Undertake differential leveling by using dumpy level/Auto Level and leveling staff for Installation of irrigation pipelines.	4	CO4
LLO 15.1 Conduct block contouring for the area of 40m x 40m to draw its contour plan.	15	Prepare Contour Plan/map using Block Contouring for the area of 40m x 40m to draw its contour plan.	4	CO4
LLO 16.1 Prepare Contour Plan/map using block contouring method.	16	*Plotting contour map using block contouring method for a block of 150m x 150m with grid of 10m x 10m for given land parcel. (Compulsory).	6	CO4
LLO 17.1 plotting contour map using block contouring method for 10 Acre Agriculture land.	17	Prepare Contour plan for control farming using block contouring method .	2	CO4

BASIC SURVEYING**Course Code : 332302**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 18.1 Use plane table survey to prepare plan and locate details by using Radiation Method.	18	Prepare plans and locate details by using Radiation Method.	2	CO5
LLO 19.1 Use plane table survey to prepare plans and locate details by Intersection Method.	19	*Prepare plans and locate details by Intersection Method.	2	CO5
LLO 20.1 Use plane table survey to prepare plans locate details by Traversing Method.	20	*Prepare traverse using Plane table Surveying .	4	CO5
LLO 21.1 Use plane table survey to prepare plans plan to establish plant nursery.	21	Prepare plan to establish plant nursery .	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Assignment**

- Determine the reservoir capacity from a give contour map of reservoir.
- Measure area of small open ground by plane tabling.
- Measure the height of the flag post using Theodolite.
- Draw the representative contour maps for the following: Ridge of a mountain, Hillock, Valley, Pond/lake, Gentle slope, Very Steep Slope, Plain Surface
- Explain one method each to measure the distance between points on either side of obstacles in case of following: River, Lake, Building.
- Set the alignment of proposed road using Theodolite.
- Interpret the given contour maps.
- Determine the reservoir capacity from a give contour map of reservoir.

Micro project

- Observe Topographical maps and interpret the details.
- Collect the contour maps of different terrains available with various authorities & prepare a report on its interpretation.
- Determine the RLs of the components of existing structures like Plinth, lintels, chajja, slab, and beam etc
- Collect the information of survey instruments available in the market with their specifications.
- Prepare a flex chart to explain one method of plane tabling.
- Compare Traversing with plane table and compass method.
- Perform reconnaissance survey for plotting the alignment of road.
- Carry out comparative study of following survey instruments of different make and brands : Auto level and Dumpy Level
- Collect the map of city /town and calculate the ward wise and total area using digital planimeter.

BASIC SURVEYING**Course Code : 332302****Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Arrows 400 mm long and made up of good quality hardened and tempered steel wire of 4 mm in diameter.	1,2
2	Metric Chain made from galvanized mild steel wires 4mm in dia, brass handles with swivel joints, brass tallies provided at every 5 m length of chain - 20 and 30m.	1,2
3	Metallic Ranging rods of 2 m length, circular or octagonal in cross section of 30 mm diameter, Lower shoe of 150 mm long. Painted in black, white and red stripes of 200 mm each.	1,2,3,4,5,6,7,8,9,13,14,15,16,17,18,19,20,21
4	Pegs of length 400 mm and c/s area of 50 mm x 50 mm	1,2,3,4,5,6,7,8,9,18,19,20,21
5	Metallic tape-, Steel tape, Invar, Fiber glass tape satisfying IS 1269 (Part 1 and Part 2) : 1997 specifications.	1,2,5,9,13,14,15,16,17,18,19,20,21
6	Dumpy level and automatic levels confirming to IS: 9613 – 1986 with stand and internal focusing telescope of standard make.	10,11,12,13,14,15,16,17
7	Leveling staff- 2 m and 4 m, telescopic type confirming to IS 11961 -1986 or Folding type confirming to IS 1779 (1961), 5 mm least count.	10,11,12,13,14,15,16,17
8	Plane table with accessories- Plane and telescopic Alidade, Trough compass, U-fork, Spirit level.	18,19,20,21
9	Digital planimeter of standard make with Ni Cd batteries and AC Adapters	3
10	Prismatic compass confirming to IS 1957-1961 with stand, made in Gun metal material having diameter of 85-110 mm and the least count of 30 minutes.	4,5
11	Twenty Second Transit theodolite with accessories.	6,7,8,9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Overview and Classification of Surveying	CO1	6	2	4	0	6
2	II	Cross Staff and Compass Surveying	CO2	12	4	4	6	14

BASIC SURVEYING**Course Code : 332302**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
3	III	Theodolite Surveying	CO3	18	4	4	12	20
4	IV	Levelling and Contouring	CO4	18	2	8	12	22
5	V	Plane Table Surveying	CO5	6	4	4	0	8
Grand Total				60	16	24	30	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Termwork, Assignment, Microproject (60% Weightage to process and 40% weightage to product), Question and Answer

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test), Practical Exam, Oral Exam

XI. SUGGESTED COS - POS MATRIX FORM

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	PSO-3
CO1	3						2			
CO2	3	3	1	2	1	1	3			
CO3	3	3	2	3	1	2	3			
CO4	3	3	2	3	1	2	3			
CO5	3	2	2	3	1	2	3			

Legends :- High:03, Medium:02, Low:01, No Mapping: -
 *PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Kanetkar T. P.; Kulkarni, S. V.	Surveying and Levelling volume I	Pune Vidyarthi Gruh Prakashan, Pune; ISBN:978-81-858-2511-3
2	Basak, N. N.	Surveying and Levelling	McGraw Hill Education, New Delhi ISBN 93-3290-153-8
3	S. K. Duggal	Survey I	McGraw Hill Education, New Delhi, ISBN: 978-00-701-5137-6
4	Punmia, B.C, Jain, Ashok Kumar Jain, Arun Kumar	Surveying I	Laxmi Publications., New Delhi. ISBN: 8-17-008853-4

BASIC SURVEYING**Course Code : 332302**

Sr.No	Author	Title	Publisher with ISBN Number
5	Bhavikatti, S. S.	Surveying and Levelling, Volume 1	I. K. International, New Delhi ISBN: 978-81-906-9420-9

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://dspmuranchi.ac.in/pdf/Blog/Survey.pdf	Surveying and Levelling
2	https://archive.nptel.ac.in/courses/105/104/105104101/	Introduction to Surveying, Principles of surveying, and Classification of Surveying
3	https://lnct.ac.in/wp-content/uploads/2020/03/UNIT4B.pdf	Theodolite Surveying.
4	https://www.slideshare.net/gauravhtandon1/plane-tablesurvey-27614680	Plane Table Surveying-accessories and methods
5	http://www.pkace.org/Lecture_Notes/Survey-lecturenotes.pdf	Levelling-methods of levelling and types of levels
6	https://civilplanets.com/compass-surveying/	Compass Surveying and its types, Temporary adjustments
7	http://ecoursesonline.iasri.res.in/mod/page/view.php?id=128285	Traversing by Prismatic Compass, WCB and RB conversion and Terms in Compass Surveying
8	https://www.youtube.com/watch?v=x9ZPMxrlS3U	Measurement of bearing by prismatic compass
9	https://youtu.be/j8poe2vvD2Q	Temporary adjustment of auto level
10	https://www.youtube.com/watch?v=c9U0xlmCzGI	Temporary adjustment of Transit Theodolite
11	https://youtu.be/L54T4uvpMTg	Levelling operation by using Dumpy Level
12	https://www.youtube.com/watch?v=boPrQFZEN9A	Radiation method by plane table surveying
13	https://www.youtube.com/watch?v=PQfr1LABZWg	Contouring and its characteristics, Methods of Contouring
14	https://www.youtube.com/watch?v=-mkf7uJG8DI	Intersection method of Plane Table Surveying
15	https://theconstructor.org/surveying/chain-survey/29812/	Chain, Tapes and other linear measurement equipments

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 01/10/2024**Semester - 2, K Scheme**

ECONOMIC AND FIELD GEOLOGY**Course Code : 332303**

Programme Name/s : Mining & Mine Surveying/ Mining Engineering
Programme Code : MS/ MZ
Year : Second
Course Title : ECONOMIC AND FIELD GEOLOGY
Course Code : 332303

I. RATIONALE

This course will help the students to use knowledge of geology, stratigraphy and remote sensing in mining engineering works, geological mapping, in search of ground water and nature of strata. After acquiring knowledge and related skill student will choose site according to its use for mining and civil engineering projects. This course is also useful for the ground control underground mines and slope stability in opencast mining

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to achieve following industry identified outcomes through various learning experiences in a) Use geological knowledge and skills to identify Indian geological formation b) Execute knowledge of an exploration and economic mineral, mining work by using conventional and remote sensing method.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify Ore minerals, Industrial minerals and Economical minerals.
- CO2 - Use knowledge of Geological Formation of India in given situation.
- CO3 - Apply prospecting and subsurface exploration method in given situation.
- CO4 - Illustrate Hydrological characteristics and interpretation of water table contour map.
- CO5 - Analyse Engineering Geological problems and study of remote sensing.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks	
				Actual Contact Hrs./Week	SLH		NLH			Paper Duration	Theory				Based on LL & TL				Based on SL				
															Practical								
											CL	TL	LL	FA-TH	SA-TH	Total		FA-PR		SA-PR			SLA
Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min												
332303	ECONOMIC AND FIELD GEOLOGY	EFG	DSC	2	-	2	1	5	5	3	30	70	100	40	25	10	25#	10	50	20	200		

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe given processes of Economic Minerals formation. TLO 1.2 Explain given properties of specified Economic Minerals. TLO 1.3 Describe given physical ,chemical properties and origin of Petroleum. TLO 1.4 Intoduction to Minerals and their Exploitation in Ancient India.	Unit - I Economic Geology and Petroleum 1.1 Elements of Economic geology, Process of ore formation of economic Minerals deposits with examples. 1.2 Metaliferrous deposits of India – Iron,Copper,Mangnese,Aluminium,Gold,Lead and Zinc (Fe, Cu, Mg, Al, Au, Pb& Zn)Mineralogy, Origin, Distribution, uses, grades and reserves. 1.3 Petroleum-Physical and Chemical properties,Uses Origin and Occurrence of Petroleum in India. 1.4 Iron age in India.(1200BC- 600 AD) (IKS)	Video Demonstrations Presentations Lecture Using Chalk-Board
2	TLO 2.1 Interpret principles of Stratigraphy and PhysiographIc Divisions of India. TLO 2.2 Describe given Geological Formations of India. TLO 2.3 Introduction to Ancient Geology.	Unit - II Stratigraphy 2.1 Principles of Stratigraphy, Geological Time-scale, Physiographic Divisions of India. 2.2 Major geological formations of India.Classification, Distribution, Lithology, Structures and Economic importance of following systems. 1) Archean & Dharwar system 2)Cuddapah system 3)Vindhyan System 4)Gondwana super group 5)Deccan trap 2.3 Minerals and Metals in Harappan era.(3200-1800BC) (IKS)	Demonstration Presentations Case Study Lecture Using Chalk-Board

ECONOMIC AND FIELD GEOLOGY**Course Code : 332303**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Select relevant field equipments for Geological mapping. TLO 3.2 Describe various Geological Prospecting method. TLO 3.3 Use suitable Geological Prospecting method.	Unit - III Geological Field Work 3.1 Field equipment's required for geological Mapping, Method of field work, and collection of samples. 3.2 Geological prospecting-Airborne prospecting Method, aerial photographs, Ground prospecting Method, Surface prospecting Method, Mapping, Test pitting, trenching, editing, drilling. 3.3 Geophysical Methods of Prospecting - Magnetic, gravity, electrical, resistivity. 3.4 Geochemical Methods of prospecting-Soil, stream, water, rock sampling methods.	Case Study Demonstration Presentations Lecture Using Chalk-Board
4	TLO 4.1 Describe Ground Water Hydrology. TLO 4.2 Explain various water bearing properties of rocks. TLO 4.3 Interpret water table Contour Map. TLO 4.4 Explain Groundwater Movement. TLO 4.5 Interpret Ground Water Provinces of India.	Unit - IV Ground Water Hydrology 4.1 Hydrological cycle, Zones of Ground water, Occurrence of ground water, Geological work done by groundwater. 4.2 Water bearing properties of rocks, Porosity, permeability. 4.3 Water table contour map. 4.4 Ground water monitoring system, Darcy's law of ground water movement, specific yield and specific retention, pumping of well. 4.5 Ground water provinces of India, Interpretation of map, location and types of rocks found in various provinces.	Video Demonstrations Presentations Lecture Using Chalk-Board
5	TLO 5.1 Explain relevant engineering properties of rocks TLO 5.2 Investigate geological problems related to Dams and Tunnels in given situation. TLO 5.3 Describe Remote Sensing and GIS	Unit - V Engineering Geology and Remote sensing 5.1 Engineering properties of rocks ,Criteria for selection of building stones- availability, workability, strength, durability, porosity, permeability, texture, resistance the, colour and cost. 5.2 Geological problems associated with dam and tunnel side. 5.3 Introduction to remote sensing techniques ,analog and digital data product. 5.4 Remote sensing satellite and application of remote sensing in mining operation. 5.5 Introduction to GIS and its application.	Video Demonstrations Presentations Case Study Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify any two Iron ore minerals based on given physical properties.	1	*Identification of iron ore minerals (Hematite / Limonite / Magnetite/ Siderite/ Pyrite/ Pyrrhotite/ Goethite/ Siderite/ Marcasite.)	2	CO1

ECONOMIC AND FIELD GEOLOGY**Course Code : 332303**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Identify any two Manganese ore minerals based on given physical properties.	2	*Identification Manganese ore minerals (Braunite / Pyrolusite/ Psilomelane/ Manganite.)	2	CO1
LLO 3.1 Determine any two Iron ore minerals based on given physical properties.	3	*Identification of Copper ore minerals (Azurite/ Malachite/ Cuprite/ chalcopyrite/ covellite/ Bornite/ Chalcocite.)	2	CO1
LLO 4.1 identify of anyone mineral based on given physical properties.	4	*Identification Lead and Zinc ore minerals – (Galena, sphalerite)	2	CO1
LLO 5.1 identify any two Aluminium ore minerals based on given physical properties.	5	*Identification of Aluminium ore minerals (Bauxite/corundum/ gibbsite/Correndum/Diosper)	2	CO1
LLO 6.1 Interpret physical properties of any two Miscellaneous ore minerals.	6	*Identification of Miscellaneous ore minerals.(Chromite/ Ilmenite/ Baryte/ Magnesite/ Arsenopyrite/ Realgar/ Monazite/ Molybdenite/ Cinnabar/ Orpiment/ Wolframite.)	2	CO1
LLO 7.1 Select three suitable Industrial minerals based on given physical properties.	7	*Identification of Various types Industrial minerals (Talc/Kyanite, Graphite/Asbestos/Gypsum/Graphite/Coal/ Limestone/Calcite/Mica/Sillimanite/Garnet/Asbestos.)	2	CO1
LLO 8.1 Draw Geological time scale with stratigraphical units.	8	*Indian Stratigraphy	2	CO2
LLO 9.1 Draw Geological succession of Archean and Gondwana rocks.	9	*Geological Formation of India.	2	CO2
LLO 10.1 Interpretation of topography from given topographical maps.	10	*Study of Toposheet (Any 5)	2	CO3
LLO 11.1 Interpretation of Geology from given Satellite Imagery.	11	*Study of Satellite photographs. (Any three)	2	CO3
LLO 12.1 Draw outcrop map by three point problem method.	12	*Outcrop Map (Three point problem method)	2	CO3
LLO 13.1 Draw outcrop map when true dip is given on the map.	13	*Outcrop Map (True dip is given)	2	CO3
LLO 14.1 Draw outcrop map when out crop exposures are given on the map.	14	*Outcrop Map (Outcrop exposures are given)	2	CO3
LLO 15.1 Draw outcrop map when out crop exposures are given only on one contour.	15	*Outcrop Map (One Counter given)	2	CO3
LLO 16.1 Draw a outcrop map When out crop exposures are given in a bore hole on either side of fault.	16	*Outcrop Map(When out crop exposures are given in a bore hole on either side of fault.)	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 17.1 Calculation of strike,dip and depth of given strata,When out crop exposures are given in a bore hole on either side of fault.	17	*Calculation of strike,dip and depth of given strata.	2	CO3
LLO 18.1 Calculate dip and strike of beds by actual measurement in the field by Compass.	18	*Aplication of Brunton/Clinometer Compass.	2	CO3
LLO 19.1 Calculate apparent dip when true dip is given in amount by graphical method.	19	Calculation of apperent dip when true dip is given .	2	CO3
LLO 20.1 Calculate true dip when apparent dip is given in amount by graphical method.	20	Calculation of true dip when apparent dip is given.	2	CO3
LLO 21.1 Draw a water table map on the basis of given water table data of the area.	21	Water Table Map (By given water table data)	2	CO4
LLO 22.1 Interpretation of Remote Sensing Techniques in ground water survey.	22	Remote Sensing Techniques in ground water survey.	2	CO4
LLO 23.1 Identify various Engineering properties of rocks such as,Porosity, Permeability,Strength,Hardness.	23	Engineering Properties of Rocks .	2	CO4
LLO 24.1 Prepare a report on any one dam sites of Indian dam project.	24	Dam Sites Visit on Indian dam project.	2	CO5
LLO 25.1 Acquire knowledge about ground water monitoring.	25	Ground Water Monitoring	2	CO4
Note : Out of above suggestive LLOs - • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes.				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- 1)Collect photographs and samples of ore minerals by geological field work and prepare report. 2)Interpret the geological succession of nearby area prepare a report. 3)Visit to nearby site of G.S.I. and submit report of prospecting exploration work of the site you visited. 4)Visit to remote sensing station. Collect satellite imaginaries of the earth. 5)Visit to hydrological survey of India or G.S.D.A. submit report of ground water exploration work,photographs. Prepare rain water harvesting model or “jalyuktshiwari yojna”. 6)Visit to nearby dam or road, tunnel or bridge site, check how the stability of structure is checked, collect the samples, photographs and prepare report.

ECONOMIC AND FIELD GEOLOGY**Course Code : 332303****Assignment**

- Prepare chart on Geological Time Scale and Geological succession. Indian mining industry in respect of any one metallic deposit. (Iron/Copper/Manganese/Cement/Coal) Prepare chart on Ground Water zone. Prepare report on Geological Field work by visiting near by Geological Camp. Prepare a assignment on Remote Sensing Satellite.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Set of Iron ore minerals.(magnifying lenses, pen knife, streak plate)	1
2	Note-From Sr.No.1-7 must contain at least 2 or 3 sets of minerals,ores and each set contain at least 6 different samples.	1,2,3,4,5,6,7
3	Toposheet of survey of India 4x4 feet (5 Toposheet)	10
4	Colour Satellite images between 2 and 5 meter high resolution.(5 Images)	11,22
5	Set of outcrop maps with mentioned details.(set squares, roller scale, and protractor.)	12,13,14,15,16,17
6	Brunton compass and Clinometer compass (damping time of needle: <14 seconds dial scale : 1° size : 80 x 70 x 35 (mm) weight : 250 grams.), set squares, roller scale, and protractor.	18,19,20
7	Set of Manganese ore minerals.(magnifying lenses, pen knife, streak plate)	2
8	Bore hole data of water level.	21
9	UTM,Shear Stress,Compression test.	23
10	Set of Copper ore minerals.(magnifying lenses, pen knife, strike plate)	3
11	Set of Lead and Zinc ore minerals (magnifying lenses, pen knife, streak plate)	4
12	Set of Aluminium ore minerals.(magnifying lenses, pen knife,streak plate)	5
13	Set of Miscellaneous ore minerals. (magnifying lenses, pen knife and streak plates)	6
14	Set Industrial Minerals.(magnifying lenses, pen knife, streak plate)	7
15	Relevant chart and books.	8,9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Economic Geology and Petroleum	CO1	12	2	4	8	14
2	II	Stratigraphy	CO2	14	6	4	6	16
3	III	Geological Field Work	CO3	12	2	6	6	14

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
4	IV	Ground Water Hydrology	CO4	10	4	4	6	14
5	V	Engineering Geology and Remote sensing	CO5	12	2	4	6	12
Grand Total				60	16	22	32	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Mid term Test, Rubrics for CO's, Assignment, Self Learning and Term work, Seminar /presentation.

Summative Assessment (Assessment of Learning)

- Lab performance, End of term examination, viva voce
- Lab performance, End of term examination, viva voce

XI. SUGGESTED COS - POS MATRIX FORM

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	PSO-3
CO1	3			2	2	1	3			
CO2	3			1	2	1	3			
CO3	3	2		2	3	3	3			
CO4	3	3		2	3	3	3			
CO5	3	3		2	3	3	3			
Legends :- High:03, Medium:02, Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bangar K.M	Principles of Engineering Geology	Standard Publishers Distributors Delhi, 2013, ISBN-13: 978-8180141157
2	Parbeen Singh	Engineering and General Geology	S.K. Kataria and Sons, 2013, ISBN-13: 978-9350142677
3	Dr.R.K.Bopche Dr.D.K.Agarwal	General and Engineering Geology	Global Education Limited 2018 ISBN-978-81-935799-2-3

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Sr.No	Author	Title	Publisher with ISBN Number
4	A.PARTHSARATHI,V. PANCHAPAKESAN,R. NAGARJUN	ENGINEERING GEOLOGY	WILEY V. B. PUBLICATION NEW DELHI 2003 ISBN 978-8126509461
5	R.N.P.AROGYASWAMI	COURSES IN MINING GEOLOGY	CBS PUBLISHER ISBN 13-978- 8120409378
6	DR.S.KUMAR	BASICS OF REMOTE SENSING AND GIS	UNIVERSITY SCIENCE PRESS ISBN NO.978-81-318-0544-2
7	G. B. Mahapatra	A Textbook of Physical Geology	CBS Publishers & Distributors, ISBN 10-8123901100

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.gsi.gov.in/webcenter/portal/OCBIS	It has reports, maps, manuals and Guidelines. Training programmes for learning
2	https://pubs.geoscienceworld.org/	a free, public map-based toolset that allows users to search for cross sections, charts, tables, fig
3	www.geologyshop.com	printed products including maps, sheet explanations and regional guides.
4	www.geologyshop.com	printed products including maps, sheet explanations and regional guides.
5	www.geology.com	This web site has information and News about Geology and Earth Science
6	https://www.surveyofindia.gov.in/	It is a official website of Survey of India having information about maps, mines and geological info
7	https://www.bgs.ac.uk/discovering-geology/	This is good for enhancing knowledge by watching few relevant programmes on Mines and Mine Survey
8	https://youtube.com/@ExploringGeologybyGeolovers	This video is good on Exploring Geology in Hindi and information about Jobs in India.
9	https://www.mecl.co.in/Index.aspx	Site related to exploration related work.
Note : Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students		

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MINE VENTILATION**Course Code : 332304****Programme Name/s : Mining & Mine Surveying/ Mining Engineering****Programme Code : MS/ MZ****Year : Second****Course Title : MINE VENTILATION****Course Code : 332304****I. RATIONALE**

The underground working is devoid of the natural air. As such to make the working places safe for the persons to work and pass it is necessary to circulate the air artificially through the mine working. A mining engineer should be aware of the principles of how the flow of air can be created, regulated, controlled and monitored. They should be aware of the heat effect and humidity, condition and means of measuring and controlling the same. Number of mine gases is produced in the mine, which has got dangerous and toxic properties.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: • Evaluate presence of inflammable and toxic/noxious gases in the general body of air and undertake the ventilation survey as per requirement.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use various instruments for detection of inflammable and toxic/noxious gases in the mine.
- CO2 - Measure humidity and cooling power of the mine air.
- CO3 - Identify the ventilation system of a mine.
- CO4 - Identify various ventilation appliances used in mine.
- CO5 - Use various instruments in pressure and quantity survey.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week	SLH	NLH	Paper Duration	Theory				Based on LL & TL				Based on SL						
												Practical										
								CL		TL	LL	FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
																Max	Min	Max	Min	Max	Min	
332304	MINE VENTILATION	MVE	DSC	3	-	2	-	5	5	3	30	70	100	40	25	10	25#	10	-	-	150	

MINE VENTILATION**Course Code : 332304****Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the method of detection of given damp. TLO 1.2 Explain the given tests carried out by Flame Safety Lamp. TLO 1.3 Describe Methanometer and measurement of methane using Methanometer. TLO 1.4 Explain principle of Gas Chromatography.	Unit - I Mine Air 1.1 Different Gases / Damps found in mines, Definition of damp, their threshold limits, physiological effects, source of production and detection, Degree of gassiness of seam, multi gas detector. 1.2 Flame safety lamps, its principle, construction, safety features, and comparison. Detection of Methane by flame safety lamp. 1.3 Methanometer its principle of working, construction. Principle of following methods of detection of methane. a)Formation of gas cap of Flame safety lamp b)Wheatstone bridge principle c)Diffusion-Combustion - Contraction d)Difference in refractive index of pure air and methane e)Infrared spectrometry f)Reaction of methane with chemicals. 1.4 Principle of chromatography and types of gas chromatography with its applications.	Lecture Using Chalk-Board Demonstration Video Demonstrations Site/Industry Visit Hands-on Project based

MINE VENTILATION**Course Code : 332304**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Explain the objectives and standards of ventilation. TLO 2.2 Describe the method of calculation of ventilating pressure. TLO 2.3 Calculate relative humidity of mine air under given condition. TLO 2.4 Interpret effect of heat and humidity on miners. TLO 2.5 Calculate the motive column & Natural Ventilation Pressure (NVP).	Unit - II Mine Climate 2.1 Purpose and standards of ventilation, standards for minimum & maximum velocity of air for different locations. 2.2 Measurement of air Pressure, Water gauge, total pressure, Measurement of Ventilating pressure using an inclined Manometer. 2.3 Sources of heat and humidity in mines, Moisture content of mine air, relative humidity, wet bulb temperature, measurement and calculation of relative humidity using Whirling Hygrometer. 2.4 Cooling power of mine air, determination of cooling power by using Kata Thermometer, methods of improving cooling power of mine air, effect of heat and humidity on miners. 2.5 Natural ventilation Pressure, geothermic gradient, Factors causing NVP, Motive column, calculation of natural ventilation pressure.	Chalk-Board Demonstration Video Demonstrations Site/Industry Visit Hands-on
3	TLO 3.1 Compare given types of fans used for mine ventilation. TLO 3.2 Calculate different efficiencies and theoretical depression produced by fan.	Unit - III Artificial Ventilation 3.1 Different types of fans used in mines: centrifugal & axial flow, their principle of working, Exhaust & forcing type. Purposes of evasee & volute casing. Fans in series and parallel, Comparison between axial flow & Centrifugal fan; exhaust & forcing Fan. 3.2 Fan laws, Manometric efficiency overall efficiency, theoretical depression produced by fan. Calculation of water guage, BHP, efficiency, theoretical depression using fan laws.	Chalk-Board Demonstration Video Demonstrations Site/Industry Visit Hands-on
4	TLO 4.1 Calculate the quantity of air flowing in mines under given condition. TLO 4.2 Describe the given ventilation devices & auxiliary fans. TLO 4.3 Describe the given ventilation devices & auxiliary fans.	Unit - IV Distribution & Coursing of Air in Mines 4.1 Laws of air flow in Mines, Atkinson's formula, splitting, its advantages & disadvantages, Calculation of quantity of air in each split, Equivalent orifice: Definition and formula. 4.2 Ventilation appliances, Auxiliary ventilation: Different methods, advantages & disadvantages, hazards associated with auxiliary ventilation, precautions required. Booster fan: purpose, dangers associated, precautions before installation, numerical on booster fan. 4.3 Ascensional and Descensional ventilation, advantages and disadvantages	Chalk-Board Demonstration Video Demonstrations Site/Industry Visit Hands-on
5	TLO 5.1 Describe given type of ventilation survey. TLO 5.2 Describe given instruments to measure the quantity and pressure of mine air. TLO 5.3 Explain given ventilation survey.	Unit - V Ventilation Survey 5.1 Scope and importance of ventilation survey, survey interval and location of survey station, ventilation plan. 5.2 Measurement Of quantity & pressure difference, anemometer, pitot static tube. 5.3 Method of conducting Pressure & quantity survey, precautions during and before conducting ventilation survey, conventional signs used in ventilation survey.	Chalk-Board Demonstration Video Demonstrations Site/Industry Visit Hands-on

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

MINE VENTILATION**Course Code : 332304**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Detect percentage of Firedamp/Whitedamp/Blackdamp/Stinkdamp/oxygen.	1	*Use of Multigas detector (Drager Xam 5600/Mini Warn)	2	CO1
LLO 2.1 Identify various parts of MSA Methanometer and detecting percentage of methane.	2	*Use of MSA Methanometer.	2	CO1
LLO 3.1 Identify GL5, GL50, GL60 & GL7 flame safety lamps	3	*Flame safety lamps.	2	CO1
LLO 4.1 Dismantle & assemble of GL50 and GL7 Flame safety lamps.	4	*GL50 and GL7 Flame safety lamps.	2	CO1
LLO 5.1 Use flame safety lamp for accumulation test.	5	*Use of Flame safety lamp.	2	CO1
LLO 6.1 Use flame safety lamp for percentage test.	6	*Use of Flame safety lamp.	2	CO1
LLO 7.1 Identify various parts of whirling hygrometer.	7	*Whirling hygrometer.	2	CO2
LLO 8.1 Use whirling hygrometer to determine relative humidity of air.	8	*Use of whirling hygrometer.	2	CO2
LLO 9.1 Use kata thermometer to determine cooling power of mine air	9	*Use of Kata thermometer.	2	CO2
LLO 10.1 Identify various parts of centrifugal fan.	10	*Centrifugal mine fan.	2	CO3
LLO 11.1 Identify various parts of axial flow fan.	11	*Axial flow fan.	2	CO3
LLO 12.1 Identify various parts of air crossing.	12	*Air crossing model.	2	CO4
LLO 13.1 Identify various types of ventilation stopping.	13	*Ventilation stopping model.	2	CO4
LLO 14.1 Simulate working of a regulator.	14	*Regulator model.	2	CO4
LLO 15.1 Identify various parts of permanent stopping.	15	*Construction of Permanent stopping.	2	CO4
LLO 16.1 Identify various parts of an Air lock	16	Air lock model.	2	CO4
LLO 17.1 Use Vane Anemometer for calculating quantity of air as per given conditions.	17	*Use of Vane Anemometer.	2	CO5
LLO 18.1 Identify various parts of Velometer.	18	*Velometer.	2	CO5
LLO 19.1 Measure air velocity by Velometer.	19	*Use of Velometer	2	CO5
LLO 20.1 Identify various parts of inclined manometer.	20	Inclined manometer	2	CO5
LLO 21.1 Calculate velocity pressure by using Inclined Manometer.	21	Use of Inclined Manometer	2	CO5
LLO 22.1 Identify various parts of Pitot Static Tube.	22	Pitot Static Tube.	2	CO5
LLO 23.1 Calculate static pressure & velocity pressure by using Pitot Static Tube.	23	Use of Pitot Static Tube.	2	CO5
LLO 24.1 Draw various Conventional signs used in Ventilation Plan.	24	Conventional signs used in Ventilation Plan.	2	CO5
Note : Out of above suggestive LLOs - • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes.				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Prepare a report on measurement of different gases by using multigas detector by visiting nearby underground mine.
- Prepare a report on mine fan house regarding water gauge by visiting nearby underground mine.
- Prepare report on design parameters of evasee.
- Present a power point presentation on various types of fans used in Indian underground mines for ventilation purpose.
- Prepare any one model of ventilation devices.
- Conduct a ventilation survey in nearby underground mine and prepare a report of it.
- Prepare a report/paper on history of gas testing by old conventional methods.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Multigas detector(drager X-am 5600/ Mini warn:- It has an ergonomic design, and used for detection of explosive, combustible and toxic gases as well as oxygen.	1
2	Model of Centrifugal fan	10
3	Model of Axial flow fan.	11
4	Model of Air crossing.	12
5	Model of Ventilation stopping.	13
6	Model of Regulator.	14
7	Model of Airlock.	16
8	Vane Anemometer :- It is an instrument to determine the distance travelled by air in a given time and is used where the air velocities are between 60m/min and 1000m/min. Its possible measuring wind speed is 1-15m/sec.	17
9	Velometer :- It is an electronic device which directly measure the air velocity in m/sec at any point of observation. Its range varies from 0-15m/sec.	18,19

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
10	MSA Methanometer :- MSA D6 Methanometer is commonly used in our coal mines, It is suitable for spot checking of gas accumulation with measurement range from 0 to 5 % by volume, The battery lasts for nearly 1000 ten-sec and the complete charging takes about 14 hours.	2
11	Inclined Manometer :- Its is used for measuring pressure/ water gauge in mines. Maximum range of pressure measurement is 250mm Wg.	20,21
12	Pitot Static tube :- Its is used to measure to measure the static pressure, velocity pressure or the total pressure. L-type pitot tube feature a modified ellipsoidal head with a single forward facing hole (for total pressure) and a ring of side holes (for static pressure).	22,23
13	Flame safety lamp (GL5, GL50, GL60, GL7) :- It is used for detection of inflammable gases (Firedamp) in underground coal mines, It can detect accumulation and perecentage of firedamp in the atmosphere. It is manufactured by J.K. Dey & Sons, Kolkata.	3,4,5,6
14	Whirling hygrometer :- It is used to determine relative humidity in mine air. Its range generally varies from -5 to 50 degree celcius.	7,8
15	Kata thermometer :- It is used to measure the cooling power of mine air, It consist of an alcohol thermometer with a large bulb 4cm. long and 2cm. in diameter and a stern 20cm. long. It is graduated at two points namely 38 degree celsius and 35 degree celsius	9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Mine Air	CO1	19	4	4	6	14
2	II	Mine Climate	CO2	19	4	4	6	14
3	III	Artificial Ventilation	CO3	20	2	4	10	16
4	IV	Distribution & Coursing of Air in Mines	CO4	18	2	4	10	16
5	V	Ventilation Survey	CO5	14	2	4	4	10
Grand Total				90	14	20	36	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Progressive test
- Progressive test
- Lab performance
- Journal submission

Summative Assessment (Assessment of Learning)

- End Year Examination
- Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

MINE VENTILATION**Course Code : 332304**

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	PSO-3
CO1	3			3	3		2			
CO2	3	2		3	3		2			
CO3	3	1	2	3			2			
CO4	3	1	2	3	3		2			
CO5	3	2	2	3	3	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
 *PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	D.J. Deshmukh	Elements of Mining Technology- Vol.2	Dennet, Nagpur, ISBN: 978-81-89904-34-0
2	G.B. Misra	Mine Environment and Ventilation	Oxford University Press, ISBN: 0 19 562232 4
3	L.C. Kaku	Numerical Problems on Mine Ventilation	Lovely Prakashan, Dhanbad, ISBN: 978-8179561393
4	L.C. Kaku	Gas Testing	Lovely Prakashan, Dhanbad, ISBN: 978-8179561522

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/Id4R-2KT9jc?si=xv-Z7yCrcHAewK2n	Use of Whirling Hygrometer to determine relative humidity of mine air.
2	https://youtu.be/tH3O9dlOvfs?si=B_hPrtzFfWqF47h	Types of fans used in mines for artificial ventilation.
3	https://youtu.be/JHb6fkqNyTY?si=Oda0_61_NTa_9cGh	Types of damp.
4	https://youtu.be/N7PSFm680Is?si=5X66qXmZZ9eRNINW	Types of Flame Safety lamps used in mines.
5	https://youtu.be/Ww5BxnIkj_0?si=kJgOlGKHSC7niqkG	Concept of Water gauge and Ventilation pressure.
6	https://youtu.be/LmctN-Kw75Q?si=MG8upv0CjFl5Q90M	Instruments used in mines for ventilation survey.
7	https://youtu.be/6j6DZGcxocM?si=s59fsBvMGOhzrlsd	Concept of Methanometer for firedamp detection.

MINE VENTILATION**Course Code : 332304**

Sr.No	Link / Portal	Description
Note : Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students		

MSBTE Approval Dt. 01/10/2024**Semester - 2, K Scheme**

MINING TECHNOLOGY**Course Code : 332305****Programme Name/s : Mining & Mine Surveying/ Mining Engineering****Programme Code : MS/ MZ****Year : Second****Course Title : MINING TECHNOLOGY****Course Code : 332305****I. RATIONALE**

The students of Mining and Mine surveying must know basic mining operations carried out in underground Coal and Metal Mines. The knowledge of Drilling, Charging, Explosives and detonators used for underground Blasting is essential for Mining Diploma Holders. As a Overmen /Sirdar diploma holder is in charge of the under ground mining district and responsible for safety of persons working under him . The knowledge of different types of roof supports will help mining engineer to choose appropriate method of supporting to make working safe. The course will also provide useful information to students for shot firing and ground control in underground coal and metal mines.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences: Select relevant type of support for different ground conditions and undertake the blasting operation at face as per regulation.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Choose relevant explosives and accessories used for underground blasting.
- CO2 - Prepare the face for solid blasting in underground mines.
- CO3 - Carry out the process of shot firing safely in underground mines.
- CO4 - Install and withdraw the different types of conventional supports used in underground mines.
- CO5 - Install different types of roof bolt and cable bolts in underground mines.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week	SLH	NLH	Theory	Based on LL & TL				Based on SL											
								Practical															
								FA-TH	SA-TH		Total	FA-PR		SA-PR		SLA							
												Max	Min	Max	Min	Max	Min						
332305	MINING TECHNOLOGY	MTE	DSC	2	-	2	-	4	4	1.5	30	70*#	100	40	25	10	25#	10	-	-	150		

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Classify given types of explosives based on their properties TLO 1.2 Select suitable type of Permitted explosives in given situation TLO 1.3 Select suitable type of detonators in a given situation. TLO 1.4 Choose suitable type of safety fuse, detonating cords, detonating relays in given situation TLO 1.5 Suggest proper types of shot firing tools and exploders for particular application.	Unit - I Explosives And Blasting Accessories 1.1 Ancient explosive and blasting process (IKS), Common explosive bases, Properties of Explosives, High Explosive & Low explosive, and their comparison. 1.2 Permitted explosives their types, composition, properties, uses, advantages & disadvantages. Brand names of some commonly used explosive of each type. 1.3 A detonator, common types of detonators, plain detonators, instantaneous and delay action detonators their construction, uses, comparison etc. low tension & high-tension detonators. 1.4 Safety fuses, detonating cords, detonating relays. 1.5 Applications of various Shot firing tools, and exploders	Presentations Lecture Using Chalk-Board Lecture Using Chalk-Board Video Demonstrations Model Demonstration

MINING TECHNOLOGY

Course Code : 332305

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Interpret given drilling patterns for shot firing. TLO 2.2 Explain proper sequence of shot firing procedure. TLO 2.3 Follow the precautions while blasting-off- solid. TLO 2.4 Describe Historical Blasting Practices.	Unit - II Blasting Practices in U/G Mines 2.1 Drilling patterns for shot firing on machine cut face, in stone drift etc. 2.2 Face preparation for shot firing, Preparation of priming charge, charging of hole in coal and rock in underground working only, Direct and inverse initiation, shot firing circuits, procedure of shot firing of holes in gassy mine, precautions. Simultaneous & delay firing. 2.3 Solid blasting, conditions to be satisfied before doing solid blasting, advantages of solid blasting, drilling patterns used with solid blasting 2.4 The use of explosives in mining in ancient time and the standard method for blasting rocks was to drill a hole to a considerable depth and deposit a charge of gunpowder.	Video Demonstrations Video Demonstrations Presentations
3	TLO 3.1 Calculate detonator factor and powder factor. TLO 3.2 Identify causes of Misfire shot. TLO 3.3 Identify stemming materials and their purpose. TLO 3.4 Interpret the explosive magazines. TLO 3.5 Describe the procedure of disposal of out dated explosives.	Unit - III Safety in Blasting 3.1 Charge of explosive required for blasting in coal, rock. Powder factor, detonator factor. Precaution to improve blasting results. 3.2 Misfires, causes, remedy and method of relieving dealing with misfires, blown out shots, blown through shots causes and precautions. 3.3 Purpose of stemming, Stemming materials used for shot firing, water ampoules for stemming. 3.4 Storage of explosives, Magazines 3.5 Disposal of outdated explosives.	Lecture Using Chalk-Board Video Demonstrations Presentations Video Demonstrations Video Demonstrations
4	TLO 4.1 Explain various types of support used in Mines. TLO 4.2 Identify given types of wooden support Prop, chock, crossbar, fore poling, safari support. TLO 4.3 Describe the installation and Withdrawal of support. TLO 4.4 Interpret support density as per given support plan.	Unit - IV Conventional Roof Support 4.1 Classification of different types of supports used in Underground Mines. 4.2 Different types of Wooden Supports used in Underground Mines (Description of Prop , chock, crossbar, fore poling , safari support, only) 4.3 Installation and Withdrawal of support. 4.4 Support Plan and support density.	Lecture Using Chalk-Board Video Demonstrations Video Demonstrations Presentations

MINING TECHNOLOGY**Course Code : 332305**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Apply the theory of mechanics of strata behavior for stability of underground opening. TLO 5.2 Describe the use of various types of roof bolt supports based on their principle of action TLO 5.3 Follow the specific code of practice for roof bolting. TLO 5.4 Describe the procedure of roof stitching. TLO 5.5 Describe the procedure of cable Bolting TLO 5.6 Classify given types of yielding props. TLO 5.7 Identify given types of friction props and hydraulic props.	Unit - V Roof Bolting, Cable Bolting and Yielding Prop 5.1 Theories of mechanics of strata behavior: Dome or arch theory, Beam theory. 5.2 Roof Bolting: Theories, Principle of action, functions, Types (Cement capsule grouted bolts, Resin bolt). 5.3 Anchorage testing of Roof Bolts, Code of practice for roof bolting in underground mines. 5.4 Roof stitching, Principle of Roof stitching. 5.5 Cable Bolting, W-strap. 5.6 Yielding supports, Classification .important definition like setting load, 5.7 Different types of friction prop and Hydraulic Props and their installation and withdrawal.	Presentations Video Demonstrations Presentations Video Demonstrations Video Demonstrations Lecture Using Chalk-Board Model Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify different Types of permitted Explosives Cartridges.	1	*Identification of permitted Explosive Cartridges. (P1-Permitted Explosive,P2-Sheathed Explosive,P3-Equivalent Sheathed Explosive,P4-Extra Safe Explosive,P5-Explosive of Solid Blasting.	2	CO1
LLO 2.1 Use the cut section of Instantaneous Electric Detonator	2	*Demonstration of cut section of Instantaneous Electric Detonator. (Neoprene Plug,Flashing Mixture,Prime Charge (ASA),Base Charge (PETN).	2	CO1
LLO 3.1 Use the cut section of delay Detonator.	3	*Demonstration of cut section of delay Detonator. . (Neoprene Plug,Flashing Mixture,Delay Element,Prime Charge (ASA),Base Charge (PETN).	2	CO1
LLO 4.1 Use the different types of shot Firing tools.	4	*Identification of different shot Firing tools.(Electric Lamp/Torch, Stop Watch, Flame Safety Lamp, Wooden Stemming Rod, Scraper, Crack Detector, Wooden Pricker , Sharp Knife and Crimper).	2	CO2
LLO 5.1 Use different drilling patterns for shot firing.	5	*Demonstration of different drilling patterns for shot firing. (Concentric Rings, Pyramid Cut, Diamond Cut, Wedge Cut, Fan Cut, Drag Cut, Burn Cut and Coromant Cut.)	2	CO2
LLO 6.1 To Prepare and Understand Prime Cartridge.	6	*Prepare primer cartridge for solid blasting. (Using Explosive Cartridge and Detonator).	2	CO2

MINING TECHNOLOGY**Course Code : 332305**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Identify the direct initiation and indirect initiation of blast hole.	7	*Demonstration of direct initiation and indirect initiation of blast hole (Direct Initiation for coal mines and Indirect Initiation for drivages of shaft, drifts and tunnels).	2	CO2
LLO 8.1 Identify series and parallel connection for blast holes.	8	*Preparation of Blasting Circuits (Series and Parallel).	2	CO2
LLO 9.1 Calculate detonator factor and powder factor under given conditions/ problems.	9	*To determine detonator factor and powder factor under given conditions/ problems.	2	CO3
LLO 10.1 Identify Misfire shot and carry out the procedure to deal Misfire shot.	10	*Identification of Misfire shot and carry out the procedure to deal Misfire shot.	2	CO3
LLO 11.1 Draw a layout of Magazine under given conditions.	11	*Preparation of layout of Magazine under given conditions.	2	CO3
LLO 12.1 Install the prop support (with the help of model) under given condition.	12	*Installation of Prop Support.	2	CO4
LLO 13.1 Install the chock/cog support (with the help of model) under given condition.	13	*Installation of Chock/Cog Support.	2	CO4
LLO 14.1 Install the crossbar, and safari support under given condition.	14	*Installation of Cross bar and Safari Support.	2	CO4
LLO 15.1 Carryout the appropriate steps for fore poling method of Support.	15	*Installation of Fore Poling Method of Support	2	CO4
LLO 16.1 Withdraw the support using Sylvester prop withdrawer with the help of model.	16	*Demonstrate the procedure of withdrawal of support.	2	CO4
LLO 17.1 Draw support plan and frame SSR under given conditions.	17	*Preparation of support plan and apply of SSR	2	CO4
LLO 18.1 Identify different types of roof bolts	18	*Demonstration of Roof Bolts	2	CO4 CO5
LLO 19.1 Develop the procedure to install cement capsule (quick setting cement) roof bolts using video clip and virtual media.	19	Installation of Cement Capsule Roof Bolt	2	CO5
LLO 20.1 Develop the procedure to install resin capsule roof bolts using video clip and virtual media.	20	Installation of Resin Capsule Roof Bolts	2	CO5
LLO 21.1 Develop the procedure to install Roof stitching using video clip and virtual media.	21	Installation of Roof Stitching	2	CO5

MINING TECHNOLOGY**Course Code : 332305**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 22.1 Develop the procedure to install Cable bolting using video clip and virtual media.	22	Installation of Cable Bolting	2	CO5
LLO 23.1 Install Friction Prop (with the help of model) under given condition.	23	Installation of Friction Prop	2	CO5
LLO 24.1 Install hydraulic prop (with the help of model) under given condition.	24	Installation of Hydraulic Prop	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Micro project**

- Detonators: Prepare report of various Detonators used in that mine by visiting any underground coal mine.
- Prepare a report on Safety Fuse, Detonating cords and Detonating Relays used in that mine by visiting any underground coal mine.
- Explosives and Blasting Accessories: Prepare report of various explosives and accessories used in that mine by visiting any underground coal mine.
- Prepare a Report on Roof Bolting and Cable Bolting.
- SSR : Collect the copy of Systematic Support Rules of nearby mines and calculate support density.
- Conventional Roof Support : Prepare the cut out Model of Different types of support used in mines.
- Safety in Blasting: Collect actual data for measuring pull, Detonator factor and powder Factor.
- Prepare a report on Prime cartridge ,Direct Initiation and Inverse Initiation .
- Blasting Patterns: Prepare a Report on Various types of Blasting /Drilling Patterns.
- Prepare a Report on various shot firing tools and Exploders used in that mine by visiting any underground coal mine.
- Yielding Support : Collect data on different types of Yielding Support used in Indian Mines ,their Load bearing capacity and manufacturers.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Dummy cartridges of different Types of permitted Explosives Cartridges.	1,6,8
2	Flame safety lamp with dark room facility.	10
3	Models of the prop, chock, crossbar, and safari support.	12,13,14
4	Model of fore poling method of Support	15
5	Sylvester prop withdrawer.	16
6	Model of cement capsule (quick setting cement) used in roof bolts.	18,19
7	Cut out models of Instantaneous Electric Detonator	2
8	Model of different types resin capsule used in roof bolts.	20
9	Model of Friction Prop	23
10	Model of Hydraulic Prop	24
11	Cut out models of delay Detonator used for Shot firing in underground Mines.	3
12	Different shot Firing tools.	4
13	Crack detector used for detecting cracks in shot holes.	4,5,7
14	Templates for different drilling patterns used for shot firing.	5
15	Single Shot and multi shot exploder.	7,8,10
16	Smart Classroom fitted with computer and DLP	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Explosives And Blasting Accessories	CO1	12	2	6	6	14
2	II	Blasting Practices in U/G Mines	CO2	12	2	6	6	14
3	III	Safety in Blasting	CO3	10	4	4	6	14
4	IV	Conventional Roof Support	CO4	10	2	4	4	10
5	V	Roof Bolting, Cable Bolting and Yielding Prop	CO5	16	4	6	8	18
Grand Total				60	14	26	30	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Assignment, Self-Learning and Team Work
- Mid Term Test
- Rubrics for COs
- Seminar/Presentation

Summative Assessment (Assessment of Learning)

- Lab Performance
- End Of Term Examination
- Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

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	PSO-3
CO1	2	1	2	3	1	3	3			
CO2	3	2	2	3	1	3	3			
CO3	3	3	2	3	1	3	3			
CO4	3	1	3	3	1	3	3			
CO5	3	1	2	3	1	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
 *PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	G.K. Pradhan	Explosive and Blasting Technology	Lovely Prakashan, Dhanbad,ISBN-978-9058096050
2	L.C.Kaku	Mining Digest	Lovely Prakashan, Dhanbad,ISBN Number-13. 978-8179561515
3	Dr.B.P.Verma	Roof Bolting	Lovely Prakashan, Dhanbad,ISBN-13. 978-8179561652
4	D.J.Deshmukh	Elements of Mining Technology	Lovely Prakashan, Dhanbad,ISBN-818990433-7
5	R.D.Singh	Principles & Practices of Modern Coal Mining	New Age International (P) Limited Publishers,New Delhi,ISBN Number-81-224-0974-1
6	Heartman L.Howard	Introductory Mining Engineering	John Wiley & Sons,New York,ISBN Number-0471-62804-2

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.slideshare.net/search?searchfrom=header&q=explosives	Regarding Mining
2	https://www.youtube.com/results?search_query=mining+technology	For Videos on mining
3	https://drive.google.com/file/d/1c-LHOVpvEoySm_68wbGeyVoEHHTUcl6u/view	Explosive and blasting Related Information
4	https://www.e-education.psu.edu/geog000/node/827	Regarding mining videos and books
5	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsyFCoiPyJlPmzHDxg==	Mining Related Information

MINING TECHNOLOGY**Course Code : 332305**

Sr.No	Link / Portal	Description
Note :		
Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students		

MSBTE Approval Dt. 01/10/2024**Semester - 2, K Scheme**

ROCK MECHANICS**Course Code : 332306**

Programme Name/s : Mining & Mine Surveying/ Mining Engineering
Programme Code : MS/ MZ
Year : Second
Course Title : ROCK MECHANICS
Course Code : 332306

I. RATIONALE

The Diploma holder in Mining and Mine surveying must have knowledge of Rock Mechanics as the underground opening are subject to accumulation of stresses which makes the underground opening unstable, therefore students must understand the kind of support required to stabilize the opening. They also required to work as Technical Assistant in various mining related Technical and Research Institutes, therefore they must have knowledge of different properties of rock and procedure of determining the properties of rock in laboratory and insides the mine.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Resolve broad-based mining engineering related problem by using acquired knowledge and skills of rock mechanics.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Comprehend different physical and mechanical properties of rock and rockmass.
- CO2 - Determine various strength properties of rock in the laboratory.
- CO3 - Evaluate support requirement for underground mine panel/stope.
- CO4 - Execute preventive measures of rockmass failure in the mines.
- CO5 - Carry out monitoring of roof by using strata monitoring instruments.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH		SA-TH		Total		FA-PR		SA-PR		
							Max	Min			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
332306	ROCK MECHANICS	RME	DSC	3	-	2	-	5	5	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Define given terms related to pre-mining stresses. TLO 1.2 Explain the given physical properties of a rockmass. TLO 1.3 Explain the given mechanical properties of a rockmass. TLO 1.4 Describe the given strength indices of a rockmass.	Unit - I Physico-Mechanical Properties of Rockmass 1.1 Important definitions : Homogeneous, Heterogeneous, Isotropic, Anisotropic, Bed rock, competent rock, Intact Rock, Rockmass, Rock material. Concept of stress and strain in rock. Pre-mining stresses in the rocks. Historical perspective, Rock Engineering problems and application areas. 1.2 Physical Properties of a Rock: Mineralogical Composition, Structure, Texture.; Specific Gravity; Unit Weight & Density; Cohesion; Porosity & Void Ratio; Moisture Content & Degree of saturation; Permeability; Abrasivity; Electrical/Thermal Properties; Swelling; Hardness; Durability. 1.3 Mechanical/Strength Properties of Rock: Uniaxial Compressive Strength; Tensile Strength; Shear Strength; Flexural Strength. 1.4 Strength Indices of a rock: Point Load Strength Index; Protodykonov Strength Index; Impact Strength Index; Hardness; Young's Modulus, Poisson's ratio, Shear Modulus, Bulk Modulus.	Presentations Chalk-Board Demonstration Flipped Classroom

ROCK MECHANICS**Course Code : 332306**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Explain ISRM standards for preparation of rock samples to conduct lab tests. TLO 2.2 Determine the various mechanical properties of a rockmass. TLO 2.3 Determine the various strength indices of a rock. TLO 2.4 Determine Dynamic properties of rock.	Unit - II Rock Testing 2.1 ISRM standards for preparation of rock samples to determine its Physico-Mechanical properties. 2.2 Laboratory methods to determine mechanical properties of rock: UCS Test, Indirect Tensile (Brazilian) Test, Shear Strength (by Double shear, Punch test, Triaxial cell, Direct shear method). 2.3 Laboratory methods to determine strength indices of rock: Point Load Strength Index, Protodykonov Strength Index, Impact Strength Index, Rebound Hardness by Schmidt Hammer. 2.4 Dynamic properties of rock: Primary Waves and Secondary Waves. Seismic Profiling method for determining P-wave & S-wave in field.	Video Demonstrations Presentations Chalk-Board Hands-on
3	TLO 3.1 Classify the rock according to the various strength parameters. TLO 3.2 Calculate the support requirement for the underground excavations at gallery and junction area.	Unit - III Rockmass Classification 3.1 Engineering Classification of Intact Rock based on Strength, Hardness, RQD, Bieniawski RMR Classification. 3.2 Design of underground support using CMRI-ISM Geo-mechanics classification system.	Presentations Flipped Classroom Case Study Chalk-Board
4	TLO 4.1 Analyse the given physical behaviour of rockmass. TLO 4.2 Execute the prevention of Rock Burst & Coal Bumps for given cause/s. TLO 4.3 Determine the size of the pillar in underground excavations considering the required factor of safety.	Unit - IV Rockmass Failures 4.1 Material Characteristics: Brittle, Ductile, Elastic, Plastic and Time Dependent Properties: Creep and Convergence. 4.2 Rock Burst & Coal Bumps: Causes and prevention. 4.3 Pillar Design: Factors Considered, Tributary Area approach, Strength of Pillar, Factor of safety of pillar.	Presentations Case Study Chalk-Board Site/Industry Visit
5	TLO 5.1 Classify the field instrumentation for strata monitoring. TLO 5.2 Describe the use of field instruments based on their working principles.	Unit - V Strata Monitoring Instrumentation 5.1 Classification of field instrumentation for ground control & rock mechanics studies. 5.2 Working principles & applications of: All types of Tele tell, All types of Extensometers, Magnetic Ring Multipoint Borehole Extensometer (MRMPBX), All types of Closure meter/ convergence indicators, Stress meter, All types of load cells, Flat Jack for insitu stress measurement.	Video Demonstrations Chalk-Board Presentations Case Study

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Determine the Slake Durability Index for a given rock sample.	1	*Determination of physical property (Durability) of rock.	2	CO1

ROCK MECHANICS**Course Code : 332306**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Determine the Slake Durability Index for a given rock sample.	2	*Preparation of rock sample as per ISRM standards.	2	CO2
LLO 3.1 Determine the Uniaxial Compressive Strength of a rock sample.	3	*Determination of Uniaxial Compressive Strength of a rock.	2	CO2
LLO 4.1 Determine the Tensile Strength (by Brazilian test) of a rock sample.	4	*Determination of indirect tensile strength of rock.	2	CO2
LLO 5.1 Determine the Shear Strength of a rock sample by Double block shear test	5	*Determination of shear strength of cylindrical rock specimen.	2	CO2
LLO 6.1 Determine the Shear Strength of a rock sample by Single shear test (Direct shear method).	6	*Determination of shear strength of irregular block rock specimen.	2	CO2
LLO 7.1 Determine the values of shear strength parameters for a given rock sample i.e. apparent cohesion and angle of internal friction by Triaxial compression apparatus (Triaxial Cell).	7	*Determination of shear strength parameters for rock by using The Mohr-Coulomb failure criterion.	2	CO2
LLO 8.1 Determine the Point Load Strength Index of a rock sample.	8	*Determination of Point Load Strength Index.	2	CO2
LLO 9.1 Determine the Protodykonov Strength Index of a rock sample.	9	*Determination of Protodykonov Strength Index.	2	CO2
LLO 10.1 Determine the hardness of rock sample by using Rebound Hammer.	10	*Determination of rebound hardness of rock.	2	CO2
LLO 11.1 Determine the Core recovery & RQD of a given core log sample.	11	*Classification of rock by using Rock Quality Designation.	2	CO3
LLO 12.1 Design a support requirement using cement capsule grouted bolts under given condition.	12	*Use of CMRI-ISM geomechanics classification system for underground support design.	2	CO3
LLO 13.1 Design a support requirement using resin bolts under given condition.	13	*Use of CMRI-ISM geomechanics classification system for underground support design.	2	CO3
LLO 14.1 Determine the factor of safety of the pillar under given condition.	14	*Use of Tributary area approach of pillar design.	2	CO4
LLO 15.1 Measure strata dilation using Single Height and Dual Height Tell Tale.	15	*Use of strata dilation instruments (Single Height and Dual Height Tell Tale).	2	CO5
LLO 16.1 Measure strata dilation using Three-point and Four-point Tell Tale.	16	*Use of strata dilation instruments (Three-point and Four-point Tell Tale).	2	CO5
LLO 17.1 Measure strata dilation using Rotary Tell Tale.	17	*Use of strata dilation instruments (Rotary Tell Tale).	2	CO5
LLO 18.1 Measure strata dilation using Auto warning Tell Tale.	18	*Use of strata dilation instruments (Auto warning Tell Tale).	2	CO5
LLO 19.1 Measure strata dilation using Multi Point Borehole Extensometer.	19	Use of strata dilation instruments (Multi Point Borehole Extensometer).	2	CO5
LLO 20.1 Measure convergence using Telescopic Convergence Indicators.	20	Use of closure meter (Telescopic Convergence Indicators).	2	CO5

ROCK MECHANICS**Course Code : 332306**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 21.1 Measure convergence using Remote Convergence Indicators.	21	Use of closure meter (Remote Convergence Indicators).	2	CO5
LLO 22.1 Determine the load acting on roof support by using Vibrating wire, mechanical, and hydraulic load Cells.	22	Use of various load cells for determining load on support.	2	CO5
LLO 23.1 Identify various types of stress cells/stress meters.	23	Study of various types of stress meters.	2	CO5
LLO 24.1 Determine insitu stress using flat jack.	24	Determination of insitu stress.	2	CO5
Note : Out of above suggestive LLOs - • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes.				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Prepare a visit report on any nearby underground mine (coal/metal) to find out the process of RMR of mine working at various working places.
- Prepare a visit report on any nearby underground mine (coal/metal) to find out the process of pillar size determination with required factor of safety.
- Prepare a report on any nearby underground mine (coal/metal) for collecting of ground control data and analysing them through instrumentations.
- Prepare a report for ground control data analysis system by visiting research laboratory.
- Prepare a detailed report on various systems of Engineering Rockmass Classification from past to recent.

Assignment

- Collect the information on recent developments in strata monitoring instrumentations and present using PPT.
- Collect the data on various methods in practice for insitu stress determination and present using PPT.
- Collect the information regarding various Software used for strata monitoring and present using PPT.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

ROCK MECHANICS**Course Code : 332306**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Core drilling machine: with Single phase AC motor, four cutting speeds of 600, 800, 1100 and 1500 rpm. With necessary drilling bits 21.46 mm dia., 30.10 mm dia., 38 mm dia., 42.04 mm dia., 54.74 mm dia.	1
2	Core Cutting and Grinding Machine: designed for cutting & grinding cylindrical rock specimens upto cores of size 75mm. A V-Vice to hold the sample upto 55mm dia x 140mm long to be cut parallel and square to the longitudinal axis, three phase AC supply.	1
3	Core lapping and polishing machine: This unit is provided with a 0.25 HP, single phase, AC motor. 20 cm dia top and adapter to hold polishing cloth or paste. Sample Holders to accommodate upto NX size Cores.	1
4	Schmidt Hammer: impact energy 2.207 Nm (N), 0.735 Nm (L)	10
5	Tele tells: Single height, Dual height, Three point, Four point, Rotary, Auto warning.	15,16,17,18
6	Extensometers: Multipoint borehole extensometer	19
7	Slake Durability Apparatus: Suitable at working at 220V, Single phase, AC supply, supplied with electric timer 0-30 min. including coupling to enable upto 4 test drums to be driven at a time.	2
8	Electric Oven inner size 18"x18"x18"; temperature range 100-250 °C with the capacity of 40 lt.	2
9	Closure meters: Telescopic convergence indicators, Remote convergence indicators with rheostat.	20,21
10	Load cells: Vibrating wire, rock bolt, mechanical, hydraulic, strain gauge.	22
11	Stress meters: Stress cell 3D measurement, earth pressure cell, pillar strain meter, crack meter, continuous pressure chart recorder.	23
12	Flat jack: Hydraulic Pump, Semi-oval Flat jack of Dimensions 350x260x4 & Effective area 761.5 cm ² , Mechanical gauge extensometer of Gage length 100/240 mm & Dial gage of 0-50 mm.	24
13	Unconfined Compression Tester for Rock: As per ASTM 2983; Load frame 200 KN, 12 speeds; Compression proving ring 100 KN.	3
14	Digital Vernier caliper: Stainless Steel, Range (millimeter): 150mm, Standards: 0.001mm, Maximum speed of displacement : 2.5 m/sec.	3,4,5,6,7,8
15	Digital weight balance (Capacity 5kg with LC 1gm)	3,4,5,6,8,9
16	Brazilian test Apparatus with accessories: Having pairs of Jaws for 60, 70, 80, 90, 100 mm diameter samples; load frame of 200 KN.	4
17	Direct Shear Apparatus hand operated for Rock: Shear box size, (300mm x 300mm x 100mm) 1 No Moulds for Casting the samples 2 Nos. Jack Capacity 100 KN 3 Nos a) One Jack for Normal load b) One jack for shear Load c) One jack to return the sample to original Position Dial Gauges 25mm X 0.01mm - 6 Nos (2 Nos for measurement of shear displacement . 4 Nos for normal displacement and consolidation of sample hand operated Hydraulic Pump 700 bar - 2 Nos . Load Gauge - 0.100kn X 0.05 kN - 2 Nos	5
18	Double shear block for shear test cylindrical rock specimen.	6
19	Triaxial cell: Triaxial Testing System for BX & NX samples, Test Apparatus Outfit for 600 kg/cm ² - high strength rock	7
20	Point Load Index Tester, Cap.:- 100 kN	8
21	Protodyakonov strength index cylindrical apparatus: 76mm dia, 600mm in length with 2.4 kg of dead weight.	9
22	Volumometer (23 mm dia)	9
23	Sieve size 0.5mm with pan and cover	9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Physico-Mechanical Properties of Rockmass	CO1	14	4	4	2	10
2	II	Rock Testing	CO2	20	2	4	10	16
3	III	Rockmass Classification	CO3	20	2	4	8	14
4	IV	Rockmass Failures	CO4	20	2	4	10	16
5	V	Strata Monitoring Instrumentation	CO5	16	2	2	10	14
Grand Total				90	12	18	40	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Progressive Tests
- Progressive Tests
- Lab. performance
- Journal submission

Summative Assessment (Assessment of Learning)

- End Year Examination
- Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

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	PSO-3
CO1	3			3						
CO2	3			3		1	2			
CO3	3	2	2	2	1		2			
CO4	3	2	2		3	1	3			
CO5	3			3	3		3			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

ROCK MECHANICS**Course Code : 332306**

Sr.No	Author	Title	Publisher with ISBN Number
1	S.K. Das	Modern Coal mining Technology	Lovely Prakashan Dhanbad, 2nd edition 1994.
2	Dr. B.P. Verma	Rock Mechanics for Engineers.	Khanna Publication Delhi. ISBN-10-?9387394158
3	R. D. Singh	Principles & Practices of Modern Coal Mining	New Age International (P) Limited, Publishers, New Delhi. ISBN: 81-224-0974-1
4	Dr. B. P. Verma	Engineering Geology & Rock Mechanics	Khanna Publishers, New Delhi. ISBN No.: 978-93-87394-15-5
5	John A. Hudson & John P. Harrison	Engineering Rock Mechanics (an introduction to the principles)	ELSEVIER SCIENCE Ltd The Boulevard, Langford Lane Kidlington, Oxford OX5 1GB, UK. Second impression 2000, ISBN: 0 08 04 19 12 7 (Hardbound)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.slideshare.net/search?searchfrom=header&q=rock+mchanics	Key learning
2	https://www.youtube.com/watch?v=Vlm28FVRtWI&list=PLLy_2iUCG87AlAfsQmvchKRkbnhpLG3OC	Key learning
3	https://www.itascainternational.com/software/3DEC	Key learning
4	https://archive.nptel.ac.in/course.html	Key learning

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 01/10/2024**Semester - 2, K Scheme**

UNDERGROUND COAL MINING**Course Code : 332307**

Programme Name/s : Mining & Mine Surveying/ Mining Engineering
Programme Code : MS/ MZ
Year : Second
Course Title : UNDERGROUND COAL MINING
Course Code : 332307

I. RATIONALE

It is important that the mining diploma students should have knowledge about the common methods of working coal with special reference to Indian Coal Mining. This subject is introduced to understand Methods of Mining of Coal e.g. Board and Pillar working , development and depillaring, Long wall methods both advancing and retreating, special methods for working under special difficult situation and of contiguous seams and thick seam Working. Since new working methods like High wall Mining, Punch Long wall Mining and blasting Gallery method are likely to be practiced in future , these topics have been included this course.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Aim of this course is to help the student to attain the following industry identified outcomes . Select suitable Method of working for underground Coal Mining and Design suitable layouts for Board and Pillar and Long wall Mining.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use appropriate method of working under given geological condition to prepare suitable layout.
- CO2 - Select type of depillaring method for existing roof conditions of the underground coal mines.
- CO3 - Choose the appropriate method of thick seam working and prepare a working plan.
- CO4 - Design long wall working layout under given geological conditions.
- CO5 - Identify the effect of subsidence due to underground working to control .

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL			
				CL	TL	LL									Practical							
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
															Max	Min	Max	Min	Max	Min	Max	
332307	UNDERGROUND COAL MINING	UCM	DSC	3	-	2	-	5	5	3	30	70	100	40	25	10	25#	10	-	-	150	

UNDERGROUND COAL MINING**Course Code : 332307****Total IKS Hrs for Sem. : 1 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Classify the given types of method of working. TLO 1.2 Select the suitable method of working. TLO 1.3 Calculate Manpower and OMS under given condition. TLO 1.4 Compare panel System of working on the basis of given criteria.	Unit - I Board and Pillar Method (Development) 1.1 Classification of methods of working ,stripping ratio ,geological parameters , technical parameters, history of Indian Coal Mining (IKS). 1.2 Conditions for selection of method of working, Board and pillar applicability advantages and disadvantages, different types development (Strike and Dip development), their advantageous and disadvantages. 1.3 Calculation of percentage of extraction, Design of panel, Different layout classification ,SDL chain conveyor layout ,Continuous miners ,LHD and chain conveyor layout ,Manpower calculation and OMS. 1.4 Open and closed panel system. advantageous and disadvantages ,isolation stopping (Ordinary and explosion proof).	Model Demonstration Video Demonstrations Lecture Using Chalk-Board Presentations

UNDERGROUND COAL MINING**Course Code : 332307**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Execute Preparatory arrangements to be done before depillaring. TLO 2.2 Explain types of pillar extraction methods. TLO 2.3 Describe procedure of Goaf Treatment.	Unit - II Board and Pillar Method (Depillaring) 2.1 Preparatory arrangements before depillaring, permission from different regulatory authorities, check and joint survey, updation of plans and sections, construction of isolation and preparatory isolation stopping, Line of extraction and numbering of pillars, Systematic support rules. 2.2 Different types of pillar extraction methods depending upon the roof condition, spitting and slicing , slicing, extraction , partial extraction, formation of Goaf, withdrawal of support. 2.3 Caving, definition of local fall, main fall, cavability index, dangers associated with caving, precautioid air blast, Hydraulic Stowing, definition of hydraulic profile, (H/L Ratio), Surface and underground arrangements to be done for carrying hydraulic stowing.	Model Demonstration Video Demonstrations Lecture Using Chalk-Board Site/Industry Visit
3	TLO 3.1 Describe the procedure of working of coal seam in Board and Pillar Method. TLO 3.2 Follow safety precautions while working near restricted areas. TLO 3.3 Follow safety precautions while Working near fire area. TLO 3.4 Follow safety precautions while working below waterlogged area. TLO 3.5 Follow safety precautions while working below depillared goaf .	Unit - III Thick seam and Contiguous Seam Working 3.1 Thick seam and Contiguous Seam Working, precautions to be taken while working contiguous seams. Layout and case study. 3.2 Precautions while working near restricted areas as per CMR 2017. 3.3 Working near fire area as per CMR 2017. 3.4 Working below waterlogged area as per CMR 2017. 3.5 Working below depillared goaf as per CMR 2017.	Model Demonstration Video Demonstrations Presentations Site/Industry Visit
4	TLO 4.1 Design the longwall Panel under given geological condition. TLO 4.2 Describe different types of longwall mining methods.	Unit - IV Longwall Mining 4.1 Applicability of longwall mining, Design of long wall panel, Factors affecting length of longwall face, Barrier width, gate road length. 4.2 Different types of Longwall Mining, Longwall advancing, Longwall retreating ,Cyclic longwall ,Non cyclic long wall, single unit face and double unit face, different cutting machines used Single ended ranging drum shearer (SERD) and Double ended ranging drum shearer (DERD) Layout of DERD manpower calculation.	Video Demonstrations Presentations Lecture Using Chalk-Board Site/Industry Visit

UNDERGROUND COAL MINING**Course Code : 332307**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Describe the theories of subsidence. TLO 5.2 Identify critical factors which causes subsidence. TLO 5.3 Elaborate precautions to be taken for reducing subsidence. TLO 5.4 Explain the techniques of measurement of subsidence.	Unit - V Subsidence due to Underground Mining 5.1 Different Theories of subsidence, Normal Theory, Vertical Theory, in-between Normal and vertical, Dome theory, Different definition related to subsidence, different types of failure. 5.2 Different factors affecting subsidence, Depth Thickness, nature of strata, method of working, relation of subsidence with time. 5.3 Precautions to be taken on surface and underground to reduce subsidence Concept of Harmless Depth. 5.4 Measurement of subsidence and preservation of record, various techniques used, Measurement of Subsidence using Survey.	Model Demonstration Video Demonstrations Case Study Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Workout the percentage of extraction during development.	1	Calculation of the percentage of extraction during development under given geological conditions of mining.	2	CO1
LLO 2.1 Prepare layout of Development by Side Discharge Loader (SDL)/Load Haul Dumper (LHD) with chain conveyor.	2	Drawing layout of development by SDL/LHD with chain Conveyor. and Calculate Manpower and Output per Men per Shift (OMS) by assuming your own Conditions.	4	CO1
LLO 3.1 Prepare a layout of Development by Continuous Miner with shuttle cars.	3	Drawing layout of development by Continuous Miner with shuttle cars and calculate Manpower and OMS by assuming your own Conditions.	4	CO1
LLO 4.1 Estimate the number of pillars in closed panel.	4	Calculation of number of pillars in closed panel under given conditions.	2	CO1
LLO 5.1 Draw Ordinary Isolation stopping and Explosion proof isolation stopping.	5	Creation of Ordinary Isolation stopping and Explosion proof isolation stopping.	2	CO1
LLO 6.1 Evolve suitable arrangements to be made before starting depillaring.	6	Preparation of panel for depillaring. Suggest the suitable arrangements to be done before starting depillaring.	2	CO2
LLO 7.1 Plan the line of extraction.	7	Design of line of extraction under given roof conditions and other factors.	2	CO2
LLO 8.1 Suggest suitable Strata Control and Monitor Plan.	8	Creation of Strata Control and Monitor Plan under given conditions.	2	CO2
LLO 9.1 Prepare the layout of different types of extraction of coal pillars.	9	Drawing of layout of different types of extraction of coal pillars under given conditions.	2	CO2
LLO 10.1 Prepare layout of Sand Stowing.	10	Drawing of layout of Sand Stowing in underground coal mines.	2	CO2

UNDERGROUND COAL MINING**Course Code : 332307**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Identify the dangers associated with caving method. LLO 11.2 Suggest suitable remedial measures.	11	Identification of dangers associated with caving method and suggest suitable remedial measures.	2	CO2
LLO 12.1 Draw layout of development of contiguous working. LLO 12.2 Prepare layout of depillaring of contiguous working.	12	Drawing layout of development of contiguous working and Drawing layout of depillaring of contiguous working.	4	CO3
LLO 13.1 Develop the working plan for working near restricted areas.	13	Preparation of working plan for working near restricted areas.	2	CO3
LLO 14.1 Execute the working plan for Working near fire area.	14	Preparation of working plan for Working near fire area.	2	CO3
LLO 15.1 Ensure the working plan for Working below waterlogged area.	15	Preparation of working plan for Working below waterlogged area.	2	CO3
LLO 16.1 Ensure the working plan for Working below depillared goaf.	16	Development of working plan for Working below depillared goaf.	2	CO3
LLO 17.1 Sketch a layout of Longwall Advancing. LLO 17.2 Sketch a layout of Longwall retreating.	17	Drawing a layout of Longwall Advancing and layout of Longwall retreating.	4	CO4
LLO 18.1 Sketch a layout of Longwall Single unit Face. LLO 18.2 Sketch a layout of Longwall Double unit Face.	18	Draw a layout of Longwall Single unit Face and. Draw a layout of Longwall Double unit Face.	4	CO4
LLO 19.1 Prepare a layout of Non cyclic Longwall Mining using DERD. LLO 19.2 Calculate manpower and OMS for prepared layout.	19	Drawing a layout of Non cyclic Longwall Mining using DERD and Calculation of manpower and OMS.	4	CO4
LLO 20.1 Sketch Angle of Draw , Limit Line of subsidence basin. LLO 20.2 Sketch Normal plane ,vertical plane of subsidence basin.	20	Interpretation of different theories of Subsidence. and Drawing a Angle of Draw , Limit line , Normal plane ,vertical plane.	4	CO5
LLO 21.1 Sketch a vertical, angle of break. LLO 21.2 Sketch mode of failure , subsidence basin.	21	Interpretation of different terminologies used in Subsidence. and Drawing a vertical, angle of break. and drawing mode of failure of subsidence basin.	2	CO5
LLO 22.1 Identify different types of methods used for measurement of subsidence.	22	Selection of different types of methods used for measurement of subsidence.	2	CO5
Note : Out of above suggestive LLOs - • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes.				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

UNDERGROUND COAL MINING**Course Code : 332307****Micro project**

- Visit any underground coal mine and Draw the layout of Depillaring and calculate OMS.
- Prepare PPT and brief report of histroy of Mining activities in ancient India.
- Visit any underground coal mine and Draw the layout of development and calculate OMS.

Assignment

- Collect the data of nearby mines where DERD/SERD is using for production.
- Collect the information of Subsidence (Case Study).
- Collect the information of nearby mines working with long wall mining methods, machineries, supports, production etc
- Articulate case study of Thick Seam Working in any underground coal mine.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Model of Coal Pillar showing extraction of gallery	1
2	Model showing Hydraulic sand stowing in depillaring area	10
3	Model showing caving method with safety	11
4	Model Showing working of Contiguous seam	12
5	Model showing plan of working below depillared goaf area.	16
6	Model showing Longwall Advancing method.	17
7	Model showing Longwall Retreating method.	17
8	Model showing working of Single unit and double unit Long wall method.	18
9	Smart Classroom fitted with computer and DLP	19,20,21,22
10	Model of layout of Development district by using SDL/LHD	2
11	Model of layout of Development district by using Continuous Miner	3
12	Model showing closed panel system of working	4
13	Model of Ordinary and Explosion proof Isolation Stopping	5
14	Model of depillaring district.	6
15	Model showing different Line of Extraction methods.	7
16	Model showing Application of Strata Contrl and Monitoring Plan in depillaring district	8
17	Model showing Stooking, splitting & Slicing of pillar Extraction.	9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Board and Pillar Method (Development)	CO1	20	2	8	6	16
2	II	Board and Pillar Method (Depillaring)	CO2	20	2	8	6	16
3	III	Thick seam and Contiguous Seam Working	CO3	12	2	4	4	10
4	IV	Longwall Mining	CO4	24	2	6	12	20
5	V	Subsidence due to Underground Mining	CO5	14	2	2	4	8
Grand Total				90	10	28	32	70

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- First Progressive Test
- Second Progressive test
- Lab Performance
- Journal Submission

Summative Assessment (Assessment of Learning)

- End Year Examination
- Viva -voce

XI. SUGGESTED COS - POS MATRIX FORM

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	PSO-3
CO1	3	2	2	1			2			
CO2	3	2	3	1			1			
CO3	3	2	1	1			3			
CO4	3	2	1	1			2			
CO5	3	2	1	1			1			

UNDERGROUND COAL MINING**Course Code : 332307**

Legends :- High:03, Medium:02,Low:01, No Mapping: -
 *PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	R. D. Singh	Principles & Practices of Modern Coal Mining	New Age International (P) Limited, Publishers, New Delhi ISBN: 81-224-0974-1
2	Heartman L. Howard	Introductory Mining Engineering	John Wiley & Sons, New York, ISBN: 0-471-62804-2
3	G.K. Pradhan	Explosive and Blasting Technology	Lovely Prakashan, Dhanbad
4	L.C. Kaku	Mining Digest	Lovely Prakashan, Dhanbad
5	CIMFR	Ground Control in Board and Pillar Mines	Lovely Prakashan, Dhanbad
6	Dr B.P. Verma	Roof Bolting	Lovely Prakashan, Dhanbad
7	D.J.Deshmukh	Elements of Mining Technology	Lovely Prakashan, Dhanbad

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=oDduxw9d6lw	videos regarding mining
2	https://discoveryjournals.org/discoveryengineering/index.htm	videos regarding mining
3	https://www.slideshare.net/pramodgpramod/coal-mining-methods-74267944?from_search=0	coal mining methods
4	https://youtu.be/wjNOG36i0Aw?si=Y9TXqLiEgApcWHKF	subsidence
5	https://www.slideshare.net/anilbhu/longwall-top-coal-caving-method?from_search=7	longwall top coal caving method
6	https://www.slideshare.net/shanz2u/longwall-mining-14602171?from_search=0	longwall mining

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

ESSENCE OF INDIAN CONSTITUTION**Course Code : 332001****Programme Name/s : Mining & Mine Surveying/ Mining Engineering****Programme Code : MS/ MZ****Year : Second****Course Title : ESSENCE OF INDIAN CONSTITUTION****Course Code : 332001****I. RATIONALE**

This course will focus on the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The Constitution of India is the supreme law of India. The document lays down the framework demarcating the fundamental political code, structure, procedures, powers, and sets out fundamental rights, directive principles, and the duties of citizens. The course on constitution of India highlights key features of Indian Constitution that makes the students a responsible citizen. In this online course, we shall make an effort to understand the history of our constitution, the Constituent Assembly, the drafting of the constitution, the preamble of the constitution that defines the destination that we want to reach through our constitution, the fundamental right constitution guarantees through the great rights revolution, the relationship between fundamental rights and fundamental duties, the futurist goals of the constitution as incorporated in directive principles and the relationship between fundamental rights and directive principles.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry /employer expected outcome – Abide by the Constitution in their personal and professional life.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - List salient features and characteristics of the constitution of India.
- CO2 - Follow fundamental rights and duties as responsible citizen and engineer of the country.
- CO3 - Analyze major constitutional amendments in the constitution.
- CO4 - Follow procedure to cast vote using voter-id.
- CO5 - Outline the Functions of the Parliament and various State Legislatures
- CO6 - Outline the role played by Union and State in governance.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme														
				Actual Contact Hrs./Week			SL	LH		NLH	Paper Duration	Theory				Based on LL & TL				Based on SL				Total Marks
				CL	TL	LL										Practical								
												FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA				
																Max	Max	Max	Min	Max	Min	Max	Min	
332001	ESSENCE OF INDIAN CONSTITUTION	ICO	VEC	1	-	-	1	2	2	-	-	-	-	-	-	-	-	-	50	20	50			

Total IKS Hrs for Sem. : Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the meaning of preamble of the constitution. TLO 1.2 Explain the doctrine of basic structure of the constitution. TLO 1.3 List the salient features of constitution. TLO 1.4 List the characteristics of constitution.	Unit - I Constitution and Preamble 1.1 Meaning of the constitution of India. 1.2 Historical perspective of the Constitution of India. 1.3 Salient features and characteristics of the Constitution of India. 1.4 Preamble to the Constitution of India.	Chalk and board Presentations Blogs Hand-outs Modules Flipped classroom Case studies
2	TLO 2.1 Enlist the fundamental rights. TLO 2.2 Identify fundamental duties in general and with engineering field. TLO 2.3 Identify situations where directive principles prevail over fundamental rights.	Unit - II Fundamental Rights and Directive Principles 2.1 Fundamental Rights under Part-III. 2.2 Fundamental duties and their significance Part IV A 2.3 Relevance of Directive Principles of State Policy under Part-IVA	Chalk and board Presentations Blogs Hand-outs Modules Flipped classroom Case studies
3	TLO 3.1 Enlist the constitutional amendments. TLO 3.2 Elaborate the elements of Centre-State Relationship. TLO 3.3 Analyze the purposes of various amendments.	Unit - III Governance and Amendments 3.1 Amendment of the Constitutional Powers and Procedure. 3.2 The Principle of Federalism and its contemporary significance along with special committees that were setup. 3.3 Major Constitutional Amendment procedure - 42nd, 44th, 74th, 76th, 86th, 91st and 102nd	Cases of Federal disputes with relevant Supreme court powers and Judgements Presentations Blogs Hand-outs Problem based learning

ESSENCE OF INDIAN CONSTITUTION

Course Code : 332001

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain the importance of electoral rights TLO 4.2 Write the step by step procedure for process of registration TLO 4.3 Explain the significance of Ethical electoral participation TLO 4.4 Explain the steps to motivation and facilitation for electoral participation TLO 4.5 Enlist the features of the voter's guide TLO 4.6 Explain the role of empowered voter TLO 4.7 Write the steps of voting procedure TLO 4.8 Write steps to create voter awareness TLO 4.9 Fill the online voter registration form TLO 4.10 Follow procedure to cast vote using voter-id.	Unit - IV Electoral Literacy and Voter's Education 4.1 Electoral rights 4.2 Electoral process of registration 4.3 Ethical electoral participation 4.4 Motivation and facilitation for electoral participation 4.5 Voter's guide 4.6 Prospective empowered voter 4.7 Voting procedure 4.8 Voter awareness 4.9 Voter online registration https://www.ceodelhi.gov.in/ELCdetails.aspx	Presentations Blogs Hand-outs Problem based learning

ESSENCE OF INDIAN CONSTITUTION**Course Code : 332001**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain Parliamentary democracy in India. TLO 5.2 Enlist the salient points of Bicameral Legislatures TLO 5.3 Explain Federalism and Quasi-Federal Structure TLO 5.4 Explain role of Prime Minister & Council of Ministers for the center. TLO 5.5 Explain the role of Chief Minister and Council of Ministers in the State. TLO 5.6 Differentiate between the Composition of the House of People and Council of States TLO 5.7 Explain the Functions of the Parliament and State Legislatures TLO 5.8 Write the step by step procedure for making (i) Finance Bills, (ii) Money Bills, (iii) Bills other than Money Bills for the TLO 5.9 Explain the Division of Legislative powers in the given situation. TLO 5.10 Difference between Constitutional Courts, Courts and Tribunals TLO 5.11 Explain Public interest Litigation for social welfare TLO 5.12 Outline the Legislative and Executive Functions TLO 5.13 Outline the Constitutional Role of President, Vice President and Governors	Unit - V Legislature of Union and States & Judicial System 5.1 Parliamentary democracy and Bicameral Legislatures Federalism and Quasi-Federal Structure 5.2 Federalism and Quasi-Federal Structure 5.3 Role of Prime Minister & Council of Ministers; Chief Minister and Council of Ministers 5.4 Composition of the House of People and Council of States Sessions and Functions of the Parliament and State Legislatures 5.5 Procedure in case of (i) Finance Bills, (ii) Money Bills, (iii) Bills other than Money Bills 5.6 Division of Legislative powers: Union List, State List, 5.7 Concurrent List Interpretation of Schedule VII: Doctrine 5.8 of Pith and Substance; Doctrine of Colorable Legislation, 5.9 Doctrine of Eclipse, and Waiver 5.10 Judicial Setup in India; Difference between Constitutional Courts, Courts and Tribunals 5.11 Constitutional Courts- Supreme Court & High Courts - 5.12 Jurisdiction and power 5.13 Independence of Judiciary under Indian Constitution, 5.14 Judicial Appointments etc. 5.15 Public interest Litigation 5.16 Legislative and Executive Functions 5.17 Constitutional Role of President, Vice President and 5.18 Governors	

ESSENCE OF INDIAN CONSTITUTION**Course Code : 332001**

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
6	TLO 6.1 Explain the role of Commission of Inquiry/in terms of intervention in the given situation TLO 6.2 Explain the role of Central Vigilance Commission/Information Commissions in functioning of the state. TLO 6.3 Explain the checks adopted by Reserve Bank of India in terms of money. TLO 6.4 Discuss the role of Ombudsman/ Lokpal and Lokayukta/Planning Commission and Niti Ayog/ Disaster Management Authority in Checks and balances on governance.	Unit - VI Regulatory Authorities: Checks and balances on governance 6.1 Commission of Inquiry; The CBI, Inquiries by Legislative 6.2 Committees, Judicial inquiries, etc 6.3 Central Vigilance Commission 6.4 Information Commissions 6.5 Reserve Bank of India 6.6 Ombudsman, Lokpal and Lokayukta; 6.7 Planning Commission and Niti Ayog 6.8 Disaster Management Authority	

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)****Assignment**

- Assignments are to be provided by the course teacher in line with the targeted COs.
- Prepare an essay on Constitution of India.
- Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA .
- Explain the meaning of preamble and doctrine of basic structure of the constitution.
- Identify fundamental duties in general and in particular with engineering field.
- Analyze the purposes of various amendments.
- Outline the procedure to submit application for Voter-id
- Discuss the role of Ombudsman/ Lokpal and Lokayukta/Planning Commission and Niti Ayog/ Disaster Management Authority in Checks and balances on governance.

Micro project

- Organize a workshop-cum discussions for spreading awareness regarding Fundamental Rights of the citizen of the country.
- Prepare a report on where directive principle of State policy has prevailed over Fundamental rights with relevant Supreme Court Judgements.
- Organize a debate on 42nd, 97th and 103rd Constitutional Amendment Acts of Constitution of India.
- Prepare collage stating differences in the ideals of Social democracy and Political democracy.
- Write a report on Democracy and Women's Political Participation in India.
- Discuss situations that have witnessed the checks of RBI in the financial systems in India.

Cases: Suggestive cases for usage in teaching:

ESSENCE OF INDIAN CONSTITUTION**Course Code : 332001**

- **A.K. Gopalan Case (1950)** : SC contented that there was no violation of Fundamental Rights enshrined in Articles 13, 19, 21 and 22 under the provisions of the Preventive Detention Act, if the detention was as per the procedure established by law. Here, the SC took a narrow view of Article 21.
 - Shankari Prasad Case (1951)** : This case dealt with the amendability of Fundamental Rights (the First Amendment's validity was challenged). The SC contended that the Parliament's power to amend under Article 368 also includes the power to amend the Fundamental Rights guaranteed in Part III of the Constitution.
 - Minerva Mills case (1980)** : This case again strengthens the Basic Structure doctrine. The judgement struck down 2 changes made to the Constitution by the 42nd Amendment Act 1976, declaring them to violate the basic structure. The judgement makes it clear that the Constitution, and not the Parliament is supreme.
 - Maneka Gandhi case (1978)** : A main issue in this case was whether the right to go abroad is a part of the Right to Personal Liberty under Article 21. The SC held that it is included in the Right to Personal Liberty. The SC also ruled that the mere existence of an enabling law was not enough to restrain personal liberty. Such a law must also be "just, fair and reasonable." Other cases:
1. **Kesavananda Bharati Case (1973)** : In this case the Hon. SC laid down a new doctrine of the 'basic structure' (or 'basic features') of the Constitution. It ruled that the constituent power of Parliament under Article 368 does not enable it to alter the 'basic structure' of the Constitution. This means that the Parliament cannot abridge or take away a Fundamental Right that forms a part of the 'basic structure' of the Constitution.
 2. **Mathura Rape Case (1979)** : A tribal woman Mathura (aged 14 to 16 years) was raped in Police Custody. The case raised the questions on the idea of 'Modesty of Woman' and here it was a tribal woman who succumbs to multiple patriarchies. Custodial rape was made an offence and was culpable with the detainment of 7 years or more under Section 376 of Indian Penal Code. The weight of proofing the allegations moved from the victim to the offender, once sexual intercourse is established. The publication of the victim's identity was banned and it was also held that rape trials should be conducted under the cameras.
 3. **Puttsamy vs Union of India (2017)** : In this landmark case which was finally pronounced by a 9-judge bench of the Supreme Court on 24th August 2017, upholding the fundamental right to privacy emanating from Article 21. The court stated that Right to Privacy is an inherent and integral part of Part III of the Constitution that guarantees fundamental rights. The conflict in this area mainly arises between an individual's right to privacy and the legitimate aim of the government to implement its policies and a balance needs to be maintained while doing the same.
 4. **Navtej Singh Johar & Ors. v. Union of India (2018)** : Hon. SC Decriminalised all consensual sex among adults, including homosexual sex by scrapping down section 377 of the Indian penal code (IPC). The court ruled that LGBTQ community are equal citizens and underlined that there cannot be discrimination in law based on sexual orientation and gender.
 5. **Anuradha Bhasin Judgement (2020)** : The Supreme Court of India ruled that an indefinite suspension of internet services would be illegal under Indian law and that orders for internet shutdown must satisfy the tests of necessity and proportionality. The Court reiterated that freedom of expression online enjoyed Constitutional protection, but could be restricted in the name of national security. The Court held that though the Government was empowered to impose a complete internet shutdown, any order(s) imposing such restrictions had to be made public and was subject to judicial review.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Constitution and Preamble	CO1	5	0	0	0	0
2	II	Fundamental Rights and Directive Principles	CO2	5	0	0	0	0
3	III	Governance and Amendments	CO3	5	0	0	0	0
4	IV	Electoral Literacy and Voter's Education	CO4	5	0	0	0	0
5	V	Legislature of Union and States & Judicial System	CO5	5	0	0	0	0
6	VI	Regulatory Authorities: Checks and balances on governance	CO6	5	0	0	0	0
Grand Total				30	0	0	0	0

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- Assignment, Self-learning and Terms work Seminar/Presentation

Summative Assessment (Assessment of Learning)**XI. SUGGESTED COS - POS MATRIX FORM**

ESSENCE OF INDIAN CONSTITUTION**Course Code : 332001**

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	PSO-3
CO1	1	-	-	-	2	-	-			
CO2	1	-	-	-	2	-	-			
CO3	1	1	-	-	2	-	1			
CO4	1	-	-	-	1	1	1			
CO5	1	-	-	-	1	1	1			
CO6	1	1	-	-	1	1	-			
Legends :- High:03, Medium:02,Low:01, No Mapping: - *PSOs are to be formulated at institute level										

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	P.M.Bakshi	The Constitution of India	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105 (Check the new edition)
2	D.D.Basu	Introduction to Indian Constitution	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3	B. K. Sharma	Introduction to Constitution of India	PHI, New Delhi, 6th edition, 2011, ISBN:8120344197
4	MORE READS :	Oxford Short Introductions - The Indian Constitution by Madhav Khosla. The Indian Constitution: Cornerstone of a Nation by Granville Austin. Working a Democratic Constitution: A History by Garnville Austin Founding Mothers of the Indian Republic: Gender Politics of the Framing of the Constitution by Achyut Chetan. Our Parliament by Subhash C. Kashyap. Our Political System by Subhash C. Kashyap. Our Constitution by Subhash C. Kashyap. Indian Constitutional Law by Rumi Pal.	Extra Read
5	B.L. Fadia	The Constitution of India	Sahitya Bhawan, Agra, 2017, ISBN:8193413768

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
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ESSENCE OF INDIAN CONSTITUTION**Course Code : 332001**

Sr.No	Link / Portal	Description
1	https://en.wikipedia.org/wiki/Constitution_of_India	Parts of constitution
2	http://www.legislative.gov.in/constitution-of-india	Constitution overview
3	https://www.india.gov.in/my-government/constitution-india	Constitution overview
4	https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/	Fundamental rights and duties
5	https://main.sci.gov.in/constitution	Directive principles
6	https://legallaffairs.gov.in/sites/default/files/chapter%203.pdf	Parts of constitution
7	https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india-e.htm	Parts of constitution
8	https://constitutionnet.org/vl/item/basic-structure-indian-constitution	Parts of constitution

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 01/10/2024**Semester - 2, K Scheme**

INDUSTRIAL TRAINING / PROJECT 1**Course Code : 332002****Programme Name/s : Mining & Mine Surveying/ Mining Engineering****Programme Code : MS/ MZ****Year : Second****Course Title : INDUSTRIAL TRAINING / PROJECT 1****Course Code : 332002****I. RATIONALE**

The aim of the diploma education in Mining is to create a pool of skill based manpower to supervise the various operations in Underground and Opencast working. Industrial training in mining has been the integral part of curriculum of Mining. Industrial training shall be completed in summer vacation of First year and students are free to choose the training in Underground Mines or Opencast Mines. The provision is also made for Study project instead of Training for those students who are below 18 years and could not get the required permission from DGMS office to undergo training.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop the skills of mining and applying theoretical knowledge to the practical field experience of Mines.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Adhere mine safety practices as per statutes.
- CO2 - Get acquainted with mine working environment.
- CO3 - Carryout survey related to wining and working processes.
- CO4 - Perform allotted work as vocational trainee.
- CO5 - Prepare and present industrial training report based on work experience.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks	
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
							Max	Min							Max	Min	Max	Min	Max	Min		
332002	INDUSTRIAL TRAINING / PROJECT 1	ITP	INP	-	-	2	4	6	6		-	-	-	-	-	50	20	50#	20	100		40

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 30 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
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VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Follow rigorously underground mine safety practices.	1	Underground mine safety practices: • Taking instruction from safety officer • Recording the safety practices to be followed in mine. • Recording Don'ts and Do's/ SOP followed in variousmining operations.	16	CO1
LLO 2.1 Collect the general information about mine	2	Collection of general information of underground mine like: • Name of the Mine • Name of the Owner • Name of the project officer / manager • Duration of training • Nature of training • Location of Mine • Mode of entry – there number and type.	8	CO2

INDUSTRIAL TRAINING / PROJECT 1**Course Code : 332002**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Collect information related to geology of the mine.	3	Collection of information related to geology of the underground mine. • Bore hole section, showing different strata overlying the seam • Depth of the seam from surface • Number of coal seam & their average thickness. Dip of working seam :- flat / moderate incline / steeply incline Strike length of seam • Nature of roof • Nature of floor • Details of presence of major fault / fold if any. Geological Map of the Mine.	8	CO2 CO3 CO4
LLO 4.1 Collect the information and data related to drilling and Work in section as per the instructions by the concerned.	4	Collection of information related to drilling work in underground mine: • Name of drilling machine and its specification voltage rating, type of motor used, pilot circuit for operation its importance. • Type of drill machine – rotatory or percussive Type of drill rod, its length, Arrangement for fixing drill bit Type of drill bit, Diameter of drill hole in mm. Average time taken to drill one hole. • No. of holes drilled on face with size of face width x height.	24	CO2 CO3 CO4

INDUSTRIAL TRAINING / PROJECT 1**Course Code : 332002**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Collect the information and data related to blasting and Work in section as per the instructions by the concerned.	5	Collection of information related to blasting in underground mine: • Name of explosive used - i) During development ii) During depillaring • Type of explosive used • Weight of cartridge • Diameter of cartridge • Length of cartridge • Charge per hole • Total explosive charged in single face / single hole • Stemming material used • Type of initiation – direct/indirect • Type of detonator used – its construction details and specification. • Study of following blasting tools. • Exploder – its name, type – magneto or battery condenser capacity in terms of round it can blast at a time, operating details – direction of key • Circuit tester for continuity, crimper, Scraper, Crack detector, Stemming rod • Powder factor and Detonator factor.	24	CO2 CO3 CO4

INDUSTRIAL TRAINING / PROJECT 1

Course Code : 332002

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Collect the information regarding various type of mine support and observe erection and withdrawal of supports.	6	Collection of the information regarding various type of underground mine support: - Name of support – prop / chock / cog / cross-bar / safari support / roof stitching / roof bolting / friction prop / hydraulic prop / brick walling / any other type. - Type of support – permanent / semi permanent / temporary - Method of erecting each type of support. - Load bearing capacity of support – in case of hydraulic support i) Yield load and ii) Setting load. Additional information to be collected in case of - Prop support – dimensions of lid, wedge, and base plate (if exit) - Chock / cog support – dimensions of sleepers used, pressure releasing devise (if installed) - Roof bolting – type of roof bolt, depth of hole, if mortar (mixture of sand and cement) is used sand: cement ratio. - Systematic support rules of the mine. – Copy should be obtained. - Withdrawal of supports – study the various type of safety devices used in withdrawing the support. Good sketches of all types of supports should be brought with dimensions work with Limba Misty on the faces for few days.	24	CO2 CO3 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Collect the information and data related to panel development and Work in section as per the instructions by the concerned.	7	Collection of the information related to underground mine panel development: • Type of development :- Dip / Strike / cross – cut development • Height of gallery : • Width of gallery at face : • Dimensions of pillar :- • Shape of pillar : _ square / rectangle • Number of district / panel • Number of pillar in each panel • Type of panel : closed / open • Incubation period :- • If mechanized development then in addition to above information following information is to be collected. • Name of the loading machine • Bucket capacity • Fill factor • Type / crawler mounted • Loading capacity per day • Transportation from the face chain conveyer / tubs / shuttle cars • Cycle of different operation on the faces: 1. Operation involved 2. Their Sequence 3. Time taken for each individual operation 4. Man power require for each operation 5. Production form each face / of dimension / progress per blast 6. Production of district / No of faces worked for meeting that manpower require / O.M.S of the district & faces	24	CO2 CO3 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 8.1 Collect the information and data related to depillaring and Work in section as per the instructions by the concerned.	8	Collection of following information related to depillaring of underground mine panel: • Method of depillaring • Size of split • Size of stook • Line of extraction • Preparatory arrangement before depillaring • Systematic support rules (S. S. R.) • Type of depillaring: by stowing / by caving. 1. If stowing: - general stowing arrangements stowing bunker location, water : sand ratio, signaling arrangements 2. If caving: - air blast & general precautions taken to prevent air blasts.	48	CO2 CO3 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Carryout mine ventilation survey and collect related information and data.	9	Conduction of underground mine ventilation survey: • Fan House: • Type of fan - 1. Centrifugal - backward bladed or forward bladed 2. Coaxial flow - Single stage or No. of stages • Manufacture • Diameter of fan • No. of blades • Rotations per minutes (RPM) • Water gauge developed • Motor and transmission details: 1. Specifications of motor – HP/kW, volts. R.P.M. 2. Transmission – Reduction Ratio, Type 3. Sketch of motor to fan transmission. • Water gauge 1. Construction, 2. Sketch of instrument showing how it is fitted in the fan house. 3. Reading of instrument • Fan Drift – size – width * height length inclination • Evasee chimney – sketch with dimensions – top & bottom • Air Lock doors – arrangement & to understand how the at fan house reversal of air is arranged. Sketching the arrangements for the following ventilation appliances with dimensions. • Ventilation stoppings. • Ventilation doors – In haulage roadways and in other gallery • Air crossing :- • Air lock doors underground • If available regulators • If available fire stopping – its specifications, fitting preparatory stoppings in depillaring area. • Inspection of stoppings by supervisors / assistant Managers. • Intake airway and downcast shaft. • Upcast shaft and return airway • Study ventilation plan to see the distribution of air inside the mines, splits, ventilation districts. • Study of auxiliary fan arrangement if installed and precautions. Specifications of fan, specification of tubing's, layouts. Ventilation Measurements:	48	CO2 CO3 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
		• Measurement of quantity flowing 1. Anemometer 2. Velometer • Measurement of humidity 1. Hygrometer 2. Katathermometer		

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 10.1 Collect the information and data related to mining machinery.	10	Collection of information related to underground mining machinery: Transportation: • General haulage system :- Rope haulage / belt conveyor • Number of haulages • Type of each haulages • Capacity or rating of each haulage motor • Safety appliances used on each haulage like i) Stop block, ii) Run away switch, iii) drag iv) Pull Cord. – Draw Sketches with dimension to be brought. • Signalling arrangement and code of signals • Other haulage features like i) Re-railer ii) Manholes iii) Tub arrester iv) Pullcord system in case of conveyor. v) Rollers. • Type of haulage rope – no of strands, splicing of ropes • Surface tippler – its layouts, tipping arrangements • Track, crosses, sleepers, Track fillings. Method of laying track – work with track layer for few days. Pumping Arrangement: • Type of different pumps used in the mines their i) Head, ii) H. P. – Study the Literature available in mech. Department. • Electrical switches – detail. • Starting & stopping of pump. • Sketch general arrangement – starting from strainer / foot valve, suction pipe, pump, delivery pipe, delivery valve, • Arrangement for priming of the pump. • Sketch of tub with name of the parts & its capacity • Couplings, Sockets, clips etc used with haulage • No of tubs (loaded & empty) attached to different capacity haulage. Mine Shaft: • No. of shafts • Finished diameter of each shaft. • Type of lining • Shape of shaft • Headgear – General construction • Type of head gear winding- • No. of cage • Various safety appliances like – i) Safety hook (type) ii) Automatic contrivance iii) Cage arrester,	48	CO2 CO3 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
		• Construction and use of keys • Guides – type, and its use		
LLO 11.1 Collect the information related to surface features.	11	Collection of the information related to <u>surface features of underground mine</u>: • Lamp room layout – cap lamp, • Explosive Magazine – precautions taken to prevent pilferage of explosive • Store room – general procedure of issuing store material • Winding engine room	16	CO2 CO3 CO4
LLO 12.1 Follow rigorously surface mine safety practices.	12	Surface mine safety practices: • Taking instruction from safety officer • Recording the safety practices to be followed in mine. • Recording Don'ts and Do's/ SOP followed in various mining operations.	24	CO1
LLO 13.1 Collect the general information about surface mine	13	Collection of <u>general information of surface mine</u> like: • Name of the Mine • Name of the Owner • Name of the project officer / manager • Duration of training • Nature of training • Location of Mine • Mode of entry – there number and type	8	CO1
LLO 14.1 Collect the information related to geology of surface mine.	14	Collection of information related to <u>geology of surface mine</u>: • Bore hole section, showing different strata overlying the seam • Depth of the seam from surface • Number of coal seam & their average thickness. • Dip of working seam :- flat / moderate incline / steeply incline • Strike length of seam • Details of presence of major fault / fold if any • Geological Map of the Mine.	16	CO2 CO3 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Collect the information and data related to method of working of surface mining and Work in section as per the instructions by the concerned.	15	Mine Opening: • Site preparations • Type of entry • Mine layout • Statutory provisions & permissions w.r.t. mine opening. Method Of Working: • Type of mechanisation (manual, semi-mechanised, mechanised) • Manpower requirement • Bench geometry: Height, width, slope, ultimate pit slope, haulroad preparation. • ROM handling from mines to processing plant. • Statutory permissions and provisions w.r.t. method of working. • Monsoon preparations.	48	CO2 CO3 CO4
LLO 16.1 Collect the information and data related to drilling, blasting and Work in section as per the instructions by the concerned	16	Drilling and Blasting in surface mining: • Blast geometry: Spacing, burden, length & diameter of drill hole, subgrade drill, stemming, explosive charge per hole, powder factor, column charge, priming charge, deck charging, etc. • Type of explosive used, its specifications, bulk explosive and cartridge explosives. • Type of initiation system of explosives, accessories used in explosives initiations, their specifications, blast initiation pattern and connections. • Blasting procedure and precautions. • Statutory permissions w.r.t. blasting. • Arrangement for storage and transportation of explosives. • Statutory permissions and provisions w.r.t. storage and transportation of explosives.	72	CO2 CO3 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 17.1 Collect the information and data related to surface mining machinery and Work in section as per the instructions by the concerned.	17	Surface Mining Machinery Construction, Working principle, Specifications and Applications of Machineries used in the respective mine: • Scraper • Dozer & Ripper • Motor grader • Roller • Drill Machines • Excavators (Rope &/or Hydraulic) • Dumpers &/or Tippers • Conveyors • Explosive van • Water tankers / sprinklers • Rock breaker • Backhoe • Other machineries.	72	CO2 CO3 CO4
LLO 18.1 Collect the information and data related to environmental impacts & measurements:	18	Environmental Impacts & measurements: • Types of environmental impacts • Measurement of ground vibrations. • Precautionary measures of ground vibration, fly rock, air blast at mines site. • Precautionary measures to reduce air-water-land pollution at mines site. • Land reclamation procedure. • EIA & EMP	48	CO2 CO3 CO4
LLO 19.1 Prepare industrial training report in standard format. LLO 19.2 Perform plagiarism check from free internet site and Submit report of plagiarism check to the allotted teacher with industrial training report.	19	Preparation of industrial training report in standard format, which includes following: • Title Page which includes: Title, Purpose of submission, Institute logo, Students Name, Industry Name, Department and Institute Name • Certificates: Student declaration, Certificate from industry • Acknowledgement • Text • Introduction to Industry • Safety Practices in Industry • Industrial Process and collected information • Working Experience • Results • Summary/Conclusion. References	30	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 20.1 Prepare PPT for presentation of industrial training report.	20	Presentation of industrial training report.	16	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Study Project**

- The students below 18 years of age and those who could not attend the training, will have to select the topic and prepare the study project based on that Topic and present it before Panel of Teachers and External Examiner.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE****X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Attendance during training /Selection of topic
- Collection of data / information.
- Work done and Feasibility of work/ problem identified.

Summative Assessment (Assessment of Learning)

- Report Writing and submission.

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- Presentation
- Viva voce
- End Year Examination

XI. SUGGESTED COS - POS MATRIX FORM

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	PSO-3
CO1		3		3	3	3	3			
CO2	3	3	3	3	3	3	3			
CO3	3	3	3	3	3	3	3			
CO4	3	3	3	3	3	3	3			
CO5						3	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
 *PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Heartman L. Howard	Introductory Mining Engineering	John Wiley & Sons, New York, ISBN: 0-471-62804-2
2	R. D. Singh	Principles & Practices of Modern Coal Mining	New Age International (P) Limited, Publishers, New Delhi ISBN: 81-224-0974-1
3	S. D. Prasad & Rakesh	Legislation in Indian Mines: A Critical Appraisal (Volume - I & II)	Vivek P-8, New Medical Enclave. B.H.U., Varanasi – 221005.

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.mining-journal.com/category/projects	Research paper publication on Mining Projects.
2	http://www.infomine.com/library/publications	Webinar publications on Mining Projects.
3	https://www.mining-technology.com/?cf-view	Publications on foreign mining practices.

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students