VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E. in Mining Engineering
Scheme of Teaching and Examinations2021
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 - 22)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Mathematics Course (Common to all)	TD- Maths PSB-Maths	2	2	0		03	50	50	100	3
2	IPCC 21MN32	Drilling and Blasting	TD: Mining PSB: Mining	3	0	2		03	50	50	100	4
3	IPCC 21MN33	Mining Geology	TD: Mining PSB: Mining	3	0	2		03	50	50	100	4
4	PCC 21MN34	Elements of Mining Engineering	TD: Mining PSB: Mining	3	0	0		03	50	50	100	3
5	PCC 21MNL35	Computer Aided Mining Drawing Lab	TD: Mining PSB: Mining	0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB HSMC	0	2	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21MN38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NCMC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE)(Sports and Athletics),and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out between III semester to VIII semester (for 5 semesters). SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities.
		NCMC 21PE83	Physical Education (PE) (Sports and Athletics)	PE	
		NCMC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note:BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course,**INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.
L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.**TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2021-22 may be referred.

21INT49Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internshipof 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A)Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the coursesAdditional Mathematics I and IIshall be indicated as satisfactory in the grade card. Non-completion of the coursesAdditional Mathematics I and IIshall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21MN381	Mastering Office	21MN383	Programming in C++
21MN382	Personality Development and Soft Skills		

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(Effective from the academic year 2021 - 22)

IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MN41	Probability and Statistics	TD, PSB-Maths	2	2	0		03	50	50	100	3
2	IPCC 21MN42	Rock Mechanics	TD: Mining PSB: Mining	3	0	2		03	50	50	100	4
3	IPCC 21MN43	Mining Machinery	TD: Mining PSB: Mining	3	0	2		03	50	50	100	4
4	PCC 21MN44	Mine Surveying	TD: Mining PSB: Mining	3	0	0		03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	1	2	0		02	50	50	100	2
6	PCC 21MNL46	Mine Surveying Laboratory	TD: Mining PSB: Mining	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	0	2	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21MN48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period ofII and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCCshall be included in the SEE question paper.For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics IIshall be indicated as satisfactory in the grade card. Non-completion of the coursesAdditional Mathematics IIshall be indicated as Unsatisfactory.

Ability Enhancement Course - IV

21MN481	Technical Writing Skills	21MN483	Quantum GIS
21MN482	Programming in Python		

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68Innovation/ Entrepreneurship/ Societalbased Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internshipshall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprises (MSME), Innovation centres, or Incubation centers. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes.Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offer a chance to gain hands-on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours.Start-ups and small companies are a preferred place to learn the business tack ticksor future entrepreneurs as earning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation.Entrepreneurship internships can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoys. The rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in name of the Program

Scheme of Teaching and Examinations 2021

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MN51	Surface Mining	TD: Mining PSB: Mining	3	0	0		03	50	50	100	3
2	IPCC 21MN52	Mineral Processing	TD: Mining PSB: Mining	3	0	2		03	50	50	100	4
3	PCC 21MN53	Underground Coal Mining	TD: Mining PSB: Mining	3	0	0		03	50	50	100	3
4	PCC 21MN54	Mine Ventilation	TD: Mining PSB: Mining	3	0	0		03	50	50	100	3
5	PCC 21MNL55	Mine Ventilation Laboratory	TD: Mining PSB: Mining	0	0	2		03	50	50	100	1
6	AEC 21XX56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by University	1	2	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	0	2	0		1	50	50	100	1
8	AEC 21MN58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses: 1	0	0		01	50	50	100	1
				If offered as lab. courses: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - IV

21MN581	Introduction to IOT	21MN583	Industry 4.0
21MN582	Gender Sensitisation		

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science & Management Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21MN61	Mine Management	Any Department	2	2	0		03	50	50	100	3
2	IPCC 21MN62	Mine System Engineering	TD: Mining PSB: Mining	3	0	2		03	50	50	100	4
3	PCC 21MN63	Underground Metal Mining	TD: Mining PSB: Mining	3	1	0		03	50	50	100	3
4	PEC 21MN64x	Professional Elective Course-I	TD: Mining PSB: Mining	3	0	0		03	50	50	100	3
5	OEC 21MN65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21MNL66	Computer Application in Mining Lab	TD: Mining PSB: Mining	0	0	2		03	50	50	100	1
7	MP 21MNMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective - I

21MN641	Open Pit Slope Analysis and Design	21MN643	Mine Environmental Engineering
21MN642	Ground Control		

Open Electives – I offered by the Department to other Department students

21MN651	Introduction to Mining		
21MN652	Introductory Rock Mechanics		

Note:HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, O**EC**–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, **T** – Tutorial, **P** - Practical / Drawing, **S** – Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses(PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.
(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.
The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
No SEE component for Mini-Project.

VII semester Class work and Research Internship /Industry Internship (21INT82)

Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
Elucidation:
At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship.
Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.
The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82 Research Internship/ Industry Internship/Rural Internship
Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.
Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.
The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

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Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21MN71	Mine Legislation and Safety	TD: Mining PSB: Mining	3	0	0		3	50	50	100	3
2	PCC 21MN72	Mineral Economics	TD: Mining PSB: Mining					3	50	50	100	2
3	PEC 21MN73X	Professional elective Course-II	TD: Mining PSB: Mining	3	0	0		3	50	50	100	3
4	PEC 21MN74X	Professional elective Course-III	TD: Mining PSB: Mining	3	0	0		3	50	50	100	3
5	OEC 21MN75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21MNP76	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21MN81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester toVIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21MN731	Underground Mine Planning and Design	21MN734	Advanced Mine Ventilation
21MN732	Surface Mine Planning and Design		
21MN733	Environmental Management in Surface Mines		

Professional Elective - III

21MN741	Mine Geo-statistics	21MN744	Dimensional Stone Mining
21MN742	Mine Safety Engineering		
21MN743	Mine Automation and Data Analytics		

Open Electives - II offered by the Department to other Department students			
21MN751	Introduction to Mine Surveying		
21MN752	Introduction to Rock Breakage		
21MN753	Underground Space Technology		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To install responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the samefor all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks.■No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum program period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Semester - III

DRILLING AND BLASTING			
Course Code	**21MN32**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	03

Course objectives:

- To understand the rock breakage concepts and methods such as drill and blast; mechanical cutting.

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-I 8 HOURS

Explosives and Initiating Systems: Types of explosives, their composition and properties, classification; Selection of explosives; Manufacture, transport, storage and handling of explosives; Testing of explosives; Types of initiating systems – Electrical Detonators, Detonating cord, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

MODULE-28 HOURS

Drilling in Surface Mines: Blasthole drills – types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, drilling errors, Selection of drilling systems, organization of drilling.

Teaching-Learning Process	. Chalk and talk, PowerPoint Presentation

MODULE-3 8 HOURS

Blasting in Surface Mines: Mechanics of rock fragmentation; Livingston theory of crater formation; factors affecting blast design, Blast design - estimation of burden and spacing, estimation of charge requirement; initiation patterns; secondary blasting techniques; problems associated with blasting and remedies, ground vibration and air over pressure, blast instrumentation; cast blasting.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
MODULE-4 8 HOURS	
Drilling & Blasting in Underground Mines Coal mines: Drilling systems and their applicability, blasting-off-solid, different blasting cuts, calculation of specific charge, specific drilling and detonator factor, initiation patterns. **Metal mines:** Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, long hole blasting, vertical crater retreat blasting.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
MODULE 5 8 HOURS	
Mechanised Cutting: Ripping, Cutting using– surface and underground machinery, rock breakers. **Blast design and analysis software.**	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Drilling rate index.
2	Preparation and procedure for shot firing
3	Control blasting
4	Blast vibration measurement.
5	Blast design in surface mine
6	Blast design in underground coal mine
7	Blast design in underground metal mine
8	Fragmentation analysis. **(Can be Demo experiments for CIE)**

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Understanding about the explosives and initiating systems used in rock breakage.
- Blast hole drilling mechanism and selection of a drill for surface excavation.
- Ability to design the surface blast round and predict the outcomes of the blast design.
- Ability to design underground blast round and predict the outcomes of the blast design.
- Understanding the basics of mechanized excavation techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures

not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more

than the 20 marks.

- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. Drilling and blasting of rocks – Jimeno, Carcedo, Jimeno, T&F, 1995
2. Rock Blasting and Overbreak Control- C.J. Konya, 1991
3. Surface and underground excavations – R. R. Tatiya, 2010

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc22_mm02/preview**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

Semester - III

MINING GEOLOGY			
Course Code	**21MN33**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- The primary objective of the course is to introduce fundamental concepts, ideas and materials in geology to students of science and engineering.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-1 8 HOURS	
Introduction to science of Geology; its various branches and its application in mining engineering. **Mineralogy:** General properties; Bowen's Reaction Series, Classification of minerals and properties of common rock-forming minerals; Megascopic identification of some rock-forming minerals	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

MODULE-2 8 HOURS	
Petrology: Rock cycle, Rock types, Classification and description of some common rocks; Megascopic identification of igneous, sedimentary and metamorphic rocks	
Teaching-Learning Process	. Chalk and talk, PowerPoint Presentation

MODULE-3 8 HOURS
Physical Geology: Evolution of the earth; Exogenous and endogenous processes shaping the earth; Important geomorphological features. **Stratigraphy:** Principles of stratigraphy; Geologic Time Scale; Broad stratigraphic subdivisions and associated rock types of important coal belts and oil fields of India;

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
MODULE-4 8 HOURS	
Mineral and Energy Resources: Introduction and scope of economic geology (including coal and hydrocarbon resources); Ore and gangue minerals; Resource, reserve and grade; Distribution and mode of occurrence of some mineral deposits, coal and petroleum deposits; Megascopic identification of some ore-forming minerals	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
MODULE 5 8 HOURS	
Structural Geology: Interpretation of topographic and geological maps; Attitude of planar and linear structures; Effects of topography on outcrops; Unconformities, folds, faults and joints - their nomenclature, classification and recognition; Some structural geological problems and their solutions	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Megascopic identification of rock-forming minerals.
2	Megascopic identification of ore-forming minerals.
3	Megascopic identification of igneous, sedimentary and metamorphic rock types.
4	Megascopic identification of various types of coal.
5	Interpretation & description of topographic maps and Geological maps
6	Interpretation & description of structural geological maps – Dipping strata, Folded & Faulted strata and unconformities.
7	Tracing of out crop maps
8	To determine true dip when two apparent dips are known.
9	To determine the amount of apparent dip when true dip and direction of apparent dips are given.
10	To determine the direction of apparent dip when true dip and amount of amount of apparent are known.
11	Calculation of attitude, thickness and depth of ore bodies
12	Bore Hole problems (Three point problems): on ground level

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- . Understand the basics of mineralogy and petrology and learn identification of some minerals and rocks.
- Learn about the fundamentals of stratigraphy.
- Understand physical and structural geology and solve some structural geological problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. Hefferan, K. and O'Brien, J., 2010. Earth Materials, Wiley-Blackwell, Sussex; 670 p.
2. Jain, S., 2014. Fundamentals of Physical Geology, Springer, New Delhi; 494 p.
3. Van der Pluijm, B.A., Marshak, S., 2004. Earth Structure – An Introduction to Structural Geology and Tectonics, W.W. Norton & Company, New York; 656 p.

Web links and Video Lectures (e-Resources):

- **https://nptel.ac.in/courses/105105170**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes
- Field visit

15.09.2022

III Semester

ELEMENTS OF MINING ENGINEERING			
Course Code	**21MN34**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To understand the basic concept of mining industry in relation to national economy and infrastructure building.
- To be familiar with the various methods for opening up of deposits.
- To understand the technical details of various unit operations involved in shaft sinking.
- To learn various methods of shaft sinking and Tunneling methods
- To be familiar with the various types of Mine supports.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Mining Engineering: Significance to mining industry in national economy and infrastructure building, basic mining terminologies, stages in mine life cycle, geo-technical investigations, classification of mining methods and their selection criteria.

Opening up of Deposits: Types, size and location of entries into underground coal and other minerals.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos

Module-2

Shaft Sinking Operation: Preliminary geo-technical investigations for a shaft sinking, surface arrangements for sinking shafts and equipment. Unit-operations of drilling, blasting, mucking; temporary and permanent lining. Construction of insets and shaft stations.

Special and Mechanized Methods of Shaft Sinking: Methods of sinking shaft in water-logged, pressurized strata in loose and running soils. Mechanized shaft sinking, shaft borers and drop raise method. Need for widening and deepening of operating shafts. Different methods for widening and deepening shafts- cycles of operation, equipment and manpower needed. Numerical related to shaft sinking.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos

Module-3

Development of Workings: Drivage of cross cuts, drifts, inclines and raises by conventional and mechanized methods. Calculation of OMS. Arrangements for ventilations, supports, lightings, transportations and drainages. Drilling patterns for underground coal mines and hard rock mines.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos

Module-4

Mine Support Systems: Types of support: timber, prop, chock/cog, cross bar, concrete, steel and hydraulic supports. Yielding and rigid supports. Fore poling, roof stitching, roof bolting, applicability, advantages and limitations of various supports. Systematic support rules.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos

Module-5

Tunneling Methods : Conventional Method: drilling and blasting method, types of drill patterns, blasting and transportation of muck. Mechanized Method: construction and working principle of tunnel boring machine, applicability, advantages and limitations of tunnel boring machine.
Shield Tunneling Method: construction and working principle, applicability, advantages and limitations.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. The students will gain technical knowledge on stages of mining and methods of development.
2. They will be able to design various drilling patterns used in drivage of adit, shaft, incline, drives, cross-cut and tunnel.
3. They will be able to identify, formulate and solve engineering problems in shaft sinking.
4. They will possess ability to use the techniques, skills, and modern engineering tools necessary for mine

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Elements of Mining Technology, vol. I, D. J. Deshmukh, Vidyasewa Prakashan, Nagpur, 7th Ed, 1996.
2. Introductory Mining Engineering, Hartman H.L, John Wiley Sons, 1st Ed. 2004.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=HCDsFIqIfA0
- https://www.youtube.com/watch?v=S9ytDMJLHkc

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes
- Field visit

15.09.2022

MASTERING OFFICE

Course Code	**21MN381**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- Understand the basics of computers and prepare documents and small presentations.
- Attain the knowledge about spreadsheet/worksheet with various options.
- Create simple presentations using templates various options available.
- Demonstrate the ability to apply application software in an office environment.
- Use MS Office to create projects, applications.

Sl.NO	Experiments
1	**MS-Word**: Working with Files, Text – Formatting, Moving, copying and pasting text, Styles – Lists – Bulleted and numbered lists, Nested lists, Formatting lists. Table Manipulations.
2	**MS-Word**: Graphics–Adding clip Art, add an image from a file, editing graphics.
3	**MS-Word**: Page formatting - Header and footers, page numbers, Protect the Document, Mail Merge, Macros – Creating & Saving web pages, Hyperlinks.
4	**MS-Excel:** Modifying a Worksheet – Moving through cells, adding worksheets, rows and columns, Resizing rows and columns, selecting cells, Moving and copying cells,
5	**MS-Excel:** freezing panes - Macros – recording and running. Linking worksheets - Sorting and Filling, Alternating text and numbers with Auto fill, Auto filling functions.
6	**MS-Excel:** Graphics – Adding clip art, add an image from a file, Charts – Using chart Wizard, Copy a chart to Microsoft Word.
7	**MS-Power Point**: Create a Presentation from a template- Working with Slides – Insert a new slide, applying a design template, changing slide layouts – Resizing a text box, Text box properties.
8	**MS-Power Point**: delete a text box - Video and Audio effects, Color Schemes & Backgrounds Adding clip art, adding an image from a file, Save as a web page.
	Demonstration Experiments (For CIE)
9	**MS-Access**: Using Access database wizard, pages and projects. Creating Tables – Create a Table in design view.
10	**MS-Access**: Datasheet Records – Adding, Editing, deleting records, Adding and deleting columns Resizing rows and columns, finding data in a table & replacing, Print a datasheet. Queries - MS-Access.
11	**Microsoft Outlook:** Introduction, Starting Microsoft Outlook, Outlook Today.
12	**Microsoft Outlook:** Different Views in Outlook, Outlook Data Files.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Know the basics of computers and prepare documents, spreadsheets, make small presentations with audio, video and graphs and would be acquainted with internet.
- Create, edit, save and print documents with list tables, header, footer, graphic, spellchecker, mail merge and grammar checker.

- Attain the knowledge about spreadsheet with formula, macros spell checker etc.
- Demonstrate the ability to apply application software in an office environment.
- Use Google Suite for office data management tasks.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal

/external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Sanjay Saxena, A First Course in Computers (Based on Windows 8 And MS Office 2013) Vikas Publishing 2015.
2. Jennifer fulton, Sherri Kinkoph, and Joe Kraynak, The Big Basics Book of Microsoft Office 1997, PHI, 1998.
3. Laura Acklen et al, Microsoft Office 97 Professional Essentials,EEE Que E&T, PHI (1998).
4. Andy Channelle, Beginning OpenOffice 3, APress 2009.
5. R. Gabriel Gurley, A Conceptual Guide to OpenOffice.Org 2 for Windows and Linux

Semester III

Personality Development and Soft Skills			
Course Code	**21MN382**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

- Experience self-fulfilment and overall development of one's own personality by developing personal skills.
- Develop awareness about the significance of soft skills and impactful personality in professional life.
- Improve the soft skills like effective communication, business correspondence, impressive presentation, leadership qualities, team-work, Time management leading to successful performance in interviews and group discussions.
- Identify opportunities in career building and enhancement with proper time management and stress management.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video
3. Group discussion
4. Enacting, Demonstration
5. Industry interaction

Module-1	
Introduction to Soft-Skills-Personal Skills: Knowing Oneself/Self-Discovery-Confidence Building- Defining Strengths- Developing Positive Attitude- Thinking Creatively-Improving Perceptions -Forming Values.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2	
Interpersonal and Social Skills: Understanding others-Developing Inter-personal relationship Team Building-Group dynamics-Networking-Problem-solving.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-3	
Communication Skills: Art of Listening-Art of Speaking-Art of Reading-Art of Writing-Art of Writing E-mails: Email etiquette	
Teaching-Learning Process	Chalk and talk, Enacting, Demonstration.

Module-4	
Presentation skills: Group discussion- mock Group Discussion using video recording - public speaking.	
Teaching-Learning Process	Chalk and talk, Enacting, Demonstration, Activity

Module-5	
Corporate Skills: Working with others- Developing a proper body language-behavioural etiquettes and mannerism- Time Management –Stress Management	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Develop effective communication skills (spoken and written) and effective presentation skills. Actively participate in group discussion / meetings / interviews and prepare & deliver presentations
- Conduct effective business correspondence and prepare business reports which produce results.
- Develop an understanding of and practice personal and professional responsibility.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Meena K and V. Ayothi (2013) A Book on Development of Soft Skills (Soft Skills: A Road Map to Success), P. R. Publishers & Distributors, No. B-20 & 21, V. M. M Complex, Chatiram Bus Stand, Tiruchirappalli-620002. (Phone No: 0431-2702824Mobile No.: 9443370597, 9843074472)
2. Alex K. (2012) Soft Skills-Know Yourself & Know the World, S. Chand & Company LTD, Ram Nagar, New Delhi-110055. Mobile No.: 9442514814 (Dr.K.Alex

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc19_hs32/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Presentation on any social issues
- Quizzes

15.09.2022

Semester III

PROGRAMMING IN C++			
Course Code	**21MN383**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

- Understanding about object oriented programming and Gain knowledge about the capability to store information together in an object.
- Understand the capability of a class to rely upon another class and functions.
- Understand about constructors which are special type of functions.
- Create and process data in files using file I/O functions
- Use the generic programming features of C++ including Exception handling.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information ratherthan simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Object Oriented Programming: Computer programming background- C++ overview- First C++ Program -Basic C++ syntax, Object Oriented Programming: What is an object, Classes, methods and messages, abstraction and encapsulation, inheritance, abstract classes, polymorphism.

Textbook 1: Chapter 1(1.1 to 1.8)

Teaching-Learning Process	Chalk and board, Active Learning, practical based learning.

Module-2

Functions in C++: Tokens – Keywords – Identifiers and constants – Operators in C++ – Scope resolution operator – Expressions and their types – Special assignment expressions – Function prototyping – Call by reference – Return by reference – Inline functions -Default arguments – Function overloading.

Textbook 2: Chapter 3(3.2,3.3,3.4,3.13,3.14,3.19, 3.20) , chapter 4(4.3,4.4,4.5,4.6,4.7,4.9)

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration, presentation, problem solving

Module-3

Inheritance & Polymorphism: Derived class Constructors, destructors-Types of Inheritance-Defining Derived classes, Single Inheritance, Multiple, Hierarchical Inheritance, Hybrid Inheritance.

Textbook 2: Chapter 6 (6.2,6.11) chapter 8 (8.1 to,8.8).

Teaching-Learning Process	Chalk and board, Demonstration, problem solving

Module-4

I/O Streams: C++ Class Hierarchy- File Stream-Text File Handling- Binary File Handling during file operations.

Textbook 1: Chapter 12(12.5) , Chapter 13 (13.6,13.7)

Teaching-Learning Process	Chalk and board, Practical based learning, practical's

Module-5

Exception Handling: Introduction to Exception - Benefits of Exception handling- Try and catch block- Throw statement- Pre-defined exceptions in C++ .

Textbook 2: Chapter 13 (13.2 to13.6)

Teaching-Learning Process	Chalk and board, MOOC.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Able to understand and design the solution to a problem using object-oriented programming concepts.
- Able to reuse the code with extensible Class types, User-defined operators and function Overloading.
- Achieve code reusability and extensibility by means of Inheritance and Polymorphism
- Identify and explore the Performance analysis of I/O Streams.
- Implement the features of C++ including templates, exceptions and file handling for providing programmed solutions to complex problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Bhushan Trivedi, "Programming with ANSI C++", Oxford Press, Second Edition, 2012.
2. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd , Fourth Edition 2010.
3. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004.
4. Ray Lischner, "Exploring C++ : The programmer's introduction to C++" , apress, 2010
5. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004

Web links and Video Lectures (e-Resources):

1. Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
2. Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw
   Tutorial Link:
3. https://www.w3schools.com/cpp/cpp_intro.asp
4. https://www.edx.org/course/introduction-to-c-3

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of simple projects.

COMPUTER AIDED MINING DRAWING LAB			
Course Code	21MNL35	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- To understand the draw, modify and dimensioning tools in the CAD package
- To draw the orthographic projections
- To draw mining Machineries using CAD tools.

Sl.NO	Experiments
1	Learning of the following commands using a CAD package: Drawing Commands: Line, arc, circle, polygon, Donut, Solid, Spline Pline, Text, M Line, ellipse, dimensioning, object snaps point, Hatch, layers, Units. Exercise using Draw commands.
2	Learning of the following commands using a CAD package: Editing Commands: Limits, Erase, Array, Copy, Move, Offset, Stretch, Pedit, change properties, Trim, Extend, Fillet, Chamfer, Break, Mirror, Scale, Rotate, Zoom, Pan. Exercise using Edit commands.
3	Learning of the following commands using a CAD package: Id, list, Dist, Area, DB list, Status Selection sets i.e., window, crossing, fence, W polygon. Plotting.
4	Simple exercises using any of the above commands.
5	08 (Eight) Exercises (Mining Drawing) using any of the above commands.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- To use the draw, modify and dimensioning tools in the CAD package.
- Ability to draw orthographic projections using CAD package.
- Ability to draw mining Machineries using CAD tools.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. **"Machine Drawing with Auto CAD"** Goutam Pohit& Goutham Ghosh, 1st Indian print Pearson Education, 2005.
2. **"Auto CAD 2006, for engineers and designers"** Sham Tickoo. Dream tech 2005.

15.09.2022

Semester IV

	21MN41		

Semester - IV

ROCK MECHANICS			
Course Code	**21MN42**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- To describe the importance of Rock Mechanics in the field of mining and identify of the physical and mechanical properties of rocks.
- To understand stress and strain in rocks and the physical and mechanical properties of rocks, and failure criteria for rock and rock mass.
- To understand the methods of in-situ strengths of rock mass

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-1 8 HOURS	
Introduction to Rock Mechanics: Definition, Scope and importance, development and application of rock mechanics in mining. Discontinuities; Description of discontinuities, Introduction to mapping and hemispherical projection of discontinuities. Barton's shear strength of joints.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, Videos
MODULE-2 8 HOURS	
Analysis of Stress: Introduction, definition and basic concepts, stress in a plane, (two dimensional stress), Mohr's Circle of stress, equations of equilibrium, plane stress equations. Simple numerical problems.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, Videos
MODULE-3 8 HOURS	

Analysis of Strain: Introduction, definition and basic concepts, strain in a plane, (two dimensional strain), Mohr's Circle of strain, equations of compatibility, stress-strain relationship, plain strain equations, elasto plastic behaviour of rocks.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, Videos
MODULE-4 8 HOURS	
Physico-mechanical properties of rock: Determination of physical properties, strengths, strength indices and static elastic constants; Parameters influencing strength; Abrasivity of rock and its determination. **Pre-mining state of Stress**: Stresses in rock mass, Factors influencing the in-situ state of stress, Estimating in-situ stresses; Methods of Stress determination - Hydro fracturing, stress relief methods.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, Videos
MODULE 5 8 HOURS	
Rock mass properties: Strength and Deformability of Rock Mass In situ shear tests; Evaluation of shear strength; In situ bearing strength test; In situ deformability tests- Plate Loading Test, Plate Jacking Test and Borehole Jack Tests. **Failure criteria for rock and rockmass**: Theories of rock failure: Coulomb, Mohr and Griffith criteria; Empirical criteria.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, Videos

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Plotting of Stereographic Hemispherical projections of Discontinuities
2	Determination of Rock Quality Designation of rock.
3	Determination of slake durability index of rocks.
4	Determination of uniaxial compressive strength of rocks.
5	Determination of tensile strength of rock by Brazilian test.
6	Determination of compressive strength index of rocks by using point load tester.
7	Determination of Protodyakanov index of the given rock specimen.
8	Schmidt hammer test.
9	Preparation of rock specimens for laboratory tests. (**Can be Demo experiments for CIE)**

10	Determination of shear strength by direct test. (**Can be Demo experiments for CIE)**
11	Determination of triaxial strength of rock. (**Can be Demo experiments for CIE)**
12	Determination of Abrasivity of rock. (**Can be Demo experiments for CIE)**

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- describe the importance of Rock Mechanics in the field of mining and identify of the physical and mechanical properties of rocks.
- calculate the stress and strain in rocks and rockmass.
- understand the time dependent behaviour of rock.
- Understand failure criteria for rock and rock mass.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. Fundamental of Rock Mechanics by Jaeger, J.C. and Cook, NGW
2. Underground Excavation in Rock, Hoek, E and Brown, ET
3. Rock Mechanics for Underground Mining, Brady, BHG and Brown, ET
4. Introduction to Rock Mechanics, Goodman, RE.
5. Coal Mine Ground Control: Syed Peng

Web links and Video Lectures (e-Resources):

- **https://nptel.ac.in/courses/105106055**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

Semester - IV

MINING MACHINERY			
Course Code	**21MN43**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- Students will understand basic features of equipment, selection, environmental issues and design features.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-1 8 HOURS	
Ropes: Wire ropes of different types and their construction and selection, rope capping, recapping and rope splicing. estimation of size of rope and safety factor for ropes used in winding. Numerical problems. **Mine winders:** Drum, Friction, Blair winders; Rope attachments; Shaft fittings; Safety devices; Hoisting cycle; Productivity calculation; Cages; Skips; Wire ropes.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

MODULE-2 8 HOURS	
Rope haulages: Classifications; Operation; Productivity calculation; Mine cars; Rope fittings; Scope and application. **Locomotive haulages:** Electric, Battery, Diesel locomotives; Tractive effort; Drawbar pull; Ideal gradient; Optimum gradient; Neutral gradient; Super elevation; Track layouts & safety devices; Locomotive calculations; Scope & application. **Ancillary Equipment:** Road header; LHD; Shuttle cars, LPDT, SDL. Man riding systems	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

MODULE-3 8 HOURS	
Ore Transporting Equipment in Surface Mines: Dumpers: Classifications; System components and functions Belt conveyors: System components and functions; Maintenance, Capacity & power calculations; Scope & application High Angle Conveyor: Constructional features; Operation; Scope & application Cable belt conveyor: Constructional features; Operation; Scope & application Pipe belt conveyor: System components and functions; Scope & application Aerial ropeways: Classifications; Operation; Angle stations; Loading & discharging stations; Buckets; Scope & application.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
MODULE-48 HOURS	
Rock Drills: Types of rock drills, Constructional features and operation of electric and hydraulic coal drills; Jack hammers, Hydraulically operated drill machines, Electro hydraulic jumbo drills, Top hammer drills, DTH drills, Wagon drills, Blast hole drills, Drill bits, Drill rods, Flushing mechanisms. **Roof Supports:** Friction supports; Hydraulic supports; Power supports; Nomenclatures; Hydraulic circuits: Hydraulic oil & properties; Power pack unit, Roof bolts, Scope & applications.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
MODULE 58 HOURS	
Production Machines in Underground Mines: Construction and operation of shearer, plough, continuous miner; Scope & application; Cutting picks; Cutting heads; AFC; Stage loader. **Excavating Equipment in Surface Mines:** Construction and operation of Surface miners, Electric rope shovels, Hydraulic shovels, Draglines, Bucket wheel excavators; Scope & application.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	To study constructional details and functioning of Jack Hammer.
2	To study constructional details of different wire ropes.
3	To study the capping and recapping procedures of wire ropes.
4	To study the procedure for splicing the wire ropes.
5	Sketch and write details of safety hook and its function.
6	Suspension gear arrangement of the shaft.

7	Belt conveyors with their design parameters used in mines.
8	Different types of winding system and their comparative application.
9	Process of changing of winding rope and its requirement as per regulation. (**Can be Demo experiments for CIE)**
10	Designing direct rope haulage system in moderately dipping coal seam. (**Can be Demo experiments for CIE)**

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- select different type of underground mining equipment.
- Impart conceptual knowledge on constructional features.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question

papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. De, A. (2015). Latest Development of Heavy Earth Moving Machineries, Lovely Prakashan.
2. Tatiya, R. R. (2005). Surface and underground excavations: methods, techniques and equipment. CRC Press.
3. Chugh, C. P. (1977). Drilling technology handbook. Oxford & IBH Publishing Company.
4. Deshmukh, D. J. (1982). Elements of mining technology. Vidyasewa Prakashan.
5. Mukharjee, S. N. (1993), Longwall Machinery and Mechanisation, Lovely Prakashan.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_mm17/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

IV Semester

MINE SURVEYING			
Course Code	**21MN44**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- Students will be given the basic idea of principles of surveying and mine surveying.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Surveying: Definition, objective, classification and principles of surveying.
Linear Measurement: Instruments for measuring distances, ranging survey lines. EDM: Principle of measurement.
Angular measurement 1: Prismatic compass - principle and construction; bearing of lines; local attraction; magnetic declination.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Angular Measurement 2: Essentials of the micro-optic theodolite; Measurement of horizontal and vertical angles; Temporary and permanent adjustments; Theodolite traversing; Computation of co-ordinates; Adjustment of traverse.
Triangulation: classification, reconnaissance, measurement, procedures for angles and base-line; GPS and its application in mine surveying.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3

Levelling & Contouring: Types of levels, setting of level instruments and levelling staff, types of levelling methods- reciprocal levelling, profile levelling, differential levelling, reduction of levels by height of instrument method and rise and fall method. Concept of contour, Methods of contouring and uses of contours. **Tacheometry:** Principle and classification of tachometry; stadia tachometry; distance and elevation formulae.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-4	
Mine Surveying – Statutory Requirements: General requirements about mine plans and sections, Types of plans and sections, Specification of Limits of Error. **Correlation and Alignment:** Correlation of surface and underground surveys: Verticality of shafts, shaft depth measurement, Direct traversing in inclined shaft, correlation in vertical shaft – single and two shafts. Underground Levelling. Determination of Gyro-north, Modern Gyro-Laser combination Correlation.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-5	
Development and Stope Surveying: Control of direction and gradient in drifts, tunnels, raises, winzes, Methods of survey in moderately and steeply inclined ore bodies, flat and vertical ore bodies/seams. **Subsidence Monitoring**: Subsidence Monitoring of subsidence due to underground mining activities. **Setting out curves** – surface and underground.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Understanding of basic principles and need of surveying.
- Knowledge on measurement tools and techniques for mining applications.
- Plans and sections to be maintained as per statutory requirements, Accuracy assessment of surveying work including required accuracy of plans and sections.
- Orientation and alignment surveys for mine development, depillaring, stoping and tunnelling operations.
- Underground stope surveying techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Punmia, B. C. (2005), Surveying Vol. 1 and II
2. Schofield, W. and Breach M. (2006), Engineering Surveying
3. S. K. Roy, *Fundamentals of Surveying*, Printice Hall of India Pvt., New Delhi , Third Printing, 2004.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105107122
- https://nptel.ac.in/courses/105104101

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

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Semester IV

TECHNICAL WRITING SKILLS			
Course Code	**21MN481**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

- Achieve better Technical writing and Presentation skills for employment.
- Develop adequate knowledge of paragraph writing and precise writing techniques
- Write business proposals and reports.
- Write conference papers and prepare gist of published papers.
- Develop efficiency in drafting social media posts and blogs.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video
3. Practice sessions

Module-1

Technical Report Writing: Introduction to Technical writing process, Understanding of writing process, Introduction to various Technical Report writing..

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2

Art of condensation and Paragraph Writing: Introduction and importance, Types and principles of condensation. Importance of paragraph writing, Features and its construction styles.

Teaching-Learning Process	Chalk and talk, Practice sessions.

Module-3

Business Report Writing: Introduction, Definition and Salient features of Business reports. Significance and types of report writing. (Formal and Informal). Resume building and Types of resumes. (samples of resumes)

Teaching-Learning Process	Chalk and talk, Practice sessions.

Module-4

Technical Articles and Proposals: Nature and significance, Types of technical Articles Journal articles and conference papers. Elements of technical articles .Introduction to technical proposal writing, Purpose, importance, structure and types of technical proposals.

Teaching-Learning Process	Chalk and talk, Activity

Module-5

Social media posts and Blog Writing: Ethics and practices of social media posts, Principles and fundamentals, Guiding principles for composition of articles, some common pitfalls. Maintaining

common etiquette. Blogs and Blog writings strategies.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Effectively communicate in technical matters.
- Practice preparation of gist, abstract and notes from a technical article.
- Prepare a business proposals and reports.
- Write and respond in social media and write blogs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Sanjay Kumar and Pushpalata, 'Communication Skills', Oxford University Press. 2018.
2. M. Ashraf Rizvi, 'Effective Technical Communication', McGraw Hill, 2018.

3. Gajendra Singh Chauhan and et.al. 'Technical Communication', Cengage Publication, 2018.
4. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practice, Oxford University Press, 2018.

Web links and Video Lectures (e-Resources):

- https://www.digimat.in/nptel/courses/video/109106094/L01.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Practice sessions
- Presentation on any social issues
- Quizzes

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PROGRAMMING IN PYTHON			
Course Code	**21MN482**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0::2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- Demonstrate the use of Python IDLE to create Python Applications.
- Develop Python programming language for solving real-world problems.
- Utilize Object-Oriented Programming concepts in Python.

Sl.NO	Experiments
1	Develop a python program to check whether the given number is odd or even
2	Develop a python program to find the smallest and largest number in a list
3	Develop a python program to arrange the numbers in ascending and descending order
4	Develop a binary search program in python
5	Develop a python program to find the best of two test average marks out of three test's marks accepted from the user.
6	Develop a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number.
7	Write a Python program that accepts a sentence and finds the number of words, digits, uppercase letters and lowercase letters.
8	Write a Python program for pattern recognition with and without using regular expressions
	Demonstration Experiments (For CIE)
9	Develop a Python program to calculate the powder factor for a given mining conditions
10	Develop a Python program to calculate the stripping ratio for a given mining conditions and to select a suitable mining method
11	Develop a Python program to calculate the productivity for a given mining conditions
12	Develop a Python program to calculate the blending ratio for a given grade of deposits from different benches

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Demonstrate proficiency in handling of loops, lists and creation of functions.
- Identify the commonly used operations involving regular expressions.
- Solving of mining conditions by developing program in Python.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

- https://nptel.ac.in/courses/106106145
- Core Python Programming, W.Chun, Pearson.
- Introduction to Python, Kenneth A. Lambert, Cengage
- Learning Python, Mark Lutz, Orielly

QUANTUM GIS			
Course Code	21MN483	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0::2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- Learning the open source QGIS software for Civil Engineering applications.
- Understand raster and vector data.
- Creation of base map and thematic maps for specific application.

Sl.NO	Experiments
1	Introduction to QGIS
2	Creating a Basic Map using QGIS
3	Classifying Vector Data using QGIS
4	Creating Maps using QGIS
5	Creating Vector Data using QGIS
6	Vector Analysis using QGIS
7	Rasters using QGIS
8	Completing the Analysis using QGIS
	Demonstration Experiments (For CIE)
9	Plugins using QGIS
10	Online Resources using QGIS
11	GRASS using QGIS
12	Any one Application exercise

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Use open-source software for civil engineering applications
- Various tools in QGIS software
- Create thematic layers with attribute data
- Generate maps for decision making

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

- https://docs.qgis.org/2.14/en/docs/training_manual/

MINE SURVEYING LABORATORY			
Course Code	21MNL46	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- Study about chain traversing, compass traversing and plane table traversing.
- Study about handling of levelling instrument and determination of RL
- Study about handling of theodolite and to measure the angles.
- To gain insights to measure distance and elevation using optical instruments.
- To set out a curve in underground and surface.
- To connect the baseline from surface to underground.

Sl.NO	Experiments
1	To survey an area by chain survey across obstacles and to calculate the obstructed lengths by using different methods.
2	To find the difference in elevation and calculate the reduced levels of various points by H.I method, and Rise & Fall method
3	To determine the configuration of ground survey by conducting profile leveling.
4	To determine horizontal and vertical angles using theodolite.
5	To determine the distance and elevation by Stadia Method.
6	To set out a simple curve by a) Deflection distance Method. b) Rankin's Method.
7	Correlation survey by Direct Traversing through Incline and Shaft.
8	Correlation survey by Weisback Triangle Method.
	Demonstration Experiments (For CIE)
9	To study and sketch of Total Station
10	Measurement of angles, distance and determination of coordinates and RL using Total Station
11	Preparation of digital mine plans using Total station data
12	Study of GPS and data collection.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- . The students will be able to do linear measurements by chain, tape, compass and plane table surveying.
- They will possess the ability to identify, formulate, and solve engineering problems in leveling.
- An ability to measure distance and elevation using optical instruments.
- An ability to set out an curve in underground and surface.
- An ability to connect the baseline from surface to underground.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

- Punmia, B. C. (2005), Surveying Vol. 1 and II

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V Semester

SURFACE MINING			
Course Code	**21MN51**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives: To make students capable of

- Applying the basic concepts and unit operations incorporated in a surface mine.
- Selecting the appropriate equipments for excavating, loading and transporting material in open cast mines.
- Describing the application of various heavy earth moving machineries and conveyors.
- Analyzing the safety of various slope types during surface mining operation.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction

Surface mining - Basic concepts, applicability, advantages and disadvantages; Role of surface mining in total mineral production; Deposits amenable to surface mining vis-à-vis excavation characteristics; Surface mining unit operations; Surface mining systems vis-à-vis equipment systems – classification, applicability, advantages and disadvantages. Bench parameters and the factors influencing the bench parameters. Problems.

Opening up of deposits

Box cut – objective, types, parameters, methods; Factors affecting selection of site for box; Production benches – formation, parameters and factors affecting their selection.

Preparation for excavation

Ripper: Types, classification, applicability and limitations; Method and cycle of operation; Estimation of output; Concept of rippability.

Estimation of number of drills required for a given mine production.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Discontinuous/cyclic methods of excavation and transport **Shovel-dumper operation:** Applicability and limitations of electric shovel, hydraulic excavators and dumpers; Cycle time and productivity calculation for shovel and dumper; Estimation for equipment (shovel, dumper and other heavy earth moving machines) required for a given mine production; Method of work for sub-surface bedded and massive deposits and for hilly massive deposits by shovel – dumper combination. **Dragline operation:** Applicability and limitations, different modes of operation; Side cast diagram and calculation of reach; Cycle time and productivity calculation; Calculation of required bucket capacity for a given handling requirement; Maximum usefulness factor and its significance in selection of dragline for a given situation; Method of work by simple side casting. **Front-end-loaders:** Applicability and limitations; Method and cycle of operation; Minimum tipping- load – concept, estimation and significance; Calculation of maximum working load and selection of bucket capacity of a front-end-loader for a given job condition. **Scrapers:** Applicability and limitations, various types; Method and cycle of operation; Pusher dozer and pushpull operation. **Dozers:** Applicability and limitations; Types and classification; Types of blade and corresponding merits and demerits; Method and cycle of operation.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-3	
Continuous methods of excavation and transport **Bucket wheel excavators:** Applicability and limitations; Types and principle of operation; Operational methods – lateral block / half block method, full block methods and their corresponding merits and demerits; Calculation of productivity. **Continuous surface miners:** Types, classification, applicability and limitations; Principles of operation; Operational methods – classification; Wide / full bench method, block mining method and stepped cut method; Empty travel back method, turn back method and continuous mining method; Conveyor / truck loading method, side casting method and windrowing method, Respective merits & demerits and applicability & limitations of these methods. **Conveyors:** Mode of operation, applicability and limitations; Merits and demerits of conveyor as a system of transportation; Load Area Calculation for a troughed belt conveyor; Shiftable and high angle conveyors.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-4	
Semi-continuous methods of excavation and transport **Continuous excavation and partly/fully cyclic transport system:** Different methods and applicability & limitations. Cyclic excavation and partly/fully continuous transport system: Different in-pit crushing and conveying methods and their respective applicability &limitations. **Dimensional stone Mining** **Dimensional stones:** Types, occurrences and uses; Methods vis-à-vis equipment for extraction of primary blocks in granite and marble quarries.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-5	
Slopes in surface mines Types of mine slope – highwall and waste dumps; Common modes of slope failure; Factors influencing stability of slopes; Slope stability assessment techniques; Waste dumps - types and formation methods; Slope protection, stabilization and monitoring.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Apply the basic concepts and unit operations incorporated in a surface mine.
2. Select the appropriate equipments for excavating, loading and transporting material in open cast mines.
3. Describe the application of various heavy earth moving machineries and conveyors.
4. To analyze the safety of various slope types during surface mining operation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Surface Mining Technology S.K.Das, Lovely Prakashan, Dhanbad, 1994.
2. Surface Mining G.B.Mishra, Dhanbad Publishers, 1978.
3. Opencast Mining R.T. Deshmukh M. Publications, Nagpur 1996
4. Rock Slope Engineering Hock and Bray, The Institution of Mining and Metallurgy, 1981.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_mm40/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

Semester - V

MINERAL PROCESSING			
Course Code	**21MN52**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- To know the grade and quality of minerals found in earth crust and how to improve them so that the metallurgists can use the same for extraction purpose.
- To know up to what extent the improvement should be done so that it will be economic.

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-1 8 HOURS	
Introduction: Scope, objectives and limitations of mineral processing; Liberation and beneficiation characteristics of minerals and coal. Laboratory sampling. **Comminution and Liberation:** Theory and practice of crushing and grinding; Different types of crushing and grinding equipment - their application and limitations.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
MODULE-2 8 HOURS	
Size separation: Laboratory size analysis and interpretation; Settling of solids in fluids; Industrial screens; Mechanical classifiers and hydro-cyclones: Numerical problems.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
MODULE-3 8 HOURS	

Concentration: Theory and practice of classification, Classifiers- their performance and choice, Picking and washing techniques. Theory and application of sink and float, jigging and flowing film concentration- methods and equipment used.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
MODULE-4 8 HOURS	
Froth Flotation: Physico-chemical principles, flotation reagents, flotation machines and circuits, application to common sulphides, oxides and oxidized minerals. **Electrostatic and Electro-magnetic Separation** - Principles, operations and fields of applications.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
MODULE 5 8 HOURS	
Dewatering: Thickener and filter. **Hydro-metallurgical methods of recovery**: Leaching – principle, various methods and applications. **Flow Sheets:** Simplified flow sheets for the beneficiation of beach sand, coal and typical ores of copper, lead, zinc and manganese with special reference to Indian deposits.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Sampling: a) Coning and quartering b) Riffle Sampling
2	Sieve analysis and interpretation of data
3	Determination of actual capacity of a jaw crusher.
4	Determination of actual capacity of a roll crusher.
5	Determination of grindability index of the given ore.
6	Determination of free settling velocities of quartz particle and comparison of the results with theoretical results.
7	Separation of heavier from the given feed using mineral jig and calculation of ratio of concentration.
8	Study of the particle movement on the deck of an operating table.
9	Separation of ferrous minerals using magnetic separator.
10	Study of the flotation of characteristics of the sulfide and oxide ore and, calculate the ratio of concentration.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- understand the Laboratory techniques of Mineral Beneficiation.
- study various methods and equipment used for concentration.
- give exposure to flow sheets for the beneficiation of various ore/minerals with special reference to Indian deposit.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:
Books

1. A. M. Gaudin, *Principles of Mineral Dressing*, Tata McGraw & Hill,
2. R. H. Richard and C. E. Locky, *A text Book on Ore Dressing*,, A A Balkema
3. B. A. Wills, *Mineral Processing Technology*, Willy & Sons

Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc22_ce30/preview**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

V Semester

UNDERGROUND COAL MINING			
Course Code	**21MN53**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- Understand the mode of access to reach coal seams and choice of mine seam
- Gain knowledge of bord and pillar method of mining
- Gain knowledge of longwall method of mining.
- Knowledge of extracting of thick coal seams by special methods

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Choice of methods of mining coal seams; factors affecting choice of mining methods; In-seam and horizon mining; Underground coal mining methods, Comparison of underground mining methods. Opening of coal seams: Types of mine entries (shaft, incline, adit), Relative advantages and disadvantages, Location of entries.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Development: Bord and Pillar, and Room and Pillar Mining; design of bord & pillar workings, the panel system, panels and inter-panel barriers, size of pillars and galleries; methods of driving galleries; layouts for different combinations of loading and transport systems including continuous systems. **Depillaring:** preparatory arrangements for depillaring; sequence and manner of extraction of pillars; mechanized pillar extraction, setting and withdrawal of supports; air-blasts; partial extraction.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3	
Longwall Mining: Factors affecting longwall mining, longwall face layouts, advancing and retreating faces, single versus double unit longwall faces, orientation of longwall faces; single versus multiple heading gate roads, factors affecting length and width of longwall panel.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-4	
Extraction of Longwall panel: working with shearer and plough, support system of longwall face and gate roads, monolithic packing in longwall advancing gate roads; case studies of longwall faces in India. Strata mechanics around Longwall panel.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-5	
Thick seam mining: multi-section mining, slicing methods, sublevel caving, integrated sublevel caving, blasting gallery method, thick seam extraction by cable bolting, hydraulic mining. **Contiguous seam working:** working under surface structures and water bodies, harmonic mining; shaft pillar extraction; Horizon mining; Gasification of coal.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Ability to identify mode of access to reach coal seam and choice of mining method.
2. Ability to design bord and pillar method of mining.
3. Ability to design longwall method of mining.
4. Ability to design the extraction of thick coal seams by special methods.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Principles and Practices of coal mining by R.D.Singh
2. Underground Winning of Coal by T N Singh
3. SME Mining Engineering Handbook
4. S. S. Peng and H S Chiang, *Longwall mining,*, Wiley, New York , 708p.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=bXORrVmxwbM
- https://www.youtube.com/watch?v=-lF9sl00_WM
- https://www.youtube.com/watch?v=HG7H05u5GQc&t=6s
- https://www.youtube.com/watch?v=HHaUypSqdzM&t=21s
- https://www.youtube.com/watch?v=xDyfW8yjymM&t=34s
- https://www.youtube.com/watch?v=WUwdqSlxXuw

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

V Semester

MINE VENTILATION			
Course Code	**21MN54**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To gain insights of mine air, mine climate and mine ventilation.
- To comprehend the ventilation requirements of an underground mine.
- Analysis of mine air, mine climate, natural ventilation, mechanical ventilation and to conduct ventilation survey.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Composition of mine atmosphere: Mine gases - production, properties and effects; Sampling and analysis of mine air; Methane content; Methane drainage; Flame safety lamp and its uses; Methanometers; Methane layering; Radon gas and its daughter products; Monitoring of gases.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Heat and humidity: Sources of heat in mines; Effects of heat and humidity; Psychrometry, Kata thermometer; Air-conditioning.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3

Air flow through mine openings: Laws of flow, resistance of airways, equivalent orifice, losses in airways, distribution of air, economic design of airways; Flow control devices; Permissible air velocities in different types of workings/openings; Standards of ventilation.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-4

Natural ventilation: Causes, effect of seasonal variations, calculation of NVP from air densities, thermodynamic principles and other methods.

Mechanical ventilation: Types of mine fans; Theory, characteristics and suitability of fans; Selection, testing and output control; Fans in series and parallel; Forcing and exhaust configurations; Reversal of flow; Fan drifts, diffusers, evasees; Booster and auxiliary ventilation; Venturi blowers; Ventilation of deep mines - underground and open pit.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-5

Ventilation planning: Planning of ventilation systems and economic considerations; Ventilation layouts for underground coal and metal mines; Calculation of air quantity required for ventilating a mine; Calculation of total mine head; Ventilation network analysis principles and computer applications; Ventilation surveys.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. To be familiar with the mine air composition, climate and physiological effects
2. An ability to estimate the requirements of ventilation in an underground mine
3. An ability to analyze the components of mine air sample, design natural and mechanical ventilation and conduct ventilation survey.
4. An ability to decide and design ventilation system for underground mine.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Mine Environment and Ventilation by G. B. Misra.
2. Mine Ventilation by S. P. Banerjee.
3. Mine Ventilation and Air Conditioning by H.L. Hartman, J. Mutmansky and Y.J. Wang.
4. Subsurface Ventilation and Environmental Engineering by M.J. McPherson.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/123/106/123106002/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

Introduction to IOT			
Course Code	21MN581	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	2

Course objectives:

- Demonstrate to install IDE to create IoT application
- Illustrate diverse methods of deploying smart objects and connect them to network.
- Develop Python programming language to develop programs for solving real-world problems
- Analyse sensor technologies for sensing real world entities

Sl.NO	Experiments
1	Design a smart bin using IoT with Arduino / Raspberry Pi
2	Design water level monitoring system using IoT with Arduino / Raspberry Pi
3	Design temperature monitoring system using IoT with Arduino / Raspberry Pi
4	Design car parking management system using IoT with Arduino / Raspberry Pi
5	Design automated pet feeder using IoT with Arduino / Raspberry Pi
6	Design smart agriculture system using IoT with Arduino / Raspberry Pi
7	Design smart street light monitoring system using IoT with Arduino / Raspberry Pi
8	Design smart anti-theft system using IoT with Arduino / Raspberry Pi
	Demonstration Experiments (For CIE)
9	Demonstrate Alexa based smart home monitoring system using IoT
10	Demonstration ECG monitoring using IoT
11	Demonstration home automation system using IoT
12	Demonstration of face recognition bot using IoT

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Understand basic concepts of IoT, Arduino / Raspberry Pi
- Build application-oriented projects using IoT
- Develop algorithm to solve real time problems by interface sensors and controller

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743).

2. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017.

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 stEdition, VPT, 2014.(ISBN:978-8173719547)

2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1 st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

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Semester V

Gender Sensitisation			
Course Code	**21MN582**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

- Figure out the current practices of a patriarchal society.
- Balance the roles and responsibilities of different genders in a civil society.
- Appreciate the importance of family and the values it stands for.
- Balance gender issues and emphasise on gender equality at work place and society.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video

Module-1	
Understanding Gender and Related Concepts, Gender in Everyday Life, Gender of Work	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2	
Gender and Sexualities, Masculinities, Family, Love and Power Marriage, Motherhood.	
Teaching-Learning Process	Chalk and talk, Practice sessions.

Module-3	
Gendering Work, Gender and Employment , Gender Issues in Work and Labour Market, Sexual Harassment at the Workplace	
Teaching-Learning Process	Chalk and talk

Module-4	
Health in Social Contexts, Reproductive Health and Rights, Gender and Disability. Gender- Based Violence.	
Teaching-Learning Process	Chalk and talk, Activity

Module-5	
Towards Gender Equality.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Appreciate gender issues prevalent in the society.
- Value the role of each gender in family, society and state.
- Analyse the gender sensitivity at work place and evolve proper perception of the other gender.
- Sensitise oneself towards gender equality.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. IGNOU : Gender Sensitization: Society, Culture and Change (2019) BGSE001, New Delhi.
2. Jane Pilcher and Imelda Whelehan (2005): Fifty Key Concepts in Gender Studies.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.swayam2.ac.in/nou21_hs03/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Presentation on any social issues

Semester V

INDUSTRY 4.0			
Course Code	21MN583	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

- This course is designed to offer learners an introduction to Industry 4.0, its applications in the business world.
- Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video

Module-1	
Introduction to Industry 4.0: The Various Industrial Revolutions, Digitalisation and the Networked Economy Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0. The Journey so far: Developments in USA, Europe, China and other countries. Comparison of Industry. Factory and Today's Factory. Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-2	
Road to Industry 4.0: Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services. Smart Manufacturing. Smart Devices and Products. Smart Logistics. Smart Cities. Predictive Analytics	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-3	
Related Disciplines, System, Technologies for enabling Industry 4.0: Cyberphysical Systems. Robotic Automation and Collaborative Robots. Support System for Industry 4.0. Mobile Computing. Related Disciplines. Cyber Security.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
Role of data, information, knowledge and collaboration in future organizations: Resource-based view of a firm. Data as a new resource for organizations. Harnessing and sharing knowledge in organizations. Cloud Computing Basics. Cloud Computing and Industry 4.0.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	

Other Applications and Case Studies: Industry 4.0 laboratories. IIoT case studies.
Business issues in Industry 4.0: Opportunities and Challenges. Future of Works and Skills for Workers in the Industry 4.0 Era. Strategies for competing in an Industry 4.0 world.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the drivers and enablers of Industry 4.0.
2. Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services.
3. Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0 world.
4. Appreciate the power of Cloud Computing in a networked economy.
5. Understand the opportunities, challenges brought about by Industry 4.0 and how organisations and individuals should prepare to reap the benefits.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. https://drive.google.com/file/d/17CPu--DdQHwUGzcbjDdNZbEcvHQ56-Cf/view
2. Industry 4.0: The Industrial Internet of Things, Alasdair Gilchrist, 1st ed. Edition, Apress, 2016.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105195

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Presentation on any industrial issues

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MINE VENTILATION LABORATORY			
Course Code	21MNL55	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- . To study the measure and monitor different types of gases in mines
- To study ventilation survey
- To study the handling of rescue apparatus
- To study the dust sampling in mines

Sl.NO	Experiments
1	Constructional features and applications of Flame Safety Lamp
2	Gas testing using Flame Safety Lamp
3	Determine the relative humidity of the atmosphere
4	Measurement of airflow using Velometer and Vane Anemometer
5	Estimation of air cooling power using Kata Thermometer
6	Plotting of fan characteristic curves.
7	Demonstration of fire extinguishers to quench the fire
8	Detection of methane using Methanometer
	Demonstration Experiments (For CIE)
9	Analysis of mine gases using Gas Chromatograp.
10	Demonstration of self-contained breathing apparatus, self-rescuers, and short distance apparatus.
11	Detection of mine gases, viz. CO, CO2, O2, CH4 using Multi-gas Detector.
12	To determine the quantity of particulate matter using dust samplers

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- . At the end of the course the student will be able to:
- An ability to measure and monitor different types of gases in mines.
- An ability to do ventilation survey.
- An ability to handling of rescue apparatus.
- An ability to dust sampling in mines.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

- Mine Environment and Ventilation by G. B. Misra.
- Mine Ventilation by S. P. Banerjee.
- Mine Ventilation and Air Conditioning by H.L. Hartman, J. Mutmansky and Y.J. Wang.

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VI Semester

MINE MANAGEMENT			
Course Code	**21MN61**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To understand the basics of management and its application in mining industry.
- To understand the organization structure and their relative merits and demerits.
- To understand the role of personnel management, importance of communication and various motivation techniques.
- To understand the importance of industrial relation in relation to organization.
- To be familiar with financial and material management.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Brief History of Management: Evolution of Management, Scientific management, Functions of management, Principles of Management. Management and administration, Mine management: Duties and responsibilities of mines manager.

Teaching-Learning Process	• Chalk & Talk • Assignment

Module-2

Organization: Characteristics of Organization, Principles of organization, types of organization, management of conflict, management by exception, management by objective (MBO). Mine organization: Opencast and underground mines.

Teaching-Learning Process	• . Chalk & Talk • Assignment

Module-3

Personal Management: Functions of personnel management, recruitment, and selection of employees. Manpower Planning in mines. **Communication:** formal and informal communication, barriers in communication and techniques to overcome barriers and improve communication. **Industrial Psychology and Human Relation:** Definition, scope of industrial psychology, aims of industrial psychology. Group Dynamics. Motivation: definition, characteristics of motivation, kinds of motivation, factors affecting motivation, motivational techniques, theories of motivation. Maslow's hierarchy of needs, Theory X and Y, Hawthorne experiment.	
Teaching-Learning Process	• Chalk & Talk • Assignment
Module-4	
Industrial Relations : Introduction, basic requirement of industrial –relation programme. Trade unions: definition, functions of trade unions. Industrial disputes: causes, settlement of industrial disputes, handling of workers' grievances. Workers participation in management.	
Teaching-Learning Process	• Chalk & Talk • Assignment
Module-5	
Financial Management: Methods of cost analysis and cost control, Break-even analysis **Materials Management :** Introduction; Inventory Management : Introduction; components, scope, and limitations; nature of inventory; classical E. O. Q. model; E. O. Q. model with quantity discount; an E. O. Q. problem with safety stock; inventory optimisation	
Teaching-Learning Process	• Chalk & Talk • Assignment • Problem solving

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Summarize evolution of management, management vis-a-vis. administration, functions of management, organization structure, MBE and MBO
- Understand personnel management, motivational techniques and theories of motivation.
- Understand industrial relation
- Understand financial and material management

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Industrial Organization and Engineering Economics, Banga and Sharma, Khanna Publication, New Delhi, 1999.
2. Industrial Management, O. P. Khanna, Dhanpat Rai and Sons, 1999.
3. Mine Management, Legislation and Safety, Coal Fields Publisher, Asansol, 1999.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/122106031

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

Semester - VI

MINE SYSTEM ENGINEERING			
Course Code	**21MN62**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- Identify and develop operational research models from the verbal description of the Real Systems.
- Enables to create mathematical models that are useful to solve optimization problems.
- Ability to estimate the optimum cost/distance in transporting the goods.
- Able to apply the different types of strategies of game theory in decision making.
- Able to design and develop the analytical models like PERT and CPM for planning, scheduling and controlling projects.

Teaching-Learning Process (General Instructions)
These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

MODULE-1 8 HOURS	
System Engineering: Introduction to systems concept, analysis and systems engineering. Models in systems analysis. Basic concepts of statistical decision theory. **Linear Programming:** Definition, mathematical formulation, standard form, solution space, solution-feasible, basic feasible, optimal, infeasible, multiple, optimal, Redundancy, Degeneracy, Graphical and Simplex methods.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

MODULE-2 8 HOURS	
Variants of Simplex algorithm – Artificial basis techniques. Duality, Economic interpretation of Dual, Solution of LPP using duality concept, Dual simplex method. Simulation: Simulation techniques for equipment selection and production scheduling, Significance of management information systems in controlling and managing the mining activities. **Inventory Model:** Definition, deterministic models, probabilistic models and their applications to mining.	
Teaching-Learning	Chalk and talk, PowerPoint Presentation

Process	
MODULE-3 8 HOURS	
Transportation Problem: Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems. Assignment Problem: Formulation, unbalanced assignment problem, Travelling salesman problem.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
MODULE-48 HOURS	
Project Management Using Network Analysis: Network construction, Network techniques for mining projects, determination of critical path and duration, floats. **PERT** –Estimation of project duration, variance. **CPM** – Elements of crashing, least cost project scheduling. Flow in networks: Determination of shortest route, Determination of Maximum flow through the networks for mining project.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
MODULE 58 HOURS	
Queuing Theory: Queuing system and their characteristics. The M/M/I Queuing system, Steady state performance analyzing of M/M/I and M/M/C queuing model. **Game Theory:** Formulation of games, Two Person - Zero sum game, games with and without saddle point, Graphical solution (2xn, mx2game), and dominance property.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Determine cut-off grade of ore in a mine
2	Optimize cost of transportation for supplying coal from mines to various destinations
3	Determine the optimal assignment of ‘m’ jobs or workers to ‘n’ machine in a mine using Hungarian Method.
4	Scheduling of production in a mine.
5	Determine equipment replacement policy in a mine
6	Optimize mining project completion time.
7	Optimize shovel-dumper system in open cast mine by Queuing System
8	Optimization of scheduling of drilling, blasting, loading and support operation in development heading.
9	Optimize drilling and blasting cost for surface mine.

10	Determine optimum level of inventory to be maintained in a mine.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Mine Systems Engineering presents the theoretical principals and practical applications for strategic mine planning in surface and underground mining operations.
- It covers planning and valuation methodologies applicable to metal and coal mining projects.
- The students will explore and apply basic manual procedures, algorithms, computer applications and mathematical models for strategic mine planning.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a

maximum of 3 sub-questions), **should have a mix of topics** under that module.

3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. Mining Engineers Handbook, Vol. II SME Cummins AIME, New York, 1979.
2. Mathematical Models in Operations Research. Sharma J.K, Tata Mcgraw-Hill, New Delhi, 1989.
3. Operations Research and Introduction, Taha H.A .Mc. Millan. ISBN -0-02- 418940-5.
4. Introduction to Operation Research Hiller and Liberman Mc. GrawHill V Edition.

Web links and Video Lectures (e-Resources):

- **https://nptel.ac.in/courses/110106062**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

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VI Semester

UNDERGROUND METAL MINING			
Course Code	**21MN63**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- Understand the construction of the mine developments to the deposit.
- Understand the different methods of extraction of ore blocks in metal mine.
- Understand the modern methods of extraction of ore blocks in metal mine.
- the problems, method of extraction in deep mining and machineries used.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Present status of Indian metal mining industry; Scope and limitations of underground mining.

Development: Choice of level interval and back/block length; Shape, size, position, excavation and equipping of shaft station/plat, grizzly, ore/waste bin, main ore pass system, underground crushing and loading stations, underground chambers, sump and other subsidiary excavations; Arrangements for dumping into main ore pass; Underground crushing, loading and hoisting; Cross-cuts and drifts :- their shape, size and position.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Review of excavation process: ground breaking, mucking, ventilation and support; Modern methods of raising - Alimak and Jora-lift raising, longhole method including vertical crater retreat method of raising; Raise boring - systems and their details; Modern methods of winzing.

Stoping methods: Classification of stoping methods, factors affecting the choice of stoping methods like depth, dip, width, grade of ore, physio mechanical characteristics of ore and wall rock. Factors affecting the stope design.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3

Open stoping & Unsupported stoping: room and pillar, sublevel, large diameter blast hole/DTH, shrinkage and vertical crater retreat methods - their applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting, haulage and dumping. Case studies.

Supported stoping: post and pillar, square set, longwall, cut and fill- their applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting, haulage and dumping. Case studies.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-4

Stoping by Caving method: top slicing, sublevel caving, and block caving; their applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting, haulage and dumping. Case studies.

Innovations in support and reinforcement systems for hard rock mines.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-5

Special methods: Solution mining, in-situ leaching, borehole mining, underground retorting, Problems of deep mining and their remedial measures. Case studies; Mining of parallel and superimposed veins, Pillar recovery Dilution, loss and recovery in stoping.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- Ability to construct the mine developments to the deposit
- Ability to extract the ore block by different methods.
- Ability to extract the ore block by modern methods.
- Ability to identify the machinery used, methods of extraction and to analyse the problems in deep underground mine.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module arks scored out of 100 marks proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Introduction to Mining Engineering by Ratan Raj Tatia.
2. Introductory Mining Engineering by Howard L Hartman
3. SME Mining Engineering Hand Book by Howard L Hartman.
4. Y. P. Chacharkar, *A study of Metalliferous Mining Methods*, Lovely Prakashan, Dhanbad , 1994

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/123/105/123105006/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VI Semester

OPEN PIT SLOPE ANALYSIS AND DESIGN			
Course Code	**21MN641**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To explain slopes, their modes of failure and various factors/ parameters that influence stability of slopes in surface mines.
- To identify the geotechnical parameters that are required for stability studies of a slope.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Types and formation of slopes in surface mines, pit slope vis-à-vis mine economics, mechanism of common modes of slope failure, factors influencing stability of slopes, and planning of slope stability investigations.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Geotechnical Information: Site investigation and geological data collection for highwall slope, Waste Overburden Dump, Tailings Pond Embankment and their interpretation for stability studies. Physico-Mechanical Properties of rock, soil, tailings slime, flyash

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3

Shear Strength: Shear strength of intact rock, discontinuity surfaces, filled discontinuities and rock-mass - estimation and determination; Surface roughness, joint roughness coefficient – estimation and determination.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-4

Water Flow : Concepts of water flow through a material and its permeability; water flow through rock-mass, water flow through soil type material and broken spoil material; Estimation and measurement of permeability and water pressure; Graphical solution of seepage problems (flow nets), seepage forces and seepage patterns under different conditions.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-5

Analysis and Design of Pit Slopes and Waste Dumps: Slope stability assessment methods and techniques; Analysis and design criteria and methodology for high wall slopes and backfill and waste dumps; Probabilistic approaches of slope analysis and design

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Explain slopes, their modes of failure and various factors/ parameters that influence stability of slopes in surface mines.
2. Identify the geotechnical parameters that are required for stability studies of a slope.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. 1. Rock Slope Stability: Charles A. Kliche, Published By Society For Mining, Metallurgy, And Exploration, Inc., 1919 (Latest Edition)

Reference Books:

1. Rock Slope Engineering Civil Applications, Fifth Edition, Duncan C. Wyllie, Crc Press

2. Rock Slope Engineering, 3rd Ed., Evert Hoek And John Bray, Taylor & Francis Routledge

3. Slope stability In Surface Mining, William A. Hustrulid, Michael K. Mccarter And Dirk J.A. Van Zyl, Society For Mining, Metallurgy, And Exploration

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/123105007

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VI Semester

GROUND CONTROL			
Course Code	**21MN642**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- Knowledge of underground excavation; stability around the excavation, subsidence and stress around the excavation
- To comprehend the rock mass classification and support system for underground excavation
- To monitor and predict subsidence and underground disasters
- To design single and multiple opening and support system for underground excavations

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Design and stability of structures in rock: Definition, types of underground excavation, excavation design and constraints. Methods for design and stability analysis of underground excavations; Energy released by making an underground excavation; Design of single and multiple openings in massive, stratified and jointed rock mass. Numerical problems.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Design of mine pillars: Mine pillars and their classification; pillar mechanics; Design of mine pillars and shaft pillar: stresses acting on pillars; stress distribution in pillars; mechanics of pillar failure; interaction of pillar, floor and roof; design of rooms and pillars; design of barrier and yield pillars, Numerical Problems.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3

Subsidence: Causes and impacts of subsidence; Mechanics of surface subsidence, discontinuous and continuous subsidence; Monitoring, prediction, control and management of subsidence, prediction of subsidence using graphical and analytical method, monitoring and determination. Numerical Problems.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-4	
Caving of rock mass: Rock caving in mining; Mechanics of rock caving; Assessment of cavability; caving prediction and control. **Rockburst and coal bump**: Phenomenology of rockbursts and coal bump; causes, prediction, monitoring and control of rockbursts; gas outbursts.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-5	
Engineering classification of rocks and rock masses: Classification systems in rock engineering; Classification of intact rocks; Classification of rockmasses -Terzaghi's rock load, RQD, Rock Structure Rating, Bieniawski's RMR, Barton's Q-System, Laubscher's-MRMR, Hoek's-GSI, Palmstrom's RMi, CMRI-ISM Rock mass classification and Recent developments; correlations between different classification systems; Applications of Rockmass Classification in rock engineering.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. To be familiar with the types of underground excavation and to stabilize the excavation.
2. Support the rock mass based on different properties of rock.
3. Ability to estimate the subsidence and monitor the disasters.
4. To design an opening and support system for underground.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Coal Mine Ground Control, S.Peng, John Wiley and Sons, Inc. 1978.
2. Rock Mechanics and the Design of Structures in Rocks, L.Obert and W.I.Duvall, John Wiley and Sons, 1966.
3. Underground Excavations in rock, E. Hoek and E.T. Brown, IMM, 1980.
4. Strata Mechanics in Coal Mining, M. Jeremic, CRC Press, 1985.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105105212

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VI Semester

MINE ENVIRONMENTAL ENGINEERING			
Course Code	**21MN643**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits	3	Exam Hours	03

Course objectives: To make students

- Understand the causes, preventive measures and methods of fighting associated with different types of mine fires.
- Understand the problems associated with mine disasters like mine explosion and inundation.
- Able to carry out the rescue and recovery operation in a mine by knowing the use of rescue equipments.
- Able to design the lighting in underground and open cast mine.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Mine fires: Causes and classification of mine fires; Spontaneous combustion - mechanism, stages of spontaneous combustion, susceptibility indices, factors affecting spontaneous combustion; Detection and prevention of spontaneous heating and accidental fires; Dealing with mine fires - direct and indirect methods, fire stoppings; Re-opening of sealed-off areas; Fires in quarries, Coal stacks and waste dumps.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Mine explosions: Firedamp and coal dust explosions - causes and prevention, explosive limits, Problems on explosibility limit; Stone-dust and water barriers; Explosion in quarries over developed pillars; Investigation on mine explosions.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3

Inundation: Causes and prevention; Precautions and techniques of approaching old workings; Dewatering of waterlogged working, safety boring apparatus, pattern of holes; Design and construction of water dams.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-4

Rescue and recovery: Rescue equipment and their uses, classification of rescue apparatus; Resuscitation; Rescue stations and rescue rooms; Organisation of rescue work; Emergency preparedness and response system.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-5

Airborne respirable dust: Generation, dispersion, measurement and control; Physiological effects of dust, dust-related diseases.

Illumination: Cap lamps; Layout and organisation of lamp rooms; Standards of illumination; Photometry and illumination survey; Luminance calculations.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the causes, preventive measures and methods of fighting associated with different types of mine fires.
2. The mine disasters like mine explosion and inundation.
3. Carry out the rescue and recovery operation in a mine by knowing the use of rescue equipments.
4. Design the lighting in underground and open cast mine.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Mine Disasters and Mine Rescue, M.A. Ramulu, Oxford & IBH Publishing Co. Ltd., 1991.
2. Mine Ventilation, Vol. I S. Ghatak, Coal Field Publishers, Asansol, 1983.
3. Environmental Engineering in Mines, V.S. Vutukuri & R.D. Lama, Cambridge University Press, 1992.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/123106002

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes
- Enacting

15.09.2022

VI Semester

INTRODUCTION TO MINING			
Course Code	**21MN651**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To introduce the basic elements of mining engineering with a view to recognizing the key aspects of opening of mineral deposits and different mining methods.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be onlthe y traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Mining: Definition and economic importance; Mine – definition, different types and classification; Mine life cycle, Exploratory Drilling; Mineral deposit – different types and their classification; Mineral resources of India	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2	
Opening-up of Deposits: Choice of mode of entry - adit, shaft, incline, decline and combined mode, their applicability, number and disposition. Box cut- types and location	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3	
Vertical/Inclined Shafts, Inclines/Declines: Location, shape, size, and organisation of shaft sinking, sinking methods, construction of shaft collar, shaft inset, shaft fittings. Methods of incline/decline drivage.	
Teaching-Learning	Chalk and talk, PowerPoint Presentation & Videos

Process	
Module-4	
Overview of underground mining: Different coal mining methods and their applicability & limitations; Different metal mining methods and their applicability & limitations; Basic concepts of transportation, ventilation, illumination and support in underground mines.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-5	
Overview of surface mining: Types of surface mines, applicability & limitations, unit operations and equipment selection, pit geometry and layout.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. General understanding on mining lifecycle and mineral resources.
2. Decision to choose a suitable location of a mine entry.
3. Shaft sinking and drifting technology.
4. Underground mining unit operations and basic layouts.
5. Surface mine unit operations and basic layouts.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Introductory Mining by H L Hartman
2. Elements of Mining Technology (Volume 1, 2 and 3) by D J Deshmukh
3. Principles and Practices of Coal Mining by R D Singh
4. SME Mining Engineering Handbook, 3rd Edition by Peter Darling

Web links and Video Lectures (e-Resources):

- https://www.studocu.com/en-gb/document/imperial-college-london/mining-engineering/mining-engineering-lecture-notes-1/13619457

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VI Semester

INTRODUCTORY ROCK MECHANICS			
Course Code	**21MN652**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To describe the importance of Rock Mechanics in the field of mining and identify of the physical and mechanical properties of rocks.
- To understand stress and strain in rocks and the physical and mechanical properties of rocks, and failure criteria for rock and rockmass.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Rock Mechanics: Definition, Scope and importance, development and application of rock mechanics in mining. Discontinuities; Description of discontinuities, hemispherical projection of discontinuities.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-2

Analysis of Stress: Introduction, definition and basic concepts, stress in a plane, (two dimensional stress), Mohr's Circle of stress, equations of equilibrium, plane stress equations. Simple numerical problems.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-3

Analysis of Strain: Introduction, definition and basic concepts, strain in a plane, (two dimensional strain), Mohr's Circle of strain, equations of compatibility, stress-strain relationship, plain strain equations, elasto plastic behaviour of rocks.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-4

Physico-mechanical properties of rock: Determination of physical properties, strengths, strength indices and static elastic constants; Parameters influencing strength; Abrasivity of rock and its determination.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Module-5

Rock mass Classification: Rock mass classification methods and their applications.

Failure criteria for rock and rockmass: Theories of rock failure; Coulomb, Mohr and Griffith criteria; Empirical criteria.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. describe the importance of Rock Mechanics in the field of mining and identify of the physical and mechanical properties of rocks.
2. calculate the stress and strain in rocks and rockmass.
3. understand the rock mass classification
4. Understand failure criteria for rock and rock mass.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Fundamental of Rock Mechanics by Jaeger, J.C. and Cook, NGW
2. Underground Excavation in Rock, Hoek, E and Brown, ET
3. Rock Mechanics for Underground Mining, Brady, BHG and Brown, ET
4. Introduction to Rock Mechanics, Goodman, RE.
5. Coal Mine Ground Control: Syed Peng

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105105212

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

COMPUTER APPLICATION IN MINING			
Course Code	21MNL66	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- . To provide skills in operating latest software in mine design and numerical modelling.

Sl.NO	Experiments
1	Computer Programming for design of pillars
2	Computer Programming for blast design
3	Computer Programming for subsidence
4	Orebody Modelling
5	Pit Optimization
6	Wedge failure Analysis
7	Circular Failure Analysis
8	Slope stability analysis
	Demonstration Experiments (For CIE)
9	Stability around a circular opening.
10	Analysis of a rib pillars and Modelling of sequence of excavation.
11	Modelling of mechanical behaviour of pillars under different geo-mining conditions.
12	Modelling of slope.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- design and planning of surface and underground mining methods using mining software.
- design various structures in rock.
- apply basics of 2D numerical modelling.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

- https://nptel.ac.in/courses/105106055
- https://www.rocscience.com/
- https://pdfcoffee.com/surpac-tutorialpdf-pdf-free.html

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VII Semester

MINE LEGISLATION AND SAFETY			
Course Code	**21MN71**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- The students are made conversant with legal requirements and safety aspects of mining.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Introduction: Brief historical perspective legislation in Indian Mines. **The Mines Act, 1952**: Preliminary, Inspectors and Certifying surgeons, committee, mining operations and management of mines. Provisions to health and safety. Hours and limitations of employment Leave with wages, Regulations and bylaws, penalties and procedures.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-2	
The Mines Rules,1955: Preliminary, committee, court of enquiry, certifying surgeons, Medical Examination of persons employed. Workmen's inspector and safety committee, health and sanitation provision, first aid and medical appliance. Employment of persons, leave with wages and overtime. Welfare amenities, registers and notices. **General provisions of**: Mines and Minerals(Regulation and Development) Act 1957, Mineral Concession Rules 1960, Mineral Conservation and development Rules 1988	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-3	

The Metalliferous mines regulation,1961 and The Coal mines regulations,2017: Preliminary returns, notices and records, inspectors and mine officials, duties and responsibilities of work men, plans and sections, means of access, ladders and ladder ways, transport of men and materials, winding in shafts, transport of men and material haulage, mine workings, precaution against dangers from fire, dust gas and water, ventilation, lighting and safety lamps, Explosives and shot firing, machinery, plants and equipments.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
Salient Features of : The Mines Creche Rules, 1966, Maternity Benefit Act and Rules; Indian electricity Rules, 1956. **Accidents**: Their causes and prevention, accident statistics, rates of accidents, relation between accidents and efficiency, accident reports, cost of accidents.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Safety risk assessment and management, Safety Audit, Occupational health and safety in mines. Mine safety management systems, Safety education and training.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to understand:

- General principles of Mining Laws and their history
- Salient features of Mines Act and mines rules
- General provisions of CMR 1961 and MMR 1961
- Legal aspects of safety and health of Mine workers.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module MMarks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad
2. NIOSH Publications
3. DGMS Circulars by L.C.Kaku
4. Safety in Mines : A survey of accidents, their causes and prevention by Prof. Kejriwal

Web links and Video Lectures (e-Resources):

- https://www.dgms.gov.in/writereaddata/UploadFile/Mines%20Act,%201952.pdf
- https://www.dgms.gov.in/writereaddata/UploadFile/Mines_Rules_1955.pdf
- https://www.dgms.net/Coal%20Mines%20Regulation%202017.pdf
- https://www.dgms.gov.in/writereaddata/UploadFile/Metalliferous%20Mines%20Regulation,%201961.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

Semester VII

MINERAL ECONOMICS			
Course Code	**21MN72**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:0:0:0	SEE Marks	50
Total Hours of Pedagogy	20	Total Marks	100
Credits	2	Exam Hours	2

Course objectives:

- To understand the economic importance of mineral industry.
- To understand the sampling and ore reserve estimation.
- To learn various methods of mine valuation.
- To understand the various components of financial management and its application in mining.
- To understand elements of cost of production, budget and budgetary control.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Economic importance of mineral industry, special features of mineral industry, demand and supply analysis, National Mineral Policy.
Mineral Price and Pricing: International Monetary system, Factors affecting mineral price, Kinds of price quotation, Mineral Price Index, Mineral Price.

Teaching-Learning Process	• Chalk and Talk • Assignment • Tutorial for problem solving

Module-2

Sampling: Definition, purpose, scope, common methods of sampling, types of samples, errors in sampling.
Estimation of reserves: Classification of reserves, tenor, grade. Preparation of assay plans, various methods of ore reserve estimation and problems on ore reserves estimation.

Teaching-Learning Process	• Chalk and Talk • Assignment

Module-3

Mine Valuation –1 : Factors affecting mine valuation, life of mine, redemption of capital, project assessment by D.C.F., net present value methods, Hoskold's two rate formula.

Mine valuation – 2: mining fixed costs, operating costs, feasibility study, project evaluation, depreciation, problems on mine valuation and depreciation.

Teaching-Learning Process	• Chalk and Talk • Assignment

Module-4

Financial Management: Methods of financing industrial enterprises, structure, formation and capitalization. Sources of finance. Principles of book keeping as applied to mining industry and accountancy. Balance sheet, profit and loss accounts.

Teaching-Learning Process	• Chalk and Talk • Assignment • Tutorial for problem solving

Module-5

Cost Accounting: Introduction, need for cost accounting, elements of cost, overheads, allocation of over heads, breakeven analysis.

Budget and Budgetary control: Definition of budget, Principle of budget and budgetary control, types of budgets.

Teaching-Learning Process	• Chalk and Talk • Assignment • Tutorial for problem solving

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Summarize salient features of mineral industry and related policy issues, basics of financial and cost accounting aspects.
- Select proper sampling method and to classify the ore reserve and resources.
- Compute ore reserve and value of a mining project.
- Evaluate the economic feasibility of a mining project given the geological, mining and financial parameters.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE will same as 1 credit theory course for the 1st and 2ndsemester; however, for **higher** semesters depending upon the type of the course, the CIE pattern may be MCQ type (100 questions) or the same as other core theory courses**.**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination(SEE):

SEE paper will be set for 100 questions each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **120 minutes.** Marks scored are scaled down to 50 Marks.

The suggested question paper pattern is MCQ for the 1st and 2nd semester however, **for higher** semester/s depending on the type of the course SEE may be a written examination, a pattern similar to other theory courses

For non-MCQ pattern of CIE and SEE

Suggested Learning Resources:

Books

1. Mineral and Mine Economics, R.T. Deshmukh, Myra Publications, Nagpur, 1986.
2. Mineral Economics, N.L.Sharma and Sinha, Oxford and IBH, 1992.
3. Industrial Management, O.P. Khanna, DhanpatRai and Sons, 1999.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/110105067

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

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VII Semester

UNDERGROUND MINE PLANNING AND DESIGN			
Course Code	**21MN731**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- Understand the basic principles of mining law in India and role and influence of government on mining industries. To identify software for mine planning and designing.
- Explain the process of strategic mine planning and its impact on decision-making during project development and the factors considered in underground coal mine planning.
- Illustrate surface layouts, pit bottom and pit top layouts for different transport systems.
- Analyze and select suitable mine development and working methods.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Government Role and Influence in Mining: Social-Legal-Political-Economic impacts, Mining Laws, Health and safety standards, Environmental consequences. air, water and land pollution; causes and preventive measures.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2

Coal Mines: Principles of mine planning, stages of planning of new mines: pre-feasibility report, feasibility report and DPR, selection of mine sites, geological aspects, and division of a coal field into mining areas. Surface layouts, pit bottom layout, transport system. Application of computers in mine planning.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-3

Longwall panel design: Mining Area, Term of life and mine capacity, division of mining property into parts, length, number and position of productive Longwall faces, dimensions of development workings.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and Videos
Module-4	
Metal Mines **Stope planning:** Evaluate stope boundaries, selection of a stoping methods, application of computer in stope design, economics of each stope. **Production planning:** Stope reserve, development, manpower, ore/waste handling, equipment, essential services, production scheduling, time and work study for improvement of production, Optimization of mine size (mine production capacity) based on techno-economic considerations.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Mine closure planning: Initial, Progressive and Final Mine closure Planning and its components; Auditing; Legal and Financial Aspects. **Clearances and Approvals for Mining Projects for mine plan**: FC, EC, LA and others.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Knowledge of Mining laws in India and role and influence of government on mining industries and software for mine planning and designing.
2. Ability to explain Process of strategic mine planning, Factors considered in underground coal mine planning
3. Ability to apply Surface layouts, pit bottom and pit top layouts for different transport systems.
4. Ability to analyze and select suitable mine development and working methods.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
   The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. SME Mining Engineering Hand book-H.L. Hartman
2. Surface and underground excavations – R. R. Tatiya
3. Coal Mine Planning by S.P.Mathur
4. Mine Planning: Jayant Bhattacharya

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/123105006

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VII Semester

SURFACE MINE PLANNING AND DESIGN			
Course Code	**21MN732**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To be familiar with basic elements of surface mine planning
- To understand the concept of open pit planning and also production planning
- To understand the closure aspect of surface mine

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction : Stages/Phases of mine life; Preliminary evaluation of surface mining prospects; Mine planning and its importance; Mining revenues and costs - calculation of FW, PV, NPV, IRR, payback period, depreciation by different methods, cash flow and ACFC; Mine planning components, planning steps and planning inputs.

Ore reserve estimation : Ore zone and bench/level compositing; Objectives and principles of ore reserve estimation; Classification of ore reserves, Estimation of grade at unknown point; Methods of ore reserve estimation - vertical cross section method, horizontal cross section method and 3-D geological block method;

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2

Stripping ratio: Concept of stripping ratio; Types of stripping ratios and their significance; Choice between surface and underground mining.

Geometrical considerations: Basic bench geometry; Pit layouts.

Teaching-	Chalk and talk, PowerPoint Presentation

Learning Process	
Module-3	
Pit Planning: Development of economic block model; Pit Cut-off grade and its estimation; Ultimate pit configuration and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm, and computer assisted hand method. **Production planning:** Determination of optimum mine size and Taylor's mine life rule; Sequencing by nested pits; Cash flow calculations; Mine and mill plant sizing, Lanes algorithm for estimation of optimum mill cut-off grade; Introduction to production scheduling.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
Analysis and design of highwall slopes and waste dumps: Pit slope geometry; Influence of pit slope on mine economics; Highwall slope stability analysis and design methodology; Stability analysis and design methodology for waste dumps.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Design of haul roads Addition of haul road on pit plan; Design of road cross section; Design of road width, curves and gradient; Haul road safety features and their design. **Design of drainage system in surface mines.** **Selection of mining system vis-a-vis equipment system.** **Closure of surface mines.** **Feasibility Report - Contents and preparation.**	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Understand basic components of surface mine planning
2. Estimate ore reserve using various methods
3. Plan open pit mine given the ore reserve and economic condition

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Open Pit Mine Planning and Design-W. Hustrulid and M. Kuchta
2. SME Mining Engineering Hand book-H.L. Hartman

Reference Books:

1) Surface and underground excavations – R. R. Tatiya

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_mm40/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VII Semester

ENVIRONMENTAL MANAGEMENT IN SURFACE MINES			
Course Code	**21MN733**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To make student conversant with prevailing environmental legislation in India
- To provide knowledge in details about various sources of pollution in surface mines and mitigating measures against each source

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Environmental issues in mineral industry — national and global; ambient environment mining complexes; environmental impacts of mineral exploitation - opencast mining and associated activities. Air Pollution: Sources, characterization, ill effects, measurement, monitoring, standards, mitigating measures.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2

Water Pollution: Sources, ill effects, water quality parameters – physico-chemical, biological and bacteriological. Water quality criteria, standards, monitoring and mitigating measures. Heavy metal pollution and its abatement. Ground water pollution – detection and management. Acid mine drainage.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-3

Noise Pollution: Basics of acoustics. Sound power, intensity and pressure levels. Noise indices, effects, standards, instrumentation, monitoring and control. Blasting : Environmental aspects of blasting.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
Biological Land Reclamation: Environmental factors affecting revegetation – climatic, physical and chemical factors. Analysis and evaluation of site and soil. Plant species selection. Methods of vegetation establishment. Vegetation survey. **Societal Environment**: Societal environment and its management including resettlement and rehabilitation; socio-economic impacts; sustainable development; concept of carrying capacity based planning.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Environmental Administration in India: Administration and Management, Environmental Impact Assessment - Methods of EIA and their applicability; Environmental Management Plan - Structure and preparation of EMP; Environmental audit, salient features of Environment Protection Act; Environmental Laws.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. To develop expertise in legal requirement in connection with mine environment
2. To develop expertise environmental management capabilities

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Environmental Impact of Mining, C.G. Down. and J. Stock, Applied Science Publishers Ltd. London, Second Edition, 1980.
2. Mining and Environment, B.B.Dhar, Ashish Publishing House, New Delhi, 1986.
3. Environmental Pollution Control Engineering, C.S. Rao, Wiley Eastern Ltd. 1992

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/113105107
- https://nptel.ac.in/courses/120108004
- https://www.youtube.com/watch?v=LwtGqpMStnk

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

Semester VII

ADVANCED MINE VENTILATION			
Course Code	21MN734	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To impart theoretical and practical knowledge for solving the real life ventilation problems both in coal and hard rock underground mines.
- In addition, the students will be acquainted with a number of case studies demonstrating the intricate ventilation problems faced in Indian underground mines and development of methods for solving those problems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction and basics of Mine Thermodynamics: Overview and Importance of Advanced Mine Ventilation; Basics of mine thermodynamics, earth crust-infinite reservoir of heat and variation of strata temperature with depth; Computation of thermodynamic properties of mine air. Heat transfer in mine airways : Unsteady/Transient state, Quasisteady state and Steady state heat transfer, Heat transfer due to conduction, logarithmic mean area approach and related problems, Heat transfer due to convection and radiation in mines and related problems, Heat transfer at wet surfaces, computation of rate of condensation and evaporation in mine air airways and conceptual problems; Computation of heat transfer in tunnels depending upon age factor with numerical problems.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos

Module-2

Heat flow into bord and pillar, and longwall workings: Heat and mass transfer in bord and pillar panels, development of equations and calculations for designing climatic condition; Heat and mass transfer in longwall panels : Sources of heat in longwall panels, Computation of heat load and climatic conditions in mine workings, Mitigative measures for hot and humid workings, longwall ventilation practices : Global experience, A case study of a deep, hot and humid mine of the country.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos
Module-3	
Incompressible flow ventilation network analysis: Computation of volume flow using equivalent resistance method and numerical examples, Computation of volume flow using direct analysis : Application of Kirchoff's first and second laws to solve field problems, Derivation of Hardy Cross Iterative method, Application of Hardy Cross Iterative method to solve complex mine ventilation network problems, Some typical case studies on the design of ventilation system through ventilation network analysis from Indian coal and hard rock mines.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos
Module-4	
Compressible flow mine ventilation network analysis: Thermodynamic principles applied to mine ventilation network analysis : Development of equation considering no change of moisture content and application of these equations, Comparison of these equations with Bernauli's equation and concept of pseudo-pressure equation, Application of these equations to complete mine circuit, Development of equation considering change in moisture content, Application of these equations to complete mine circuit, Computation of resistance of mine roadways with change in moisture content using Atkinson's equation and Darcy weisbach equation with related numerical problems.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos
Module-5	
Mine air conditioning: Improvement of workplace environment in underground: Basic vapour compression cycle, pressure-enthalpy diagram and superimposition of pressure-enthalpy diagram on vapour compression cycle, A case study of design mine air-conditioning/cooling system. **Automation and control**: Advanced underground environment monitoring systems, automation and control.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation and videos

Course outcome (Course Skill Set)

At the end of the course the student will:

- have a broad understanding of heat flow problems as existing in underground (UG) mines.
- detailed understanding of all the methods of heat and mass transfer to ventilating air.
- be able to compute the resultant thermodynamic properties of ventilating air in bord and pillar, and longwall panels.
- be in a position to take ameliorative measures for improvement of workplace environment in UG mines.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Subsurface Ventilation and Environmental Engineering : Prof. M. J. McPherson
2. Mine Ventilation and Air Conditioning : Prof. H. L. Hartman, Prof. Jan Mutmansky and Prof. Y. J. Wang
3. Mine Environmental Engineering, Vol. 1 & Vol. 2 : Prof. Mritunjoy Sengupta
4. Environmental Engineering in Mines : Dr. V. S. Vutkuri and Dr. R. D. Lama
5. Mine Ventilation : Prof. S. P. Banerjee
6. Mine Environment and Ventilation : Prof. G. B. Mishra
7. 1 st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th and 11th International Mine Ventilation Congress Volumes

Web links and Video Lectures (e-Resources):

• https://nptel.ac.in/courses/123106002 • https://nptel.ac.in/courses/112105123 • https://nptel.ac.in/courses/112103294
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Demonstrations of Videos • Group Discussion • Quizzes

VII Semester

MINE GEOSTATISTICS			
Course Code	**21MN741**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To understand of ore body evaluation by conventional methods.
- To understand basics of classical statistics.
- To understand the application of geostatistics in ore body modelling.
- To understand the problems associated with geostatistical tools.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Introduction to Geo-statistics: Definition, Schools of geostatistics. Estimation models for mine evaluation – average method, polygonal or triangular method.	
Teaching-Learning Process	Chalk & Talk

Module-2	
Classical Statistics: Definitions, Normal distribution – Mean, variance and confidence interval estimation, Graphical estimation of mean and standard deviation; Lognormal distribution – parameter estimation and confidence intervals, graphical estimation	
Teaching-Learning Process	• Chalk & Talk. • Problem solving by the students under the supervision of course instructor.

Module-3

Correlated Random Theory-1: Semi Variogram: Definition of semi variogram, mathematical models of semi-variogram.
Practical problems – Isotropy and anisotropy, stationarity, regularization, nugget effect.

Teaching-Learning Process	• Chalk & Talk. • Problem solving by the students under the supervision of course instructor. • Assignment.

Module-4

Correlated Random Theory- 2: Extension Variance and Estimation Variance: Extension and estimation variance, calculation of estimation variance, the nugget effect and estimation variance, examples, auxiliary functions.
Correlated Random Theory – 3: Kriging: Kriging and optimal valuation, kriging equations in general cases.

Teaching-Learning Process	• Chalk & Talk. • Problem solving by the students under the supervision of course instructor. • Assignment.

Module-5

The Integrated Geological – Geostatistical System: Statistical analysis, comparative statistical analysis, geostatistical structural analysis, trend analysis, point kriging cross validation, block kriging, mineral inventory, grade – tonnage relations, examples to assess ore and metal recoveries. Example to calculate planning cut-off grade. Optimization of drilling programme. Misclassified tonnages – actual Vs estimated. Grade control.

Teaching-Learning Process	• Chalk & Talk. • Problem solving by the students under the supervision of course instructor. • Assignment.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Illustrate various methods of ore reserve estimation – conventional and geostatistical.
2. Solve problems of grade and ore reserve estimation and associated variance.
3. Analyze the applicability of geostatistical tools for ore reserve estimation.
4. Evaluate ore body in terms of grade and tonnage to develop mineral inventory and to
5. establish methodology for grade control.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. An Introduction to Applied Geostatistics, Issaks and Srivastava, Oxford, IBH, 1990.
2. Mining Geostatistics, Journel, A. G. and Huigbregts, Ch. J., John Willey and Sons, 1978.
3. An Introduction to Geostatistical Methods of Mineral Evaluation, Rendu J. M., John Willey and Sons, 1981.
4. Geostatistical Ore Reserve Estimation, David, Michel, McGraw Hill, 1977

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=QqZcFJ7ya6Y
-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VII Semester

MINE SAFETY ENGINEERING			
Course Code	**21MN742**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- comprehensive understanding of philosophy of safety engineering approach at mines to achieve target production with no or insignificant accident cost which is very important for Indian mining industry to survive in the competitive global market .

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Historical Developments of Mine Safety in India and Abroad; Need for Approving Safety Engineering Approach in Mining Industry; Engineering Safety Goals; Mine Safety Facts and Figures; Worldwide Major Mine Disasters.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2

Risk Management: Risk Management Related Terms and Definitions; Basic Concept of Risk, Reliability and Hazard Potential; Risk Components and Types; Risk Management Objectives; Risk Management Process; Functions of a Risk Manager; Common Errors in Risk Management; Risk Estimates for Selective Events; Hazards Identification and Risk Assessment (HIRA) Methodology; Implementation of HIRA and its Controls & Review; Advantages of Risk Management.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-3

Statistical Methods of Risk analysis: Basic Risk Analysis Methods based on Frequency Rates and Severity of Accidents Appraisal of advanced techniques - Preliminary Hazards Analysis (PHA); Hazards and Operability Analysis (HAZOP); Failure Mode and Effect Analysis (FMEA); Failure Mode Effect and Critical Analysis (FMECA); Job Safety Analysis (JSA); Fault Tree Analysis (FTA); Markov Model (MM) – An Important Risk analysis Tool.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
System Safety Engineering Concept in Mine Safety: An Introduction to Systems Safety Engineering; Different School of Thoughts in Accident Causations - Domino Model; Behavioural Accident Model based on the human perception; Epidemiological Accident Models, Normal Accident Theory; The Swiss Cheese Model; Systems-Theoretic Accident Modeling and Process (STAMP); In-depth Study of Accidents Due to Various Causes; Application of Structural Equation Modelling (SEM) and Artificial Neural Network (ANN) in Determining the Accident Causation in Mines.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Safety audits and control: Objectives of safety audit in mines; Different steps in safety audit; Risk control procedures. **Mine Ergonomics:** Domain, Philosophy and Objective of Mine Ergonomics; Ergonomics/ human Factors fundamentals; Work physiology and stress; Human body- structure and function, anthropometrics; Posture and movement; Posture and Job Relation – Work Posture Analysis using OWAS Method; Oxygen Consumption and Workload Analysis of Mine Workers.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. understand the historical developments of mine safety in India and abroad.
2. understand the hazards, risk associated with hazards, assessment and evaluation of risk due to the presence of hazards and mitigation & control of risk associated with existing hazards.
3. Apply bivariate and multivariate statistical methods in quantitative risk analysis.
4. understand different statistical modeling in determining the accident causation in mines.
5. understand the workplace design in respect to the body dimension and workload capacity of the mine workers/equipment operators.
6. understand the different risk control procedures that is required to be applied to manage the risk in a system.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Engineering Safety: Fundamentals, Techniques and Applications by B. S. Dhillon; World Scientific Publisher
2. Mine Health and Safety Management – Edited by Michael Karmis
3. Safety Engineering by B. S. Dhillon, Springer
4. Mine Safety by B. S. Dhillon, Springer

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/110/105/110105160/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

Semester VII

MINE AUTOMATION AND DATA ANALYTICS			
Course Code	21MN743	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- This course will cover mine automation, as well as data analytics applicable to mining systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Basic Elements of an Automated System, Automation in Production System, Principles and Strategies of Automation, Advanced Automation Functions, Levels of Automations, Introduction to automation productivity. Autonomous mining systems - Operations Centre, Autonomous haulage systems , Automated drilling system, **Fleet Management System:** TDS, CMMS, ERP for Mining Industry, Mining Remote Operations & Control: Robotics & Armchair Mining.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2

Overview of Material Handling Systems - Principles and Design Consideration, Material Transport Systems, Storage Systems. (DCS - automation).

Automated Communication and Tracking Technologies: Proximity Systems, GNSS/UPS, Vision Based Systems, Radar Systems, RFID and Geo-fencing, CCD camera, Data Logging Systems, SCADA, Image Processing etc.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-3

Descriptive Statistics: Introduction to the course; Probability Distributions Inferential Statistics: Inferential Statistics through hypothesis tests, Regression & ANOVA, **Machine Learning:** Introduction and Concepts, Differentiating algorithmic and model based frameworks **Regression** : Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification Supervised Learning with Regression and Classification techniques, Bias-Variance Dichotomy Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
Supervised Learning with Regression and Classification techniques, Ensemble Methods: Random Forest, Neural Networks, Deep learning, Unsupervised Learning and Challenges for Big Data Analytics: Clustering, Associative Rule Mining, Challenges for big data analytics: Applications of ANN and other tools in Mine operation and maintenance.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Virtual Reality Applications: Mining Equipment Concept development, Mine Safety Applications, Mining operation simulations. Application of Big Data Analytics and Artificial Intelligence (AI) in Mining; Use Case studies on Cognitive Maintenance, Ore body modelling and Mine Design etc.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. gain a comprehensive overview of state of the art mining automation, as well as, practical skills in artificial intelligence and other digital technologies used in the mining industries.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger.Applied statistics and probability for engineers. John Wiley & Sons, 2010 .
3. G. Almgren, U. Kumar, N. Vagenas : Mine Mechanization & Automation 1st Edition.
4. J. O'Shea M. Polis : Automation in Mining, Mineral and Metal Processing (1st Edition), Proceedings of The 3Rd Ifac Symposium, Montreal, Canada 18-20 August 1980 .
5. Peter V. Golde : Implementation of Drill Teleoperation in Mine Automation.

Web links and Video Lectures (e-Resources):

• https://study.curtin.edu.au/offering/unit-ug-automation-and-data-analytics-in-mining--mine3011/
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Demonstrations of Videos • Group Discussion • Quizzes

15.09.2022

Semester VII

DIMENSIONAL STONE MINING			
Course Code	21MN744	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- to make students conversant aspects of dimensional stone mining
- to develop skill in planning and design dimensional stone mining

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Introduction: Definition, historical use of natural stones. Geology and occurrences: Classification of dimensional stones, composition, chemical and geo-chemical properties, various standards for normalization of dimensional stones.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2	
Mining of dimensional stones: Various techniques of dimensional stone mining – block mining and slab mining; Manual mining; Mechanized mining – line drilling, in-situ sawing by wire saw, chain saw, portable circular saw, flame cutting. **Cutting / Sawing tools:** Tool carrier – circular steel blade, steel wire rope, chain jib saw, physical and mechanical properties, elastic properties, tension etc.; Cutting tools – diamond segments, diamond pearls / bits, tungsten bits etc.; Process of manufacture, ingredients, brazing / fitting, wearing pattern and control; Cost of cutting.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-3

Handling of blocks and slabs: Equipment used - derrick crane, front loaders, fork-lifts, mobile cranes, trucks and trailers. **Quarrying machines for dimensional stones:** Portable circular saw, wire saw, chain saw, line drills – special design features of the machines, their use and maintenance. **Production monitoring:** Recovery, waste generation, productivity, inherent defects, measurement and corrective actions, cost evaluation.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
Environmental issues: Management of solid waste, slurry waste, soil land and water; Protection and rehabilitation. **Health, safety and welfare:** Protective care from abrasive dust, personal safety and welfare.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Application, processing and architecture in dimensional stone: Application – flooring, roofing, cladding, stairs, paving, facets; Processing and polishing – various techniques for sawing of blocks, shaping of edges, polishing and calibration; Fixing and installation – techniques of fixing of dimensional stones in various applications like flooring, cladding, faceds, stairs, roofing and paving; Care and maintenance of dimensional stones – techniques for post fixing care and maintenance of dimensional stones in various applications.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- conversant aspects of dimensional stone mining
- develop skill in planning and design dimensional stone mining

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Rathore S. S., Bhardwaj G. S., Jain S. C; "Dimensional Stone Technology" Himanshu Publication New Delhi.
2. Rathore S. S., Gupta Y. C., Parmar R. L.; "Recent Development in Machinery and Equipment for Dimensional Stone Mining" held Dec. 13-14, 2003 at Udaipur.
3. Rathore S. S., Laxminarayana V.; "Safety and Technology in Marble Mining and Processing in New Millennium" Proc. of National Workshop held march 10-11 200 Udaipur.
4. India Stones, Business Magazine on Indian Stone Industry, Pub. ICONZ Communications, 203, Mahaveer Residency, 15 Main J. P. Nagar, 5th phase, Bangalore.

Web links and Video Lectures (e-Resources):

- https://drive.google.com/file/d/1PpSJu7OKVcunt3c_NgvFSGt5UjFTF_YH/view?usp=sharing

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VII Semester

INTRODUCTION TO MINE SURVEYING			
Course Code	**21MN751**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- Students will be given the basic idea of principles of surveying and mine surveying.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Surveying: Definition, objective, classification and principles of surveying. **Linear Measurement:** Instruments for measuring distances, ranging survey lines. EDM: Principle of measurement. **Angular measurement 1:** Prismatic compass - principle and construction; bearing of lines; local attraction; magnetic declination.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-2	
Angular Measurement 2: Essentials of the micro-optic theodolite; Measurement of horizontal and vertical angles; Temporary and permanent adjustments; Theodolite traversing; Computation of co-ordinates; Adjustment of traverse. **Triangulation:** classification, reconnaissance, measurement, procedures for angles and base-line; GPS and its application in mine surveying.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-3	

Levelling & Contouring: Types of levels, setting of level instruments and levelling staff, types of levelling methods- reciprocal levelling, profile levelling, differential levelling, reduction of levels by height of instrument method and rise and fall method. Concept of contour, Methods of contouring and uses of contours. **Tacheometry:** Principle and classification of tachometry; stadia tachometry; distance and elevation formulae.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-4	
Mine Surveying – Statutory Requirements: General requirements about mine plans and sections, Types of plans and sections, Specification of Limits of Error. **Correlation and Alignment:** Correlation of surface and underground surveys: Verticality of shafts, shaft depth measurement, Direct traversing in inclined shaft, correlation in vertical shaft – single and two shafts. Underground Levelling. Determination of Gyro-north, Modern Gyro-Laser combination Correlation.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos
Module-5	
Development and Stope Surveying: Control of direction and gradient in drifts, tunnels, raises, winzes, Methods of survey in moderately and steeply inclined ore bodies, flat and vertical ore bodies/seams. **Subsidence Monitoring**: Subsidence Monitoring of subsidence due to underground mining activities. **Setting out curves** – surface and underground.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation & Videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Understanding of basic principles and need of surveying.
2. Knowledge on measurement tools and techniques for mining applications.
3. Plans and sections to be maintained as per statutory requirements, Accuracy assessment of surveying work including required accuracy of plans and sections.
4. Orientation and alignment surveys for mine development, depillaring, stoping and tunnelling operations.
5. Underground stope surveying techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module . Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Punmia, B. C. (2005), Surveying Vol. 1 and II
2. Schofield, W. and Breach M. (2006), Engineering Surveying
3. S. K. Roy, *Fundamentals of Surveying*, Printice Hall of India Pvt., New Delhi , Third Printing, 2004.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105107122
- https://nptel.ac.in/courses/105104101

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

VII Semester

INTRODUCTION TO ROCK BREAKAGE			
Course Code	**21MN752**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- To understand the rock breakage concepts and methods such as drill and blast.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Explosives and Initiating Systems: Types of explosives, their composition and properties, classification; Selection of explosives; transport, storage and handling of explosives; Types of initiating systems – Electrical Detonators, Detonating cord, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2	
Drilling in Surface Mines: Blasthole drills – types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, drilling errors, Selection of drilling systems, organization of drilling.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-3

Blasting in Surface Mines: Mechanics of rock fragmentation; Livingston theory of crater formation; factors affecting blast design, Blast design - estimation of burden and spacing, estimation of charge requirement; initiation patterns; secondary blasting techniques; problems associated with blasting and remedies, ground vibration and air over pressure.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
Coal mines: Drilling systems and their applicability, blasting-off-solid, different blasting cuts, calculation of specific charge, specific drilling and detonator factor, initiation patterns.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Drilling & Blasting in Underground Metal mines: Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, long hole blasting, vertical crater retreat blasting.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Understanding about the explosives and initiating systems used in rock breakage.
2. Blast hole drilling mechanism and selection of a drill for surface excavation.
3. Ability to design the surface blast round and predict the outcomes of the blast design.
4. Ability to design underground blast round and predict the outcomes of the blast design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Drilling and blasting of rocks – Jimeno, Carcedo, Jimeno, T&F, 1995
2. Rock Blasting and Overbreak Control- C.J. Konya, 1991
3. Surface and underground excavations – R. R. Tatiya, 2010

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_mm02/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes

15.09.2022

VII Semester

UNDERGROUND SPACE TECHNOLOGY			
Course Code	**21MN753**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03

Course objectives:

- Excavation methods for construction of underground structures
- Requirement of different machinery for excavation purposes
- Facility design in under structures
- Hazards associated with underground construction works

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Historical: Natural caves, archaeological caves and their construction, tunnels for road, rail and hydropower. Need for Underground Space: Congestion driven needs for development of infrastructure for transport, water, power supply, vehicle movement in cities, storage of materials.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-2

Engineering Utilities: Hydropower tunnels and caverns, underground storage for LPG, LNG, Crude and its products – basic principles.

Nuclear Waste Disposal: Conditions for waste disposal, effect of radioactivity and heat on surrounding rock, conceptual design of a nuclear waste disposal facility.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Module-3

Strategic Utilities: Defence facilities, civil shelters, navy bases, air force hangers, safety and risk assessment systems.

Other Storage: Grain storage, their advantages, disadvantages, underground cold storage and cellar

for foods and beverages.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-4	
Modern Developments: Underground ring roads in mega cities, submerged and floating tunnels, underground libraries, museums, dwelling units, resorts.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-5	
Traffic surveillance and control system (TSCS) in tunnels: Traffic control signs, signals, lights, cameras. Assignment: Preparation of different underground space application plans.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. excavation methods for construction of underground structures
2. requirement of different machinery for excavation purposes
3. facility design in under structures
4. hazards associated with underground construction works

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 marks shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Planning, design and construction of tunnels: B.N.Whittaker & C.Frith
2. Rock Mechanics Applied to Mining and Civil Engineering, Z.T.Bieniawsky
3. Underground Excavation of Rocks : Hoek and Brown
4. Tunneling and Underground Space Technology Journal

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ce62/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Quizzes