Course Structure & Syllabi

FourYearB.Tech in Mining Engineering

Department of Mining Engineering

School of Mines & Metallurgy

A Constituent of Kazi Nazrul University

Asansol - 713340

Preamble:

The purpose of a Learning Outcome-based Curriculum Framework (LOCF) is to change the paradigm of higher education from a teacher-centric to learner-centric curriculum. It is hoped that this paradigmatic change will bring about a significant improvement in the quality of higher education and make the learners both competent and confident to face the challenges of a modern competitive world. The philosophy of this new curriculum framework is pragmatism, to realise that it is not enough for institutions of higher learning to produce good humans and responsible citizens of the country but also to produce employed graduates and postgraduates. After all, it is not prudent to expect an unemployed youth to cherish values like humanity and responsibility towards the nation; he/she first needs to have a productive employment to nourish such values.

LOCF seeks to make higher education in India learner-centric so that graduates and postgraduates not only have a more holistic understanding of their subject but also be able to better serve the humanity with dignity and honour, which can be expected only if they are able to secure productive employment after completing their higher education degrees.

Introduction to Learning Outcome Based Curriculum Framework (LOCF) in Kazi Nazrul University:

Four year BTech programs in Kazi Nazrul University have been designed as a base for research and application of knowledge. The syllabus and curricula of the BTech programmes have been developed following the UGC LOCF guidelines and through rigorous academic exercises after consulting eminent academic experts and feedback received from various stakeholders of the University. These four year programs will enable the students to join the workforce in their respective fields. Kazi Nazrul University has an aim to develop the future generation learners sensitive towards the developmental challenges of the nation with special emphasis on the local developmental needs. The University also aims to foster this future generation of learners with a systematic understanding of global development need. The learning outcome-based curricula of different disciplines reflect the national as well as global sustainable needs listed below in the respective programme and course specific outcomes:

National needs:

- Promote Right to education
- Inculcate ethical and professional values
- Increase national and international visibility;
- leverage institutional strengths through strategic partnerships;
- enlarge the academic community within which to benchmark their activities;

- mobilise internal intellectual resources;
- add important, contemporary learning outcomes to student experience;
- Develop stronger research groups.
- Encourage multidisciplinary
- Promote Cross cultural exchanges
- Preservation of traditional knowledge
- Creating human resource for Economic growth
- Promotion of scientific mind-set and critical thinking

Sustainable development needs:

- Help to eradicate poverty
- Ensuring meal for all
- Promoting good health and well being
- Promoting quality education
- Promoting gender equality
- Initiatives for clean water and sanitization
- Programmes to reduce inequalities
- Develop sustainable cities and communities
- promote decent work and economic growth
- initiate industry-academia collaboration for innovative research
- encourage responsible consumer behaviour
- encourage pro-environment awareness

Program Outcomes (PO)s:

The overall program outcome of the LOCF at BTech level are to:

- help formulate undergraduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes that are expected to be demonstrated by the holder of a BTech degree;
- enable prospective students, parents, employers and others to understand the nature and level of learning outcomes (knowledge, skills, attitudes and values) or attributes a graduate/postgraduate should be capable of demonstrating on successful completion of BTech.
- maintain national standards and international comparability of standards to ensure global competitiveness, and to facilitate postgraduate mobility; and
- provide higher education institutions and their stake holders an important point of reference for setting and assessing standards.

Undergraduate Attributes:

The undergraduate attributes reflect the particular quality and feature or characteristics of an individual, including the knowledge, skills, attitudes and values that are expected to be acquired by anundergraduate through studies at the higher education institution (HEI) such as a college or university. Such attributes include capabilities that help strengthen one's abilities for widening current knowledge base and skills, gaining new knowledge and skills, undertaking future studies and performing well in a chosen career and playing a constructive role as responsible citizen of the country. The Attributes define the characteristics of a student's university degree programme(s), and describe a set of characteristics/competencies that are designed to be transferable beyond the particular disciplinary area and programme contexts in which they have been developed. Such attributes are fostered through meaningful learning experiences made available through the curriculum, the total college/university experiences and a process of critical and reflective thinking.

The learning outcomes-based curriculum framework is based on the premise that every student is unique. Each student has his/her own characteristics in terms of previous learning levels and experiences, life experiences, learning styles and approaches to future career-related actions. The quality, depth and breadth of the learning experiences made available to the students while at the college/University help develop their characteristic attributes. The postgraduate attributes reflect both disciplinary knowledge and understanding and generic/global skills and competencies that all students in different academic fields of study should acquire/attain and demonstrate. Some of the desirable attributes which a postgraduate student should demonstrate will include the following:

- ***Disciplinary Knowledge:*** Demonstrate comprehensive knowledge and understanding of one or more disciplines that form a part of a programme of study, and knowledge and skills acquired from interaction with educators and peer group throughout the programme of study.

- ***Communication Skills:***Express thoughts and ideas effectively in writing and orally, communicate with others using appropriate media, confidently share one's views and express herself/himself, demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
- ***Critical Thinking:*** Apply analytic thought to a body of knowledge, analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence, identify relevant assumptions or implications, formulate coherent arguments, critically evaluate practices, policies and theories by following scientific approach to knowledge development.
- ***Problem Solving:*** Demonstrate capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge and apply one's learning to real life situations.
- ***Analytical Reasoning****:* Demonstrate the ability to evaluate the reliability and relevance of evidence, identify logical flaws and holes in the arguments of others, analyse and synthesise data from a variety of sources, draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
- ***Research-related Skills****:* Demonstrate a sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesising and articulating, demonstrate the ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships, plan, execute and report the results of an experiment or investigation.
- ***Collaboration/Cooperation/Team work****:* Demonstrate ability to work effectively and respectfully with diverse teams, facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.
- ***Scientific Reasoning using Quantitative/Qualitative Data****:* Demonstrate the ability to understand cause-and-effect relationships, define problems, apply scientific principles, analyse, interpret and draw conclusions from quantitative/qualitative data, and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.
- ***Reflective Thinking:*** Demonstrate critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.
- ***Information/Digital Literacy:*** Demonstrate capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources and to use appropriate software for analysis of data.

- ***Self-Directed Learning:*** Demonstrate ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
- ***Multicultural Competence:*** Demonstrate knowledge of the values and beliefs of multiple cultures and a global perspective, effectively engage in a multicultural society, interact respectfully with diverse groups.
- ***Moral and Ethical Awareness/Reasoning****:* Demonstrate the ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Demonstrate the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.
- ***Community Engagement:*** Demonstrate responsible behaviour and ability to engage in the intellectual life of the educational institution, and participate in community and civic affairs.
- ***Leadership Readiness/Qualities****:* Demonstrate capability for mapping out where one needs to go to "win" as a team or an organization, and set direction, formulate an inspiring vision, build a team who can help achieve the vision, motivate and inspire team members to engage with that vision, and use management skills to guide people to the right destination, in a smooth and efficient way.
- ***Lifelong Learning****:* Demonstrate the ability to acquire knowledge and skills, including'learning how to learn' that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Brief History of the Department:

Department of Mining Engineering has started its journey under School of Mines & Metallurgy in Kazi Nazrul University in the year 2017. The department offers 6 semesters diploma in Mining Engineering from the year 2017 and 8 semester degree in Mining Engineering from the year 2019. Both the courses are approved by All India Council for Technical Education (AICTE), Government of India. The students are admitted through WBJEE for degree programme and through JEXPO for diploma programme.

Being situated at Asansol in Raniganj Coalfield, one of the oldest coal mining areas in the whole country, the department has the advantage of very near to the country's prominent coal mining companies like ECL, BCCL, CCL (subsidiaries of Coal India Limited), Tata Steel, SAIL etc. as well as various nationally and internationally famed mining academic and research institutions like IIT(ISM)-Dhanbad, CIMFR, CMPDIL etc.

Vision of the Department:

The vision of the department is to strengthen education, research and interaction between various industry and institute in order to cater a bunch of dedicated, skilled and knowledgeable mining engineers to fulfill the need of the mining industry.

Mission of the Department:

To translate the vision into reality, the department is committed:

- To provide technical education to students in such a way that they can analysis and design various operation of mining and materials systems.
- To update the curriculum with new innovation in technology in the field of mining and allied industries.
- To work intensely with industry in pursuit of the above goals of education and research, leading to the development of cutting edge and commercially-viable technologies.

Programme Educational Objectives (PEOs):

The students are expected to obtain the following programme educational objectives after the completion of the course:

- Apply knowledge of mining engineering to extract coal/minerals keeping in view the safety, conservation and economical aspects.
- Work effectively with other engineering and science teams as a team member or leader in multidisciplinary projects.

Program Specific Outcomes (PSOs):

At the end of the degree program, the student will be:

- Able to work in a managerial capacity in a mine to look after the overall safety, conservation and economical aspects.
- Able to work as a planning engineer to carry out the short term and long term planning to operate a mine.
- Able to work as a blasting engineer in underground tunneling and hydel power project.
- Able to work as a surveyor in mining and civil projects.

Global Needs	BTCMNBSC101	BTCMNBSC102	BTCMNESC101	BTCMNESC102	BTCMNBSC201	BTCMNBSC202	BTCMNHSMC201	BTCMNESC201	BTCMNESC202
Systems thinking competency	√	√			√	√	√	√	√
Anticipatory competency			√	√					
Normative competency					√	√			
Strategic competency									√
Transdisciplinary collaboration competency	√	√	√	√	√	√	√	√	√
Critical thinking competency					√	√	√	√	√
Creativity competency			√		√	√			
Self-awareness competency			√		√	√			

Integrated problem-solving competency			√		√	√			

Global Needs	BTCMNBSC301	BTCMNBSC302	BTCMNESC301	BTCMNESC302	BTCMNHSMC301	BTCMNPCC301	BTCMNPCC302	BTCMNPCC303	BTCMNMC301	BTCMNPCC401	BTCMNPCC402	BTCMNPCC403	BTCMNPCC404	BTCMNPCC405	BTCMNOEC401	BTCMNOEC402	BTCMNHSMC401	BTCMNPROJ401
Systems thinking competency	√		√				√	√	√	√	√		√	√	√	√	√	
Anticipatory competency				√		√												
Normative competency							√	√						√	√	√	√	√
Strategic competency											√							
Transdisciplinary collaboration competency	√		√	√		√	√	√	√	√	√		√	√	√	√	√	
Critical thinking competency							√	√	√	√	√							
Creativity competency				√			√	√										
Self-awareness competency				√			√	√						√	√	√	√	√
Integrated problem-solving competency				√			√	√		√	√	√	√	√				

Global Needs	BTCMNPCC501	BTCMNPCC502	BTCMNPCC503	BTCMNPCC504	BTCMNPEC501	BTCMNPEC502	BTCMNPCC601	BTCMNPEC601	BTCMNPEC602	BTCMNPEC603	BTCMNPEC604	BTCMNOEC601	BTCMNOEC602	BTCMNOEC603	BTCMNOEC604	BTCMNMC601	BTCMNPROJ601
Systems thinking competency	√	√			√	√	√	√	√			√	√	√	√		
Anticipatory competency			√	√										√	√	√	√
Normative competency					√	√											
Strategic competency									√		√	√	√	√			
Transdisciplinary collaboration competency	√	√	√	√	√	√	√	√	√								
Critical thinking competency					√	√	√	√	√				√	√	√	√	
Creativity competency			√		√	√											
Self-awareness competency			√		√	√					√	√	√	√			
Integrated problem-solving competency			√		√	√							√	√	√	√	

Global Needs	BTCMNPCC701	BTCMNPEC701	BTCMNPEC702	BTCMNPEC703	BTCMNPEC704	BTCMNOEC701	BTCMNOEC702	BTCMNOEC703	BTCMNOEC704	BTCMNLC701	BTCMNPROJ701	BTCMNPCC801	BTCMNPROJ801	BTCMNLC801
Systems thinking competency	√	√			√	√	√					√	√	
Anticipatory competency			√	√										
Normative competency					√	√								
Strategic competency													√	
Transdisciplinary collaboration competency	√	√	√	√	√	√	√					√	√	
Critical thinking competency					√	√	√					√	√	
Creativity competency			√		√	√								
Self-awareness competency			√		√	√								
Integrated problem-solving competency			√		√	√			√		√	√		

National needs	BTCMNBSC101	BTCMNBSC102	BTCMNESC101	BTCMNESC102	BTCMNBSC201	BTCMNBSC202	BTCMNHSMC201	BTCMNESC201	BTCMNESC202
Promote Right to education	√	√			√	√	√	√	√
Inculcate ethical and professional values			√	√					
Increase national and international visibility;					√	√			
Leverage institutional strengths through strategic partnerships;									√
Enlarge the academic community within which to benchmark their activities;	√	√	√	√	√	√	√	√	√
Mobilise internal intellectual resources;					√	√	√	√	√
Add important, contemporary learning outcomes to student experience;			√		√	√			
Develop stronger research groups.			√		√	√			
Encourage multidisciplinary			√		√	√			
Promote Cross cultural exchanges	√	√	√	√	√	√	√	√	√
Preservation of traditional knowledge					√	√	√	√	√
Creating human resource for Economic growth			√		√	√			

Promotion of scientific mind-set and critical thinking			√		√	√												

National needs	BTCMNBSC301	BTCMNBSC302	BTCMNESC301	BTCMNESC302	BTCMNHSMC301	BTCMNPCC301	BTCMNPCC302	BTCMNPCC303	BTCMNMC301	BTCMNPCC401	BTCMNPCC402	BTCMNPCC403	BTCMNPCC404	BTCMNPCC405	BTCMNOEC401	BTCMNOEC402	BTCMNHSMC401	BTCMNPROJ401
Promote Right to education	√	√			√	√	√	√	√					√	√	√	√	√
Inculcate ethical and professional values			√	√								√	√	√	√	√		
Increase national and international visibility;					√	√												
Leverage institutional strengths through strategic partnerships;									√			√	√	√	√	√		
Enlarge the academic community within which to benchmark their activities;	√	√	√	√	√	√	√	√	√									
Mobilise internal intellectual resources;					√	√	√	√	√									
Add important, contemporary learning outcomes to student experience;			√		√	√					√	√	√	√	√			
Develop stronger research groups.			√		√	√												
Encourage multidisciplinary			√		√	√							√	√	√	√	√	
Promote Cross cultural exchanges					√	√	√	√	√									
Preservation of traditional knowledge			√		√	√								√	√	√	√	√

Creating human resource for Economic growth			√		√	√												
Promotion of scientific mind-set and critical thinking			√		√	√				√	√	√	√	√				

National needs	BTCMNPCC501	BTCMNPCC502	BTCMNPCC503	BTCMNPCC504	BTCMNPEC501	BTCMNPEC502	BTCMNPCC601	BTCMNPEC601	BTCMNPEC602	BTCMNPEC603	BTCMNPEC604	BTCMNOEC601	BTCMNOEC602	BTCMNOEC603	BTCMNOEC604	BTCMNMC601	BTCMNPROJ601
Promote Right to education	√	√			√	√	√	√	√		√	√	√	√	√		
Inculcate ethical and professional values			√	√													
Increase national and international visibility;					√	√						√	√	√	√	√	
Leverage institutional strengths through strategic partnerships;									√								
Enlarge the academic community within which to benchmark their activities;	√	√	√	√	√	√	√	√	√				√	√	√	√	√
Mobilise internal intellectual resources;					√	√	√	√	√								
Add important, contemporary learning outcomes to student experience;			√		√	√											
Develop stronger research groups.			√		√	√				√	√	√	√	√			
Encourage multidisciplinary			√		√	√											
Promote Cross cultural exchanges	√	√			√	√	√	√	√			√	√	√	√	√	

Preservation of traditional knowledge			√	√							√	√	√	√	√		
Creating human resource for Economic growth					√	√											
Promotion of scientific mind-set and critical thinking									√			√	√	√	√	√	

National needs	BTCMNPCC701	BTCMNPEC701	BTCMNPEC702	BTCMNPEC703	BTCMNPEC704	BTCMNOEC701	BTCMNOEC702	BTCMNOEC703	BTCMNOEC704	BTCMNLC701	BTCMNPROJ701	BTCMNPCC801	BTCMNPROJ801	BTCMNLC801
Promote Right to education	√	√			√	√	√	√	√		√	√		
Inculcate ethical and professional values			√	√										
Increase national and international visibility;					√	√						√	√	
Leverage institutional strengths through strategic partnerships;									√					
Enlarge the academic community within which to benchmark their activities;	√	√	√	√	√	√	√	√	√		√	√		
Mobilise internal intellectual resources;					√	√	√	√	√			√	√	
Add important, contemporary learning outcomes to student experience;			√		√	√								
Develop stronger research groups.			√		√	√					√	√		

Encourage multidisciplinary	√	√			√	√	√	√	√					
Promote Cross cultural exchanges			√	√							√	√		
Preservation of traditional knowledge					√	√								
Creating human resource for Economic growth									√			√	√	
Promotion of scientific mind-set and critical thinking			√		√	√			√	√			√	√

Sustainable development needs:	BTCMNBSC101	BTCMNBSC102	BTCMNESC101	BTCMNESC102	BTCMNBSC201	BTCMNBSC202	BTCMNHSMC201	BTCMNESC201	BTCMNESC202
Help to eradicate poverty	√	√			√	√	√	√	√
Ensuring meal for all			√	√					
Promoting good health and well being					√	√			
Promoting quality education									√
Promoting gender equality	√	√	√	√	√	√	√	√	√
Initiatives for clean water and sanitization					√	√	√	√	√

Programmes to reduce inequalities			√		√	√			
Develop sustainable cities and communities			√		√	√			
Promote decent work and economic growth			√		√	√			
Initiate industry-academia collaboration for innovative research	√	√	√	√	√	√	√	√	√
Encourage responsible consumer behaviour					√	√	√	√	√
Encourage pro-environment awareness			√		√	√			

Sustainable development needs	BTCMNBSC301	BTCMNBSC302	BTCMNESC301	BTCMNESC302	BTCMNHSMC301	BTCMNPCC301	BTCMNPCC302	BTCMNPCC303	BTCMNMC301	BTCMNPCC401	BTCMNPCC402	BTCMNPCC403	BTCMNPCC404	BTCMNPCC405	BTCMNOEC401	BTCMNOEC402	BTCMNHSMC401	BTCMNPROJ401
Help to eradicate poverty	√	√			√	√	√	√	√									
Ensuring meal for all			√	√								√	√	√	√	√		
Promoting good health and well being					√	√								√	√	√	√	√
Promoting quality education									√		√	√	√	√	√			
Promoting gender equality	√	√	√	√	√	√	√	√	√									

Initiatives for clean water and sanitization					√	√	√	√	√				√	√	√	√	√	
Programmes to reduce inequalities			√		√	√				√	√	√	√	√				
Develop sustainable cities and communities			√		√	√												
Promote decent work and economic growth			√		√	√								√	√	√	√	√
Initiate industry-academia collaboration for innovative research					√	√	√	√	√		√	√	√	√	√			
Encourage responsible consumer behaviour			√		√	√							√	√	√	√	√	
Encourage pro-environment awareness			√		√	√				√	√	√	√	√				

Sustainable development needs:	BTCMNPCC501	BTCMNPCC502	BTCMNPCC503	BTCMNPCC504	BTCMNPEC501	BTCMNPEC502	BTCMNPCC601	BTCMNPEC601	BTCMNPEC602	BTCMNPEC603	BTCMNPEC604	BTCMNOEC601	BTCMNOEC602	BTCMNOEC603	BTCMNOEC604	BTCMNMC601	BTCMNPROJ601
Help to eradicate poverty	√	√			√	√	√	√	√			√	√	√	√	√	
Ensuring meal for all			√	√				√	√	√	√	√					
Promoting good health and well being					√	√					√	√	√	√	√		
Promoting quality education									√								

Promoting gender equality	√	√	√	√	√	√	√	√	√			√	√	√	√	√	
Initiatives for clean water and sanitization					√	√	√	√	√		√	√	√	√	√		
Programmes to reduce inequalities			√		√	√											
Develop sustainable cities and communities			√		√	√			√	√	√	√	√				
Promote decent work and economic growth			√		√	√						√	√	√	√	√	
Initiate industry-academia collaboration for innovative research	√	√			√	√	√	√	√				√	√	√	√	√
Encourage responsible consumer behaviour			√	√						√	√	√	√	√			
Encourage pro-environment awareness					√	√						√	√	√	√	√	

Sustainable development needs:	BTCMNPCC701	BTCMNPEC701	BTCMNPEC702	BTCMNPEC703	BTCMNPEC704	BTCMNOEC701	BTCMNOEC702	BTCMNOEC703	BTCMNOEC704	BTCMNLC701	BTCMNPROJ701	BTCMNPCC801	BTCMNPROJ801	BTCMNLC801
Help to eradicate poverty	√	√			√	√	√	√	√		√	√	√	√
Ensuring meal for all			√	√				√	√	√	√			
Promoting good health and well being					√	√			√	√	√	√		

Promoting quality education									√					
Promoting gender equality	√	√	√	√	√	√	√	√	√					
Initiatives for clean water and sanitization					√	√	√	√	√					
Programmes to reduce inequalities			√		√	√				√	√	√	√	
Develop sustainable cities and communities			√		√	√			√	√	√	√		
Promote decent work and economic growth	√	√			√	√	√	√	√		√	√	√	√
Initiate industry-academia collaboration for innovative research			√	√				√	√	√	√			
Encourage responsible consumer behaviour					√	√					√	√	√	√
Encourage pro-environment awareness									√	√	√	√	√	

SCHOOL OF MINES & METALLURGY
A Constituent of KAZI NAZRUL UNIVERSITY, Asansol
B.Tech in Mining Engineering
CURRICULAR STRUCTURE FOR FIRST YEAR (FIRST SEMESTER)

SL. NO.	SUBJECT	CATEGORY	COURSE CODE	CREDITS	PERIODS			EVALUATION SCHEME				
					L	TU	PR	INTERNAL ASSESSMENT (IA)		END SEMESTER EXAMINATION (ESE)		
								TH	PR	TH	PR	TOTAL
1	Physics	Basic Science Course	BTCMNBSC101	5.5	3	1	3	30	20	70	30	150
2	Mathematics - I	Basic Science Course	BTCMNBSC102	4	3	1	0	30		70		100
3	Basic Electrical Engineering	Engineering Science Course	BTCMNESC101	5	3	1	2	30	20	70	30	150
4	Engineering Graphics and Design	Engineering Science Course	BTCMNESC102	3	1	0	4		50		50	100
TOTAL				**17.5**	**10**	**3**	**9**					**500**

STUDENT CONTACT HOURS PER WEEK : 22 hrs ; DURATION : 16 WEEKS / SEMESTER

Theory and Practical Period of 60 Minutes each.

L- Lecture, TU- Tutorials, PR- Practical, IA- Internal Assessment, ESE- End Semester Exam..

SCHOOL OF MINES & METALLURGY
A Constituent of KAZI NAZRUL UNIVERSITY, Asansol
B.Tech in Mining Engineering
CURRICULAR STRUCTURE FOR FIRST YEAR (SECOND SEMESTER)

SL. NO.	SUBJECT	CATEGORY	COURSE CODE	CREDITS	PERIODS			EVALUATION SCHEME				
					L	TU	PR	INTERNAL ASSESSMENT (IA)		END SEMESTER EXAMINATION (ESE)		
								TH	PR	TH	PR	TOTAL
1	Chemistry	Basic Science Course	BTCMNBSC201	5.5	3	1	3	30	20	70	30	150
2	Mathematics - II	Basic Science Course	BTCMNBSC202	4	3	1	0	30		70		100
3	Communicative English	Humanities and Social Sciences including Management Course	BTCMNHSMC201	3	2	0	2	30	20	70	30	150
4	Introduction to C Programing	Engineering Science Course	BTCMNESC201	5	3	0	4	30	20	70	30	150
5	Workshop Practices	Engineering Science Course	BTCMNESC202	3	1	0	4		50		50	100
TOTAL				**20.5**	**12**	**2**	**13**					**650**

STUDENT CONTACT HOURS PER WEEK : 27 hrs ; DURATION : 16 WEEKS / SEMESTER

Theory and Practical Period of 60 Minutes each.

L- Lecture, TU- Tutorials, PR- Practical, IA- Internal Assessment, ESE- End Semester Exam..

SCHOOL OF MINES & METALLURGY
A Constituent of KAZI NAZRUL UNIVERSITY, Asansol
B.Tech in Mining Engineering
CURRICULAR STRUCTURE FOR SECOND YEAR (THIRD SEMESTER)

SL.NO.	SUBJECT	CATEGORY	COURSE CODE	CREDITS	PERIODS			EVALUATION SCHEME				
					L	TU	PR	INTERNAL ASSESSMENT (IA)		END SEMESTER EXAMINATION (ESE)		
								TH	PR	TH	PR	TOTAL
1	Mathematics-III	Basic Science Course	BTCMNBSC301	4	3	1	0	30		70		100
2	Biology	Basic Science Course	BTCMNBSC302	3	2	1	0	30		70		100
3	Engineering Mechanics	Engineering Science Course	BTCMNESC301	4	3	1	0	30		70		100
4	Strength of Materials	Engineering Science Course	BTCMNESC302	3	3	0	0	30		70		100
5	Economics for Engineers	Humanities and Social Sciences including Management Course	BTCMNHSMC301	3	3	0	0	30		70		100
6	Mine Development	Professional Core Course	BTCMNPCC301	3	3	0	0	30		70		100
7	Introduction to Mining	Professional Core Course	BTCMNPCC302	3	3	0	0	30		70		100
8	Mining Geology - I	Professional Core Course	BTCMNPCC303	4	3	0	2	30	20	70	30	150
9	Environmental Science (Mandatory Course)	Mandatory Course	BTCMNMC301	0	0	0	0	15		35		50
TOTAL				**27**	**23**	**3**	**2**					**900**

STUDENT CONTACT HOURS PER WEEK : 22 hrs ; DURATION : 16 WEEKS / SEMESTER

Theory and Practical Period of 60 Minutes each.

L- Lecture, TU- Tutorials, PR- Practical, IA- Internal Assessment, ESE- End Semester Exam.

SCHOOL OF MINES & METALLURGY
A Constituent of KAZI NAZRUL UNIVERSITY, Asansol
B.Tech in Mining Engineering
CURRICULAR STRUCTURE FOR SECOND YEAR (FOURTH SEMESTER)

SL.NO.	SUBJECT	CATEGORY	COURSE CODE	CREDITS	PERIODS			EVALUATION SCHEME				
					L	TU	PR	INTERNAL ASSESSMENT (IA)		END SEMESTER EXAMINATION (ESE)		
								TH	PR	TH	PR	TOTAL
1	Underground Coal Mining	Professional Core Course	BTCMNPCC401	3	3	0	0	30		70		100
2	Underground Metal Mining	Professional Core Course	BTCMNPCC402	3	3	0	0	30		70		100
3	Mine Ventilation	Professional Core Course	BTCMNPCC403	5	4	0	2	30	20	70	30	150
4	Mine Survey - I	Professional Core Course	BTCMNPCC404	5	4	0	2	30	20	70	30	150
5	Mining Geology - II	Professional Core Course	BTCMNPCC405	4	3	0	2	30	20	70	30	150
6	Mineral Processing	Open Elective Course (Any One)	BTCMNOEC401	3	3	0	0	30		70		100
7	Chemical Processing		BTCMNOEC402									
8	Universal Human Values-II: Understanding Harmony	Humanities and Social Sciences including Management Course	BTCMNHSMC401	3	3	0	0	30		70		100
9	Vocational Training-I*	Project	BTCMNPROJ401	1	0	0	2		20		30	50
TOTAL				**27**	**26**	**0**	**2**					**900**

STUDENT CONTACT HOURS PER WEEK : 24 hrs ; DURATION : 16 WEEKS / SEMESTER
Theory and Practical Period of 60 Minutes each.
L- Lecture, TU- Tutorials, PR- Practical, IA- Internal Assessment, ESE- End Semester Exam.

* Vocational Training in an underground/surface mine for four weeks (28 days) to be taken at the end of III Semester, is credited in IV Semester

SCHOOL OF MINES & METALLURGY
A Constituent of KAZI NAZRUL UNIVERSITY, Asansol
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CURRICULAR STRUCTURE FOR THIRD YEAR (FIFTH SEMESTER)

SL.NO.	SUBJECT	CATEGORY	COURSE CODE	CREDITS	PERIODS			EVALUATION SCHEME				
					L	TU	PR	INTERNAL ASSESSMENT (IA)		END SEMESTER EXAMINATION (ESE)		
								TH	PR	TH	PR	TOTAL
1	Surface Mining	Professional Core Course	BTCMNPCC501	4	4	0	0	30		70		100
2	Mining Machinery - I	Professional Core Course	BTCMNPCC502	4	3	0	2	30	20	70	30	150
3	Mine Survey - II	Professional Core Course	BTCMNPCC503	5	4	0	2	30	20	70	30	150
4	Rock Mechanics	Professional Core Course	BTCMNPCC504	5	4	0	2	30	20	70	30	150
5	Drilling and Blasting	Professional Elective Course (Any One)	BTCMNPEC501	3	3	0	0	30		70		100
6	Mineral Economics		BTCMNPEC502									
TOTAL				**21**	**18**	**0**	**6**					**650**

STUDENT CONTACT HOURS PER WEEK : 26 hrs ; DURATION : 16 WEEKS / SEMESTER
Theory and Practical Period of 60 Minutes each.
L- Lecture, TU- Tutorials, PR- Practical, IA- Internal Assessment, ESE- End Semester Exam.

SCHOOL OF MINES & METALLURGY
A Constituent of KAZI NAZRUL UNIVERSITY, Asansol
B.Tech in Mining Engineering
CURRICULAR STRUCTURE FOR THIRD YEAR (SIXTH SEMESTER)

SL.NO.	SUBJECT	CATEGORY	COURSE CODE	CREDITS	PERIODS			EVALUATION SCHEME				
					L	TU	PR	INTERNAL ASSESSMENT (IA)		END SEMESTER EXAMINATION (ESE)		
								TH	PR	TH	PR	TOTAL
1	Mining Machinery – II	Professional Core Course	BTCMNPCC601	4	3	0	2	30	20	70	30	150
2	Mine Planning and Design	Professional Elective Course (Any One)	BTCMNPEC601	4	3	0	2	30	20	70	30	150
3.	Coal Preparation and Categorisation		BTCMNPEC602									
4	Ground Control	Professional Elective Course (Any One)	BTCMNPEC603	3	3	0	0	30		70		100
5	Numerical Methods in Mining Engineering		BTCMNPEC604									
6	Sensor and Transducer	Open Elective Course (Any One)	BTCMNOEC601	3	3	0	0	30		70		100
7	Instrumentation Engineering		BTCMNPEC602									
8	Industrial Management and Environmental Control	Open Elective Course (Any One)	BTCMNOEC603	3	3	0	0	30		70		100
9	Production & Operation Management		BTCMNOEC604									
10	Indian Constitution	Mandatory Course	BTCMNMC601	0	0	0	0	15		35		50
11	Vocational Training-II*	Project	BTCMNPROJ601	1	0	0	2		20		30	50
TOTAL				**18**	**15**	**0**	**6**					**700**

STUDENT CONTACT HOURS PER WEEK : 24 hrs ; DURATION : 16 WEEKS / SEMESTER
Theory and Practical Period of 60 Minutes each.
L- Lecture, TU- Tutorials, PR- Practical, IA- Internal Assessment, ESE- End Semester Exam.

* Vocational Training in an underground/surface mine for four weeks (28 days) to be taken at the end of V Semester, is credited in VI Semester.

SCHOOL OF MINES & METALLURGY
A Constituent of KAZI NAZRUL UNIVERSITY, Asansol
B.Tech in Mining Engineering
CURRICULAR STRUCTURE FOR FOURTH YEAR (SEVENTH SEMESTER)

SL. NO	SUBJECT	CATEGORY	COURSE CODE	CREDITS	PERIODS			EVALUATION SCHEME				
					L	TU	PR	INTERNAL ASSESSMENT (IA)		END SEMESTER EXAMINATION (ESE)		
								TH	PR	TH	PR	TOTAL
1	Mine Management, Safety and Legislation - I	Professional Core Course	BTCMNPCC701	4	4	0	0	30		70		100
3	Mine Environment	Professional Elective Course (Any One)	BTCMNPEC701	3	3	0	0	30		70		100
3	Ergonomics and Safety Engineering		BTCMNPEC702									
4	Environmental Aspects of Mining	Professional Elective Course (Any One)	BTCMNPEC703	3	3	0	0	30		70		100
5	Mine System Engineering		BTCMNPEC704									
6	Quality Assurance & Quality Control	Open Elective Course (Any One)	BTCMNOEC701	3	3	0	0	30		70		100
7	Optimization Technique		BTCMNOEC702									
8	Remote Sensing & GIS	Open Elective Course (Any One)	BTCMNOEC703	3	3	0	0	30		70		100
9	Business Analytics		BTCMNOEC704									
10	Soft Skill Development	Laboratory course	BTCMNLC701	1	0	0	2		20		30	50
11	Project-I	Project	BTCMNPROJ701	2	0	0	4		40		60	100
TOTAL				**19**	**16**	**0**	**6**					**650**

STUDENT CONTACT HOURS PER WEEK : 24 hrs ; DURATION : 16 WEEKS / SEMESTER

Theory and Practical Period of 60 Minutes each.

L- Lecture, TU- Tutorials, PR- Practical, IA- Internal Assessment, ESE- End Semester Exam.

SCHOOL OF MINES & METALLURGY
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CURRICULAR STRUCTURE FOR FOURTH YEAR (EIGHTH SEMESTER)

SL. NO.	SUBJECT	CATEGORY	COURSE CODE	CREDITS	PERIODS			EVALUATION SCHEME				
					L	TU	PR	INTERNAL ASSESSMENT (IA)		END SEMESTER EXAMINATION (ESE)		
								TH	PR	TH	PR	TOTAL
1	Mine Management, Safety and Legislation - II	Professional Core Course	BTCMNPCC801	4	4	0	0	30		70		100
5	Project-II	Project	BTCMNPROJ801	6	0	0	12		80		120	200
6	Viva-Voce	Laboratory course	BTCMNLC801	2	0	0	0		40		60	100
TOTAL				**12**	**4**	**0**	**6**					**400**

STUDENT CONTACT HOURS PER WEEK : 22 hrs ; DURATION : 16 WEEKS / SEMESTER

Theory and Practical Period of 60 Minutes each.

L- Lecture, TU- Tutorials, PR- Practical, IA- Internal Assessment, ESE- End Semester Exam.

NOTE 1: Induction program (Mandatory non-credit course) of 3 weeks duration for students to be offered right at the start of the first year. Induction Program will have the following:

- Physical activity
- Creative Arts
- Universal Human Values-I
- Literary activity
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

NOTE 2: A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

1st Semester

Subject Name:Physics **Subject Code:BTCMNBSC101** **Subject Credit: 4**

Course Objectives:

To introduce the basic physics concepts relevant to concerned branches of Engineering and Technology.

Course Outcomes:

- Construction and working details of different instruments are learnt.
- Study of magnetic and dielectric materials enhances the utility aspects of materials.

Module 1: Electrostatics in vacuum (8 lectures)

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Module 2: Electrostatics in a linear dielectric medium (4 lectures)

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module 3: Magnetostatics (6 lectures)

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Module 4: Magnetostatics in a linear magnetic medium (3 lectures)

Magnetization and associated bound currents; auxiliary magnetic field ; Boundary conditions on and . Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and feromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Module 5: Faraday's law (4 lectures)

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Module 6: Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations (5 lectures)

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from timedependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Module 7: Electromagnetic waves (8 lectures)

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Text/Reference Books

1. Griffiths, D. J.,Introduction to Electrodynamics (3rd Edition), Prentice Hall; 1999.
2. Walker, J., Halliday, D. and Resnick,R., Fundamentals of Physics (10thedition), John Wiley & Sons Inc; 2013.
3. Gaur R. K. and Gupta, S. L., Engineering Physics, Dhanpat Raj Publications,2003.
4. Palanisamy, P. K., Engineering Physics, Scitech Publications (P) Ltd, 2006.
5. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

Subject Name: Mathematics-1 **Subject Code:BTCMNBSC102** **Subject Credit: 4**

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes:

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

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- The tool of power series and Fourier series for learning advanced Engineering Mathematics.
- To deal with functions of several variables that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

Module 1: Calculus: (6 lectures)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus: (6 lectures)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 3: Sequences and series: (10 lectures)

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 4: Multivariable Calculus (Differentiation): (8 lectures)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module 5: Matrices (10 lectures)

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Text/Reference Books

1. Thomas G.B. and Finney, R.L.,Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th eprint, 2010.
5. Poole, D.,Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. Bali,N.P. and Goyal, M.,A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. Grewal, B.S.,Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Subject Name:Basic Electrical Engineering **Subject Code:BTCMNESC101** **Subject Credit: 4**

Course Objectives:

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations

Course Outcomes:

At the end of the course, student will be:

- Able to analyse the various electrical networks.
- Able to understand the operation of DC generators,3-point starter and DC machine testing by Swinburne's Test.
- Able to analyse the performance of single-phase transformer.
- Able to explain the operation of 3-phase alternator and 3-phase induction motors.
- Able to analyse the operation of half wave, full wave bridge rectifiers and OP-AMPs.
- Able to explain the single stage CE amplifier and concept of feedback amplifier.

Module 1: DC Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current andvoltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin andNorton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, realpower, reactive power, apparent power, power factor. Analysis of single-phase ac circuitsconsisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phasebalanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers (6 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit,losses in transformers, regulation and efficiency. Auto-transformer and three-phasetransformer connections.

Module 4: Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three-phase inductionmotor, Significance of torque-slip characteristic. Loss components and efficiency, starting andspeed control of induction motor. Single-phase induction motor. Construction, working,torque-speed characteristic and speed control of separately excited dc motor. Construction andworking of synchronous generators.

Module 5: Power Converters (6 hours)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltagesource inverters; sinusoidal modulation.

Module 6: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types ofWires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.Elementary calculations for energy consumption, power factor improvement and batterybackup.

Suggested Text / Reference Books

1. Kothari,D. P. and Nagrath, I. J.,Basic Electrical Engineering, Tata McGraw Hill, 2010.
2. Kulshreshtha, D. C., Basic Electrical Engineering, McGraw Hill, 2009.
3. Bobrow, L. S.,Fundamentals of Electrical Engineering, Oxford University Press, 2011.
4. Hughes, E., Electrical and Electronics Technology, Pearson, 2010.
5. Toro, V. D.,Electrical Engineering Fundamentals, Prentice Hall India, 1989.

Subject Name: Engineering Graphics and Design **Subject Code: BTCMNESC102** **Subject Credit: 3**

Course Objectives:

Engineering Graphics and Design being the principle method of communication forengineers, the objective is to introduce the students, the techniques of constructing thevarious types of polygons, curves and scales. The objective is also to visualize andrepresent the 3D objects in 2D planes with proper dimensioning, scaling etc.

Course Outcomes:

- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modelling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

Module 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module 2: Orthographic Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3: Projections of Regular Solids

Regular Solids those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Module 4:Sections and Sectional Views of Right Angular Solids

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

***Module 5: Isometric Projections* covering,**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Module 6: Overview of Computer Graphics

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7: Customisation& CAD Drawing

Consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module 8: Annotations, layering & other functions

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and twodimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Module 9: Demonstration of a simple team design project

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating

associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Text/Reference Books:

1. Bhatt N.D., Panchal V. M. and Ingle P.R., Engineering Drawing, Charotar Publishing House, 2014.
2. Shah, M. B. and Rana B.C., Engineering Drawing and Computer Graphics, Pearson Education, 2008.
3. Agrawal, B. and Agrawal C. M., Engineering Graphics, TMH Publication, 2012,
4. Narayana, K.L. andKannaiah P., Text book on Engineering Drawing, Scitech Publishers, 2008.

Subject Name:Basic Electrical Engineering Lab **Subject Code:BTCMNESC101** **Subject Credit: 1**

Laboratory Objectives:

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments and basic characteristics of transformers and electrical machines.
- Get an exposure to the working of power electronic converters.

Laboratory Outcomes:

This lab curriculum gives fundamental understanding of design of electrical instrument with targeted accuracy for physical measurements.

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (nonsinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.

7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at supersynchronous speed.

8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.

9. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Subject Name:Physics Lab **Subject Code:BTCMNBSC101** **Subject Credit: 1.5**

Laboratory Objectives:

Training field oriented Engineering graduates to handle instruments andtheir design methods to improve the accuracy of measurements.

Laboratory Outcomes:

Physics lab curriculum gives fundamental understanding of design of aninstrument with targeted accuracy for physical measurements.

Choice of experiments from the following:

1. Experiments on electromagnetic induction and electromagnetic breaking.
2. Experiments on LC circuit and LCR circuit.
3. Experiments on Resonance phenomena in LCR circuits.
4. Experiments on Magnetic field from Helmholtz coil.
5. Measurement of Lorentz force in a vacuum tube.

2nd Semester

Subject Name: Chemistry **Subject Code: BTCMNBSC201** **Subject Credit: 4**

Course Objectives:

To make the students conversant with:

- Treatment of water for domestic and industrial purpose.
- Applications of different kinds of Polymers, Lubricants and adhesives.
- Types and mechanism of corrosion and control measures.
- Application of different types of abrasives and chemical nature of building materials and composites.
- Chemistry of different types of Fuels and Explosives.

Course Outcomes:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

Module 1: Atomic and molecular structure (12 lectures)

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the

multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2:Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces (4 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria (6 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

Module 6: Stereochemistry (4 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Module 7: Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Text/Reference Books:

1. Mahan, B. H.,University Chemistry.
2. Sienko M. J. and Plane R. A.,Chemistry: Principles and Applications.
3. Banwell C. N.,Fundamentals of Molecular Spectroscopy.
4. Tembe, B. L.,Kamaluddin and Krishnan, M. S.,Engineering Chemistry (NPTEL Web-book).
5. Atkins, P. W.,Physical Chemistry.
6. Volhardt, K. P. C. and Schore N. E.,Organic Chemistry: Structure and Function, 5th Edition

Subject Name: Mathematics-II **Subject Code:BTCMNBSC202** **Subject Credit: 4**

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes:

The students will learn:

- The mathematical tools needed in evaluating multiple integrals and their usage.
- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Module 1: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module 2: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Text/Reference Books

1. Thomas,G.B. and Finney, R.L.,Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Boyce,W. E. and DiPrima, R. C.,Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
4. Ross, S. L.,Differential Equations, 3rd Ed., Wiley India, 1984.
5. Coddington, E. A.,An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6. Ince, E. L.,Ordinary Differential Equations, Dover Publications, 1958.
7. Brown,J. W.,and Churchill, R. V.,Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
8. Bali,N.P.,and Goyal, M.,A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. Grewal, B.S.,Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Subject Name: Programming for Problem Solving **Subject Code:BTCMNESC201** **Subject Credit: 3**

Course Objectives:

- Formulating algorithmic solutions to problems and implementing algorithms in C.
- Notion of Operation of a CPU, Notion of an algorithm and computational procedure, editing and executing programs in Linux.
- Understanding branching, iteration and data representation using arrays.
- Modular programming and recursive solution formulation.
- Understanding pointers and dynamic memory allocation.
- Understanding miscellaneous aspects of C.
- Comprehension of file operations.

Course Outcomes:

The student will learn:

- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
- To use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
- To apply programming to solve simple numerical method problems, namely rootfinding of function, differentiation of function and simple integration.

Module 1:

Introduction to Programming **(4 lectures)**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - **(1 lecture).**

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **(1 lecture)**

From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- **(2 lectures)**

Module 2:

Arithmetic expressions and precedence **(2 lectures)**

Conditional Branching and Loops **(6 lectures)**

Writing and evaluation of conditionals and consequent branching **(3 lectures)**

Iteration and loops **(3 lectures)**

Module 3:

Arrays **(6 lectures)**

Arrays (1-D, 2-D), Character arrays and Strings

Module 4:

Basic Algorithms **(6 lectures)**

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Module 5:

Function **(5 lectures)**

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

Module 6:

Recursion **(4 -5 lectures)**

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Module 7:

Structure **(4 lectures)**

Structures, Defining structures and Array of Structures

Module 8:

Pointers **(2 lectures)**

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Module 9:

File handling (only if time is available, otherwise should be done as part of the lab)

Text/Reference Books

1. Gottfried, B.,Schaum's Outline of Programming with C, McGraw-Hill
2. Balaguruswamy, E., Programming in ANSI C, Tata McGraw-Hill
3. Kernighan,B. W. and Ritchie, D. M.,The C Programming Language, Prentice Hall of India

Subject Name:English **Subject Code: BTCMNHSMC201** **Subject Credit: 3**

Course Objectives:

- To improve the language proficiency of the students in English.
- To enable the students to study and comprehend the prescribed lessons and subjects more effectively relating to their theoretical and practical components.
- To develop the communication skills of the students in both formal and informal situations.

Course Outcomes:

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Module 1: Vocabulary Building

1.1 The concept of Word Formation

1.2 Root words from foreign languages and their use in English

1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.

1.4 Synonyms, antonyms, and standard abbreviations.

Module 2: Basic Writing Skills

2.1 Sentence Structures

2.2 Use of phrases and clauses in sentences

2.3 Importance of proper punctuation

2.4 Creating coherence

2.5 Organizing principles of paragraphs in documents

2.6 Techniques for writing precisely

Module 3: Identifying Common Errors in Writing

3.1 Subject-verb agreement

3.2 Noun-pronoun agreement

3.3 Misplaced modifiers

3.4 Articles

3.5 Prepositions

3.6 Redundancies

3.7 Clichés

Module 4: Nature and Style of sensible Writing

4.1 Describing

4.2 Defining

4.3 Classifying

4.4 Providing examples or evidence

4.5 Writing introduction and conclusion

Module 5: Writing Practices

5.1 Comprehension

5.2 Précis Writing

5.3 Essay Writing

Module 6: Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Text/Reference Books:

1. Michael Swan., Practical English Usage. OUP. 1995.
2. Wood. F. T., Remedial English Grammar. Macmillan.2007
3. William, Z.,On Writing Well. Harper Resource Book. 2001
4. Liz Hamp-Lyons and Ben Heasly, Study Writing.. Cambridge University Press. 2006.
5. Sanjay Kumar and Pushp Lata, Communication Skills.. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Subject Name:Chemistry Lab **Subject Code:BTCMNBSC201** **Subject Credit: 1.5**

Laboratory Objectives:

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

Laboratory Outcomes

The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug

10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Subject Name:Programming for Problem Solving Lab **Subject Code:BTCMNESC201** **Subject Credit: 2**

Laboratory Objectives:

The laboratory course will consist of lab illustrating the principles of programming relevant to the study of science and engineering.

Laboratory Outcomes:

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program
- To be able to declare pointers of different types and use them in defining self referential structures.
- To be able to create, read and write to and from simple text files.

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:

Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):

Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

Subject Name:Workshop/Manufacturing Practices **Subject Code:BTCMNESC202** **Subject Credit: 3**

Course Objectives:

To impart hands-on training on basic engineering trades and skills.

Course Outcomes:

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Detailed Contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1 lecture)**
3. Fitting operations & power tools **(1 lecture)**
4. Electrical & Electronics **(1 lecture)**
5. Carpentry **(1 lecture)**
6. Plastic moulding, glass cutting **(1 lecture)**
7. Metal casting **(1 lecture)**
8. Welding (arc welding & gas welding), brazing **(1 lecture)**

Text/Reference Books:

1. Hajra Choudhury, S.K., Hajra Choudhury A.K. and Nirjhar Roy S. K., Elements of Workshop Technology, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian, S., and Steven S. S., Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
3. Gowri, P., Hariharan and Suresh Babu, A., Manufacturing Technology – I, Pearson Education, 2008.

4. Roy A. Lindberg, Processes and Materials of Manufacture, 4th Edition, Prentice Hall India, 1998.

Laboratory Objectives:

To impart hands-on practice on basic engineering trades and skills.

Laboratory Outcomes:

Upon completion of this laboratory course, students will be able to

- Fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

(ii) Workshop Practice:(60 hours) [L : 0; T:0 ; P : 4 (2 credits)]

1. Machine shop **(10 hours)**

2. Fitting shop **(8 hours)**

3. Carpentry **(6 hours)**

4. Electrical & Electronics**(8 hours)**

5. Welding shop **(8 hours (Arc welding 4 hrs + gas welding 4 hrs)**

6. Casting **(8 hours)**

7. Smithy **(6 hours)**

8. Plastic moulding& Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

3rd Semester

Subject Name: Mathematics-III (Probability and Statistics) **Subject Code: BTCMNBSC301** **Subject Credit: 4**

Course Objectives:

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Course Outcomes:

The students will learn:

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.

Module 1: Basic Probability (12 hours)

Probability spaces, conditional probability, independence; Discrete random variables,Independent random variables, the multinomial distribution, Poisson approximation to thebinomial distribution, infinite sequences of Bernoulli trials, sums of independent randomvariables; Expectation of Discrete Random Variables, Moments, Variance of a sum,Correlation coefficient, Chebyshev's Inequality.

Module 2: Continuous Probability Distributions (4 hours)

Continuous random variables and their properties, distribution functions and densities,normal, exponential and gamma densities.

Module 3: Bivariate Distributions (4 hours)

Bivariate distributions and their properties, distribution of sums and quotients, conditionaldensities, Bayes' rule.

Module 4: Basic Statistics (8 hours)

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions:Binomial, Poisson and Normal - evaluation of statistical parameters for these threedistributions, Correlation and regression – Rank correlation.

Module 5: Applied Statistics (8 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolasand more general curves. Test of significance: Large sample test for single proportion,difference of proportions, single mean, difference of means, and difference of standarddeviations.

Module 6: Small samples (4 hours)

Test for single mean, difference of means and correlation coefficients, test for ratio ofvariances - Chi-square test for goodness of fit and independence of attributes.

Text/References Books:

1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley & Sons, 2006.
2. Hoel, P. G., Port S. C. and Stone, C. J., Introduction to Probability Theory, Universal Book Stall, 2003.
3. Ross, S., A First Course in Probability, Pearson Education India, 2002.
4. Feller, W., An Introduction to Probability Theory and its Applications, Vol. 1, Wiley, 1968.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, 2010.
6. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 2000.
7. Veerarajan, T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2010.

Subject Name: Engineering Mechanics **Subject Code: BTCMNESC301** **Subject Credit: 4**

Course Objectives:

The students completing this course are expected to understand the concepts offorces and its resolution in different planes, resultant of force system, Forces acting on abody, their free body diagrams using graphical methods. They are required to understand theconcepts of centre of gravity and moments of inertia and their application, Analysis of framesand trusses, different types of motion, friction and application of work - energy method.

Course Outcomes:

Upon successful completion of the course, student should be able to:

- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
- Understand measurement error and propagation of error in processed data.
- Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).
- Understand basic dynamics concepts – force, momentum, work and energy.

Module 1: Fundamentals of Mechanics

Statics: Introduction to Engineering Mechanics, Units and Dimensions, Basic Mechanics, Laws of Mechanics, Representation of a Vector. Statics of particles: Force, system of forces, Resultant of forces, Equilibrium of Particles, Principle of Transmissibility of Forces, parallel forces, System of forces, moment, moment of force about line, Equilibrium of three forces in a plane, Varignon's theorem of moments, Couple.

Module 2: Equilibrium of Rigid Bodies

Rigid Body Equilibrium: Free body diagram, condition of equilibrium of rigid body in two dimensions, Types of beams, loads, supports, determination of support reactions, Lame's theorem.

Module 3: Introduction to Structural Mechanics

Structure: Structure of equilibrium: Trusses, Methods of joints and section.

Module 4: Properties of Surfaces

Centriod and Moment of Inertia: Centroid and center of mass: Centroids of composite plane figures and curves, Pappus and Guldinus theorem, Centre of gravity, moment of inertia, parallel axis theorem, perpendicular axis theorem, mass moment of inertia.

Module 5: Friction Force Analysis

Friction: Classification of friction, Laws of friction, Coefficient of friction, Limiting friction, Angle of repose, Wedge friction, Belt Friction

Module 6: Kinematics and kinetics of Particles

Curvilinear motion, Dynamic equilibrium, Angular momentum, Revision of Conservation of Energy, Energy and Momentum methods for Single Particle and for a System ofPartic1es, Impulsive motion.

Module 7: Kinematics and kinetics of Rigid Bodies

General plane motion, Instantaneous center of rotation, Planer motion relative to a rotating frame, Coriolis acceleration, Frame of reference in general motion. Application of the principle of impulse and momentum to the 3D motion of a rigid body, Kinetic energy in 3D, Euler's equations of motion, Motion of a Gyroscope, Eulerian angles.

Text Books/ Reference Books:

1. Beer, F. P. and Johnston Jr. E. R., Vector Mechanics for Engineers (In SI Units): Statics and Dynamics, 8th Edition, Tata McGraw-Hill Publishing Company, New Delhi (2004)
2. Vela Murali, Engineering Mechanics, Oxford University Press (2010)
3. Hibbeller, R. C and Gupta, A., Engineering Mechanics: Statics and Dynamics, 11th Edition, Pearson Education (2010).
4. Irving, H. S. and Rao. K. M. G., Engineering Mechanics-Statics and Dynamics, 4thEdition, Pearson Education (2006)
5. Meriam, J. L. and Kraige, L. G., Engineering Mechanics-Statics - Volume 1, Dynamics- Volume 2,3rdEdition, John Wiley &Sons,(1993)
6. Rajasekaran, S and Sankarasubramanian, G., Engineering Mechanics Statics and Dynamics, 3rdEdition, Vikas Publishing House, (2005).
7. Bhavikatti, S. S and Rajashekarappa, K. G., Engineering Mechanics, New Age International (P) Limited Publishers, (1998).
8. Kumar, K. L., Engineering Mechanics, 3rd Revised Edition, Tata McGraw-Hill Publishing Company, New Delhi (2008)

Subject Name: Strength of Materials **Subject Code: BTCMNESC302** **Subject Credit: 3**

Course Objectives:

- To impart the knowledge of the different types of stresses and strains acts on Beams.
- To acquire Knowledge on Shear force and Bending moment diagrams and shear stresses.

Course Outcomes:

Upon successful completion of the course, student should be able to:

- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
- Understand measurement error and propagation of error in processed data.
- Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).
- Understand basic dynamics concepts – force, momentum, work and energy.

Module 1: Simple stresses and strains

Introduction, Definition and concept and of stress and strain. Hooke's law, Stress-Strain diagrams for ferrous and non-ferrous materials, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint Venant's principle, Compound bars, Temperature stresses, Compound section subjected to temperature stresses, state of simple shear, Elastic constants and their relationship.

Module 2: Compound Stresses

Introduction, state of stress at a point, General two dimensional stress system, Principal stresses and principal planes. Mohr's circle of stresses.

Module 3: Shear Force and Bending Moments in Beams

Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations.

Module 4: Bending and Shear Stresses in Beams

Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections. Shear Centre (only concept)

Module 5: Columns and Struts:

Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns.

Module 6:Torsion in Circular Shaft:

Introduction, pure torsion, Assumptions, derivation of torsion equation for circular shafts, torsional rigidity and polar modulus Power transmitted by a shaft, combined bending and torsion.

Module 7: Theories of Failure:

Introduction, maximum principal stress theory (Rankine's theory), Maximum shearing stress theory (Tresca's theory), Strain energy theory (Beltrami and Haigh), and maximum strain theory (St. Venant's theory).

Text Books/ Reference Books:

1. Basavarajaiah, B.S. andMahadevappa,P., Strength of Materials in SI Units, University Press (India) Pvt. Ltd., 3rd Edition, 2010
2. Ferdinand, P., Beer, E., Russell, J. and Jr.John T. D., Mechanics of Materials, Tata McGraw-Hill, Third Edition, SI Units
3. Young,D.H., Timoshenko,S.P.,Elements of Strength of Materials, East West Press Pvt. Ltd., 5th Edition (Reprint 2014)
4. Bansal, R. K.,A Textbook of Strength of Materials, 4th Edition, Laxmi Publications, 2010
5. Rattan,S.S., Strength of Materials, McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013)
6. Vazirani, V. N, Ratwani M. M. and Duggal,S. K.,Analysis of Structures Vol. I, 17th Edition, Khanna Publishers, New Delhi.

Subject Name: Mine Development **Subject Code: BTCMNPCC301** **Subject Credit: 3**

Course Objectives:

- To study concept of exploration & development drilling, blasting and the technology employed.
- To learn the various modes of access and study the methods of designing the access.

Course Outcomes:

The students are expected to:

- enhance the technical knowledge on drivage of inclines, adits and shaft sinking
- possess ability to identify, formulate and solve engineering problems in drilling and shaft sinking.
- possess ability to use the techniques, skills and modern engineering tools necessary for mine development practice.
- work effectively as an individual and as a member of a multidisciplinary team.

Module 1: Opening up a deposit

Choice of mode of entry: adit, shaft, decline and combined mode, their applicability, number and disposition.

Module 2: Vertical and Inclined Shafts

Location, shape, size, and organisation of shaft sinking, construction of shaft collar, shaft fittings.

Module 3: Shaft Sinking Operations

Conventional methods of shaft sinking. Drilling, blasting, loading and hoisting of muck. Lining, ventilation, drainage and lighting. Sinking through loose, fractured, flowing and water bearing ground. Widening and deepening of shafts. Shaft boring.

Module 4: Explosives

Types of explosives and blasting agents. Detonators, fuses, delays and other accessories. Stemming materials. Testing of explosives. Storage and transport of explosives. Causes of accidents and safety precautions. Substitute of explosives.

Module 5: Type of Support

Various type of Support Materials, Supports- Prop, bar, cog, friction and hydraulic prop, girder.

Module 6: Primary and Secondary Development Drivages in Underground Mines

Drivage of drifts and main development headings. Conventional Methods. Drilling, Blasting, Loading and Transport of muck. Support, Ventilation, Drainage and Lighting. Special methods through loose, fractured, flowing and water bearing ground. High speed drivages.

Text Books/ Reference Books:

1. Hartman, H.L., Introduction to Mining Engineering, John Wiley and Sons, Second Edition, 1999.
2. Deshmukh,D.J., Elements of Mining Technology, Vol.I, VidyasevaPrakashan, Nagpur, 1994.
3. Chugh,C.P., Drilling Technology Hand Book, Oxford & IBH Publications, 1994.
4. Chugh,C.P. Diamond Drilling, Oxford & IBH Publishers, 1999.
5. Karnam,U.M.R., Principles of Rock Drilling, 1999.
6. Bhandari, S., Engineering rock blasting operations, A. A. Balkema, 1997.
7. Cummings, A.B. and Given, I, V., SME Mining Engg. Handbook Vol. I And II, Society ofMining Engineers of American Institute of Mining, Metallurgical, Petroleum Engineers Inc., New York 1992.
8. Universal Mining School - Lecture notes, Cardiff, U.K.

Subject Name: Introduction to Mining **Subject Code: BTCMNPCC302** **Subject Credit: 3**

Course Objectives:

- To introduce the field of mining and provide basic input about mining unit operations.
- To know the history of mining and describe the correlation between the development of mining and cultural progress.

Course Outcomes:

The students are expected to:

- enhance the technical knowledge on different modes of mining.
- possess ability to distinguish between resources and reserve.
- possess ability to use the techniques, skills and modern engineering tools necessary for different mode of mining practices.

Module 1: History and Contribution of Mining in Civilization

History of mining, contribution of mining to civilization and national economy. Roll of Mining Engineers in Industry.

Module 2: Introduction to Surface and Underground Mining Terms

Definition of common mining terms. Overview of unit operations in surface and underground mines.

Module 3: Classification of Mines and Mineral Deposit

Definition of different type of mines, classification; Mine life cycle; Mineral deposit –different types and their classification; Mineral resources of India.

Module 4: Mineral Resources and Reserve

Worldwide Resources and Reserve, Classification of Resources and Reserve. Resource and Reserve Calculation

Module 5: Overview of Surface Mining

Types of surface mines, unit operations, basic bench geometry, applicability & limitations and advantages & disadvantages.

Module 6: 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.

Text Books/ Reference Books:

1. Hartman, H.L., Introduction to Mining Engineering, John Wiley and Sons, Second Edition, 1999.
2. Deshmukh,D.J., Elements of Mining Technology, Vol.I, VidyasevaPrakashan, Nagpur,1994.

Subject Name: Mining Geology-I **Subject Code: BTCMNPCC303** **Subject Credit: 4**

Course Objectives:

To lay emphasis on the study of minerals, rocks and structures.

Course Outcomes:

At the end of the course, thestudents will have an understanding of the sciences of ores and minerals.

Module 1: Introduction to Geology

Geology in mining engineering: scope and applications – earth structure and composition– different studies of Geology.

Module 2: Stratigraphy

Geological time scale – mineral resource distributions and economic importance of Archean, Paleozoic, Mesozoic and Cenozoic rocks of India.

Module 3: Mineralogy

Classification of minerals – Physical properties of minerals – Properties of quartz, feldspar, pyroxene, amphibole, mica, olivine and garnet group of minerals and calcite.

Module 4: Petrology

Classification of rocks – Description of igneous, sedimentary and metamorphic rocks – forms and mode of occurrence of rocks – Engineering properties of rocks: field and laboratory tests.

Module 5: Physical Geology

Natural disintegration of rocks, weathering processes and grades – groundwater: origin, occurrence and exploration techniques.

Module 5: Structural Geology

Introduction to geological structures – folds, faults, joints and unconformities – classification, criteria for recognition in the field and significance in mineral exploration. Determination of strata thickness. Dip and strike calculations.

Text Books/ Reference Books:

1. Singh, P., Geology for Engineers, IBH Publications, N. Delhi. 1991.
2. Holemess, A., Principles of Physical Geology, Thomas Nelson and Sons, USA, 1964.
3. Ford, W. E., Dana's Textbook of Minerology (4th edition), Wiley Eastern Ltd., N. Delhi, 1989.
4. Winter, J. D., An Introduction to Igneous and Metamorphic Petrology, Prentice Hall, N. Delhi, 2001.
5. Billings, M. P., Structural Geology, Prentice Hall Ino., N. Jersey, USA, 1972.
6. Krishnan, M. S., Geology of India and Burma, 3rd Edition, IBH Publishers, N. Delhi, 1984.
7. Blyth, F. G. H. and de Freitas, M. H., Geology for Engineers, 7th edition, Elsevier Publications, 2006.
8. Bell, F. G., Engineering Geology, Elsevier Publications, 2007.
9. Mukherjee, P. K., A Text Book of Geology, The World Press Pvt. Ltd., 9th Edition, 1982.
10. Read, H. H., Rutley's Elements of Mineralogy, CBS Publishers and Distributors, 26th Edition, 1984
11. Marland, P. B., Structural Geology, Prentice Hall of India Pvt. Ltd., 3rd Edition, 1990.
12. Salisbury D. E. and. Ford, W. E., A Text Book of Mineralogy, Wiley Eastern Limited, 4th Edition, 1992.

Subject Name: Mining Geology-I Lab **Subject Code: BTCMNPCC303** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them identify minerals, rocks etc.

Laboratory Outcomes:

This lab curriculum gives understanding of difference between various rocks, minerals etc.

Module 1: Mineralogy

Identification of physical properties of quartz and feldspar varieties, hypersthene hornblends, augite, mica, asbestos, barite, calcite, fluorite, tourmaline, beryl. Study of Moh's scale of hardness.

Module 2: Petrology

Identification and description of igneous rocks – plutonic, hypabyssal and volcanic type of rocks: Sedimentary rocks – rudites, arenites, carbonates and argillites, metamorphic rocks – gneiss, marble, slate, schist, quartzite.

Module 3: Structural geology

Exercises on structural maps of geological site and interpretation of geological conditions; 3 point and 4 point bore hole problems to decipher the subsurface geological conditions for mining of resources.

Module 4: Geological Mapping Methods

Topo sheets, Map scale – types, preparation and interpretation of contour maps, drainage maps, symbols, rock and geological structures, use of clinometers, Brunton compass and knowledge on GPS.

Module 5: Geological Field Work

Geological mapping of igneous, sedimentary and metamorphic terrains. Identification of minerals and ores in the field site. Recognisition of geological structures – fault, fold joint in the field.

Subject Name: Environmental Science (Mandatory Course) **Subject Code: BTCMNMC301** **Subject Credit: Non-credit Course**

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two types of activities.

Awareness Activities:

i. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste.
ii. Slogan making event.
iii. Poster making event.
iv. Cycle rally.
v. Lectures from experts.

Actual Activities:

i. Plantation
ii. Gifting a tree to see its full growth
iii. Cleanliness drive
iv. Drive for segregation of waste
v. To live some big environmentalist for a week or so to understand his work
vi. To work in kitchen garden for mess
vii. To know about the different varieties of plants
viii. Shutting down the fans and ACs of the campus for an hour or so

Innovation

4th Semester

Subject Name: Underground Coal Mining **Subject Code: BTCMNPCC401** **Subject Credit: 3**

Course Objectives:

- Discuss the theories of coal, classification of coal, choice of coal mining method and distribution of coal in India.
- Explain the bord and pillar mining, depillaring by stowing method and caving method.
- Discuss the longwall mining of extraction of coal in underground mines.

Course Outcomes:

At the end of the course,the students are expected to:

- Enhance the technical knowledge on extraction of coal by bord & pillar mining and longwall mining.
- Possess ability to identify, formulate and solve the problems of extraction of coal from the underground mines.

Module 1: Introduction

History of coal mining; coal resource and their geographical distributions; Coalification and factors affecting coalification process, modes of accumulation of coal, evidences in support of in-situ and drift theories.

Module 2: Bord and Pillar Mining

Factors affecting Bord and Pillar Mining; General principles of Bord and Pillar (B&P) development; Semimechanised and mechanized schemes of B&P development and associated merits/demerits; Mechanised face loading; Conditions suitable for mechanical loaders and continuous miners.

Module 3: Pillar Extraction

Preparatory arrangement for depillaring operation; principles of designing pillar extraction, factors affecting choice of pillar extraction; partial and full extraction; depillaring with caving and stowing; mechanization in depillaring operation; Local and main fall, indications of roof weighting;

measures to bring down roof at regular interval; airblast and measures to minimize its effects; precautions during depillaring against fire and inundation.

Module 4: Longwall Mining

Factors affecting longwall mining, longwall face layouts, advancing and retreating faces, single versus double unit longwall faces, orientation of longwall faces; factors affecting length and width of longwall panel; Extraction of Longwall panel; working with shearer; support system of longwall face and gate roads.

Text/Reference Books:

1. Singh, T. N.,Underground winning of Coal, Oxford and IBH, New Delhi, 1992
2. Statham, I. C. F.,Coal Mining Practice, Caxton eastern agencies, Calcutta, Reprint, 1964
3. Das, S. K.,Modern Coal Mining Technology, Lovely Prakshan, Dhanbad, 1992
4. Singh, R. D.,Principles & Practices of Modern Coal Mining, New Age International, New Delhi, 1997
5. Peng,S. S. and Chiang, H. S.,Longwall Mining, John Willey and Sons, New York, 1992

Subject Name: Underground Metal Mining **Subject Code: BTCMNPCC402** **Subject Credit: 3**

Course Objectives:

- To introduce concepts of metal mining and metal mining terminology.
- To study development and operations of metal mines.
- To study about special methods of metal mining methods.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of metal mining for understanding metal mining problems.
- Acquire knowledge and hands-on competence in applying the concepts in the design and development of metal mine.
- Apply knowledge of metal mining for designing a metal mine.

Module 1: Introduction

Metal Mining Terminology; Typical modern metal mine features; typical pre stoping ore block constructional features; classification of methods; Techno economic characteristics impacting on choice of method; Typical unit cost parameters; optimum size of mine and stope.

Module 2: General Mine Design

Mode of mine and stope entry; Layouts; optimum production; Basic design – Level Intervals, ore pass, common ore pass, size of blocks ore handling in stope and other openings, overview of constructional features – X cuts, Raises, Winzes etc.

Module 3: Stoping- General Description

Unsupported methods – Room and pillar, shrinkage, sublevel stoping etc. Supported stopes – Cut and fill, square set etc. Caving methods – Top slicing, sublevel caving, block caving.

Module 3: Stope Planning and Layout

Preparing a stoping block; sequence of stoping; organization; production cycle; unit cost calculation; comparison of methods and costs.

Module 4: Novel Innovative Techniques and Special Applications

Rapid excavation; Hydraulic mining; slurry mining; solution mining; Radial – axial splitter; Thermal fragmentation; shock wave breaking; Nuclear mining. Deep mining; narrow contiguous veins; shaft and remnant pillars; VCR; Ring drilling; Large Blast hole stoping. Cast studies of Indian and foreign underground metal mines.

Text/Reference Books:

1. Cummings, A.B. and Given, I, V., SME Mining Engg. Handbook Vol. I And II, Society ofMining Engineers of American Institute of Mining, Metallurgical, Petroleum Engineers Inc., New York 1992.
2. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
3. Hustrulid, W.A. Ed., Underground Mining Methods Handbook Society of Mining Engineering, AMIE, New York, 1990.

Subject Name: Mine Ventilation **Subject Code: BTCMNPCC403** **Subject Credit: 3**

Course Objectives:

- Explain the origin, occurrence, effects and detection of various mine gases.
- Determine the quantity of air flow in mine roadways and mine ducts.
- Discuss the mine doors, regulators, stoppings, air crossing and air locks.
- Explain types of mine fans, their characteristics, suitability and selection of fans
- Explain ventilation survey in underground mines and computer application in mine ventilation.

Course Outcomes:

At the end of the course,the students are expected to:

- Enhance the technical knowledge on origin, occurrence, effects, and detection of various mine gases.
- Possess ability to identify, formulate and solve quantity of air flow in mine road ways, equivalent resistance of mines, types of fans in mines.
- Possess ability to use the techniques, skills and modern engineering tools necessary for mine ventilation in underground mines.

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.

Module 2: Heat and humidity

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

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.

Module 4: Natural ventilation

Causes; effect of depth, temperature, pressure, seasonal variationsetc; calculation of NVP from air densities.

Module 5: 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; Ventilation of deep mines.

Module 6: Ventilation planning

Classification of ventilation systems – central & boundary, homotropal & antitropal, ascending & descending; Ventilation layouts for mining of coal and ore deposits; Calculation of air quantity required for ventilating a mine; Calculation of total mine head; Network analysis principles and computer applications; Ventilation surveys

Text/Reference Books:

1. McPherson, M. J.,Subsurface Ventilation and Environmental Engineering, Chapman & Hall, 1993
2. Mishra, G. B.,Mine Environment and Ventilation, Oxford University Press, Fifth Impression, 1993
3. Hartman, H. L.,.Mutmansky, J. M., Ramani R. V. and Wang, Y. J.,Mine Ventilation and Air Conditioning, Wiley-interscience, 3rd Edition, 1997
4. Banerjee, S. P.,Mine Ventilation, Lovely Prakashan, 1st Edition, 2003
5. Vutukuri, V. S., Mine Environment Engineering, Trans Tech Publishers, 1986

Subject Name: Mine Survey-I **Subject Code: BTCMNPCC404** **Subject Credit: 4**

Course Objectives:

- Discuss the chain survey for linear measurements
- Explain the compass survey
- Discuss the plane table surveying and Miner's Dial
- Brief discussion on types of leveling instruments, temporary and temporary adjustment of leveling instruments, trigonometric leveling, reciprocal leveling.

Course Outcomes:

At the end of the course,the students are expected to:

- Enhance the technical knowledge on linear measurements by chain surveying & tape surveying, compass surveying and plane table surveying.
- Possess ability to identify, formulate, and solve engineering problems in leveling.
- Possess ability to use the techniques, skills and modern engineering tools necessary for mine surveying.

Module 1: Surveying

Definition, objective, classification and principles of surveying.

Module 2: Linear Measurement

Instruments for measuring distances; Chainsurveying – principle, field work, off-sets, booking and plotting, obstacles in taping.

Module 3: Angular Measurement

Bearing of lines; Whole circle bearing, Quadrant bearing, Magnetic bearing, True bearing, Azimuth, Forebearing, Back bearing; Rectangular coordinate system; Measurement of horizontal and vertical angles; Temporary and permanent adjustments;Theodolite traversing; Computation of co-ordinates; Adjustment of traverse; Temporary and permanentadjustments.

Module 4: Levelling

Definition & terminology; Levelling instruments types - tilting, auto set and digital levels;Levelling staves; Different types of levelling - differential, profile, cross-sectional and reciprocal levelling;Booking and reduction methods; Underground levelling; Temporary and permanent adjustments of levels.

Module 5: Contours

Concepts;Characteristics of contour; Contour Interval; Methods of contouring and uses ofcontours.

Module 6: Plane Table Surveying

Methods; Detail surveying and contouring using plane table and micro-opticalidade.

Module 7: Computation of areas and volumes

Text/Reference Books:

1. Punmia, B. C.,Surveying, Vol- I, II, III, Laxmi Publication, New Delhi, 12th Edition, 1990.
2. Kanetkar, T. P.,Surveying and Levelling, Vol I & II, United Book Corporation, Poona, 1991
3. Basak, N. N.,Surveying & Levelling, Tata McGraw Hill Education Private Limited, New Delhi, 2017
4. Roy, S. K.,Fundamentals of Surveying, Prentice Hall of India Pvt., New Delhi, Third Printing, 2004
5. Winniberg, F.,Metalliferous Mine Surveying, Mining Publications, London, 1966

Subject Name: Mining Geology–II **Subject Code: BTCMNPCC405** **Subject Credit: 4**

Course Objectives:

- Discuss the mode of occurrence, origin, distribution and industrial use of important metallic and non-metallic minerals.
- Explain the geophysical and geochemical prospecting.

Course Outcomes:

At the end of the course,the students are expected to:

- Possess ability to identify, formulate and solve the problems of economic minerals
- Possess ability to use the techniques, skills, and modern engineering tools necessary forgeophysical and geochemical prospecting.

Module 1: Economic Geology

Ore forming process, mineral deposits formed from magmatic, hydrothermal and volcanic process: mechanical concentration, oxidation and supergene enrichment.

Module 2: Economic Indian Mineral Deposit

Metallic, non-metallic deposits, study of graphite, copper, zinc, lead, gold, iron, manganese, radioactive minerals, asbestos, mica, gemstone-origin, mode of occurrence and distribution in India. Origin and occurrence of industrial minerals-ceramic, refractory, abrasive, glass and paint industry.

Module 3: Coal and Petroleum Geology

Origin, physical properties, processes, occurrence of coal and its types, petroleum deposits. Fossil fuel distribution is sedimentary basins of India.

Module 4: Geophysics

Geophysical prospecting methods – seismic, electrical, magnetic and gravity methods of mineral prospecting, Location of ore body, coal and petroleum reserves, subsurface litho-log and 3-D models.

Module 5: Remote Sensing and GIS

Introduction to aerial and satellite remote sensing, identification of photo recognition elements; applications of remote sensing and GIS in geological mapping and mineral exploration.

Text/Reference Books:

1. Singh,P., Geology for Engineers, IBH Publications, N. Delhi. 1991.
2. Holemess, A., Principles of Physical Geology, Thomas Nelson and Sons, USA, 1964.
3. Ford, W.E., Dana's Textbook of Minerology (4th edition), Wiley Eastern Ltd., N. Delhi, 1989.
4. Winter, J.D., An Introduction to Igneous and Metamorphic Petrology, Prentice Hall, N.Delhi, 2001.
5. Billings, M.P., Structural Geology, Prentice Hall Ino., N. Jersey, USA, 1972.
6. Krishnan M.S., Geology of India and Burma, 3rd Edition, IBH Publishers, N. Delhi, 1984.
7. Blyth, F.G.H. and de Freitas M.H., Geology for Engineers, 7th edition, Elsevier Publications,2006.
8. Bell F.G., Engineering Geology, Elsevier Publications, 2007.
9. Mukherjee, P. K.,*A Text Book of Geology*, The World Press Pvt. Ltd., 9th Edition, 1982.
10. Read, H. H.,*Rutley's Elements of Mineralogy*, CBS Publishers and Distributors, 26th Edition, 1984
11. Marland, P. B., *Structural Geology*, Prentice Hall of India Pvt. Ltd., 3rd Edition, 1990.
12. Salisbury D. E. and. Ford, W. E., *A Text Book of Mineralogy*, Wiley Eastern Limited, 4th Edition, 1992.

Subject Name: Mine Ventilation Lab **Subject Code: BTCMNPCC403** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different instrument used in underground mine for measuring different ventilation parameters.

Laboratory Outcomes:

This lab curriculum gives understanding of working principle of different ventilation measuring instruments.

1. Determination of relative humidity of air using Whirling Hygrometer and Assman Psychrometer.
2. Determination of cooling power of air using Kata Thermometer.
3. Determination of percentage of CO and CO2 by Multi Gas Detector.
4. Determination of Methane percentage by MSA D-6 Methanometer.
5. Study of the construction and working of Flame Safety Lamp.
6. Determination of Methane percentage by Flame Safety Lamp in a Gas Testing Chamber.
7. Measurement of Air Velocity using Vane Anemometer and Electronic Velometer.
8. Study of Pitot Static Tube & measurement of Air Velocity in a ventilation duct in combination with an Inclined Manometer.

Subject Name: Mine Survey-I Lab **Subject Code: BTCMNPCC404** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different basic instrument used in survey.

Laboratory Outcomes:

This lab curriculum gives understanding of working principle of different survey instruments.

1. Measurement of distance of a line using metric chain, engineering chain, metallic tape etc.
2. Fixing a closed traverse on the ground and measuring the length and bearing of the sides with tape and prismatic compass and calculating the included angles.
3. Establishment of difference in levels between points across a roadway and plotting of level section using rise and fall method.
4. Establishment of difference in levels between points across a roadway and plotting of level section using height of collimation method.
5. Contouring of a given area by method of gridding and plotting of the contour.
6. Carry out the plane table survey of an area using radiation, intersection, traversing and resection methods.
7. Determination of the area of an arbitrary two-dimensional shape using Digital Planimeter.

Subject Name: Mining Geology-II Lab **Subject Code: BTCMNPCC405** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different geological terms.

Laboratory Outcomes:

This lab curriculum gives understanding of different geological terms.

Module 1: Ore geology

Identification of ores of iron, manganese, lead, zinc, copper, chrome, aluminum, graphite, asbestos, ochres, corundum, kyanite, garnet, silimanite, vermiculite, mica, silica.

Module 2: Ore reserve estimation and applied geology

Ore reserve estimation – ore assaying reserve calculation. Determination of engineering properties of rocks, determination of porosity of rocks. Preparation of weathering profile, RMR, RQD.

Module 3: Remote sensing and Geophysics

Study of aerial photographs and satellite imageries. Preparation of geological and structural maps. Electrical resistivity survey, seismic survey – 2 and 3 layer problems. Preparation of panel diagrams.

Module 4: Geological Field Work

Geological mapping of igneous, sedimentary and metamorphic terrains. Identification of minerals and ores in the field site. Recognition of geological structures - fault, fold joint etc.in the field.

5th Semester

Subject Name: Surface Mining **Subject Code: BTCMNPCC501** **Subject Credit: 4**

Course Objectives:

- To develop an understanding of surface mining equipments and its operations in a surface mine.
- To achieve the ability to classify and select surface mining .methods.
- To understand the slope failures in a surface mine and study the concept of waste dump formations.

Course Outcomes:

At the end of the course,the students are expected to get a complete knowledge on layout, design and planning of opencast mines.

Module 1: Introduction to Surface Mining

Status of surface mining, types of surface mines, applicability and limitations, compilation of basic data, concept of stripping ratio, stripping economics, concept of ultimate pit limits, design of haul roads, elements of surface mine planning.

Module 2: Layout and Design of Surface Mines

Selection of site for box cut, selection of operating parameters like bench height, width, slope, etc., Working pit slope and ultimate pit slope, various modes of slope failures, factors influencing slope stability, development of opencast mine layouts, stripping methods using different machinery, Various layout problems and their solutions. Conversion of Underground mine to opencast mines.

Module 3: Ground Preparation Methods

Preparation of the site – Ripping, Drilling and Blasting; Types, operation, selection, applications and limitations of ground preparation equipment – Rippers, Dozers, Blast hole drills and rock breakers, Placer mining and hydrulicking. Economics of Drilling and blasting.

Module 4: Excavation System in Surface Mines

Selection criteria for excavation / loading and material transport equipment used in surface mines. Classification, construction, capacity, operation, productivity and application of different types of excavating / loading equipment used in surface mining projects - Shovels, Draglines, Front end loaders, Scrapers, Bucket wheel and bucket chain excavators, Surface miners. Problems of Deep open cast mining.

Module 5: Transport and Waste Dumps

Scope and application of different modes of transport system in surface mines – Trucks, Conveyors (shiftable and high-angle), Aerial ropeways, Rail transport and Pipeline transport systems. Scope and application of in-pit crushers in surface mines. Types of waste dump – internal and external; dump formation methods and corresponding equipment; Dump stability and stabilisation measures.

Text/Reference Books:

1. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990.
2. Hartman H.L., Introductory Mining Engineering, John Wiley and Sons, 2002.
3. Hartman, H.L. (Ed.), SME Mining Engg. Handbook Vol. I and II, Society for Mining, Metallurgy, and Exploration, Inc., Colorado, 1992.
4. Pfleider, E. P, Surface Mining, 1st Edition, New York, 1968.
5. Konya, C.J. and Walter, E.J., Surface Blast Design, New Jersey, 1990.
6. Rzhevsky V., Open pit Mining Operations, Mir Publications, 1971.
7. De, A, Heavy Earth Moving Machinery, Lovely Prakashan, Dhanbad, 2000.
8. Hustrulid, W. and Kuchta, M, Open Pit Mine Planning & Design, Vol. 1, Fundamentals,Balkema, Rotterdam, 1995.
9. Singh, R.D., Principles and Practices of Modern Coal Mining, New Age International (P)Ltd., Publishers, 1997.
10. Mishra G.B., Surface Mining, Dhanbad Publishers, Dhanbad, 1990.

Subject Name: Mining Machinery-I **Subject Code BTCMNPCC502** **Subject Credit: 3**

Course Objectives:

- To choose proper transportation system in underground mines depending on the geo-mining conditions of the mineral deposit.
- To learn the construction and working of various pumps.
- To understand the use of electricity in mines.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of mine machinery for understanding, formulating and solving transportation problems in underground mine.
- Acquire knowledge and hands-on competence in applying the concepts in the design and development of transportation systems.

Module 1: General Mining Machinery

Mechanical transmission of power in mining machinery, shafts, pulleys, gears, and gear/trains, belt drives, chain drives, couplings and clutches, brakes.

Module 2: Wire Ropes and Rope Haulages

Wire ropes – classification, construction, fields of application, rope capping and splicing; deterioration of rope in use and its prevention; testing of ropes, selection and maintenance, rope calculations.

Rail Track and tubs– gauge; layout, curves, turnouts and cross-over, track maintenance, main features of rolling stock like tubs, mine cars man riding cars and tipplers;

Types of rope haulages – merits, demerits and fields of application, constructional features, safety appliances and rope haulage calculations.

Module 3: Other Transport System

Locomotives – diesel, trolley-wire, battery locomotives, constructional features and safety devices and comparison of different types; underground and surface battery charging stations and safety measures, locomotive calculations; shuttle cars, underground trucks, load-haul dumps, SDL vehicles, aerial rope ways, gravity transport, principles of hydraulic& pneumatic transportation and their fields of application, electric layouts, man-riding systems.

Module 4: Compressors and Pumps

Generation, distribution and use of compressed air in mines, compressed air drills, mine pumps, pumping ranges, and fittings, elements of pipe line transportation.; Different types of drives, installation and maintenance of pumps and pipes in shafts and roadways, electrical layouts, various sources of water in mines, design of sumps. Hydraulics and mining machines: Power hydraulics, hydraulic circuits, actuators, hydraulic fluids, control of hydraulic power, cutting and mining machines for coal, surface coal/ore handling plant.

Module 5: Mine Electric Engineering

Distribution of electric power in mines, types of mine cables and their fields of applications, mining switch gears and their installation in hazardous atmosphere, flame proof enclosures, intrinsically safe circuits, (examples) safety aspects and signaling. Mine telephone system and latest development in mine communications.

Text/Reference Books:

1. Cummings, A. B. and Given, I. V., SME Mining Engg. Handbook, Vol. I and II, Society of Mining Engineers of American Institute of Mining, Metallurgical and Petroleum Engineers, INC, New York, 1992.
2. Cherkassky, B. M., Pumps, Fans, Compressors, MIR Publishers, 1980.
3. Deshmukh, D. J., Elements of Mining Technology, Vol. I, II & III, EMDEEE Publishers, Nagpur, 1979.
4. Alemgren, G., Kumar U. and Vagenas, N., Mine Mechanisation and Automation, A.A., Balkema Publication, 1993.
5. Walker, S. C., Mine Winding and Transport, Elsevier, 1988.

Subject Name: Mine Survey-II **Subject Code: BTCMNPCC503** **Subject Credit: 4**

Course Objectives:

- To choose proper method of correlation surveys for an underground mine.
- To measure the base line and perform triangulation survey.
- To perform various types of correlation survey.
- To determine the distance and elevation of any point with the help of photogrammetric survey and total station survey.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of surveying for understanding, formulating and solving surveying problems.
- Identify, analyze and solve surveying problems.
- Acquire knowledge and hands-on competence in applying the concepts in the development of minesurveying.

Module 1:Correlation Survey

Correlation of Surface and Underground mine workings; Methods of correlation – direct traversing in inclined shaft, correlation in vertical shaft – single and two shafts, Shaft depth measurement.

Module 2: Development Survey

Control of direction and gradient in drifts, tunnels, raises, winzes.

Module 3: Stope Survey

Purpose; Methods of survey in moderately and steeply inclined ore bodies, flat and vertical ore bodies/seams.

Module 4: Slope Monitoring in Opencast Mines

Geodetic and Remote Sensing Methods, Slope Stability Radars.

Module 5: Mine Plan

Preparation of mine plans and sections; Duties and responsibilities of mine surveyor under mines act and connected legislations.

Module 6: Total Station

Principle of electronic measurement of distance and angles; construction and working withTotal Station; Errors; Application and recent developments in Total Station.

Module 7: Modern Surveying Methods

Application of Remote sensing and Photogrammetry in mining; GPS; DGPS; GIS; DTM; Applicability and limitations.

Module 8: Miscellaneous Survey Applications

Dip/ Strike/ Fault interpretation from inclined angle vertical borehole data in dipping and plunging formations; interpretations of borehole maps; borehole deviation; calculation of plunge in folded terrain.

Text/Reference Books:

1. Punmia, B. C.,Surveying, Vol- I, II, III, Laxmi Publication, New Delhi, 12th Edition, 1990.
2. Kanetkar, T. P.,Surveying and Levelling, Vol I & II, United Book Corporation, Poona, 1991
3. Basak, N. N.,Surveying & Levelling, Tata McGraw Hill Education Private Limited, New Delhi, 2017
4. Roy, S. K.,Fundamentals of Surveying, Prentice Hall of India Pvt., New Delhi, Third Printing, 2004
5. Winniberg, F.,Metalliferous Mine Surveying, Mining Publications, London, 1966

Subject Name: Rock Mechanics **Subject Code: BTCMNPCC504** **Subject Credit: 4**

Course Objectives:

- To learn various physico-mechanical properties of rock and the rock mass classification.
- To determine the RMR of any mine
- To measure the insitu stress in the underground mines.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of rock mechanics for understanding, formulating and solving strata control problem in any underground mine.
- Identify, analyze and solve rock mechanics problems.
- Acquire knowledge and hands-on competence in applying the concepts in the development of rock mechanics.

Module 1: Introduction

Definition, history, inherent complexities, source of information and field of application of rock mechanics**.**

Module 2: Rockmass Classification System

Classification of rock mass; Importance of rock mass classification; Parameters of rock mass classification; RQD; RMR; Q –system.

Module 3: Physico-mechanical properties of rock

Specific gravity; hardness; porosity; permeability; moisture content; thermal conductivity; compressive, tensile and shear strengths; Modulus of elasticity; Poisson's ratio and triaxial strength; swell index; slake durability index; point load index; Protodyakonov index.

Module 4: Time dependent properties of rock

Rheological properties of rock; Importance of rheological models; Different types of rheological models; Dynamic properties of rocks; Anisotropy and Creep.

Module 5: Concept of stress and strain in rock

Stresses in two and three dimensions;Principal stress and Principal plane; Analytical method of determining the magnitudes and directions of normal and shear stress on failure plane; Mohr's circle.

Module 6: Theories of failure of rock

Griffith Theory; Mohr-Coulomb Theory; Hoek and Brown Theory; Empirical theories of failure of rock.

Module 7: Pre-mining state of stress

Sources; Measurements of in situ stress by Flat jack, Overcoring and Hydraulic fracturing technique.

Text/Reference Books:

1. Deb,D. and Verma, A. K.,Fundamental and Application of Rock Mechanics, PHI Learning, 2016
2. Verma, B. S.,The Elements of Mechanics of Mining Ground (Vol I & II), Tuhin& Co., Lucknow, India, 1981
3. Goodman, R. E.,Introduction to Rock Mechanics, John Wiley and Sons, 1980
4. VutukuriV. S. and Katsuyama, K.,Introduction to Rock Mechanics, Industrial Publishing & Consulting Inc., Tokyo, 1994
5. Brady B. H. G. and Brown, E. T.,Rock Mechanics for Underground Mining, George Allen and Unwin Ltd., 1992
6. JeagerJ. C. and. Cook, N. G. W., Fundamentals of Rock Mechanics, Chapman and Hall, 1979
7. Hudson J. A.and. Harrison, J. P., Engineering Rock Mechanics, Pergamon Press, UK, 2000

Subject Name: Elective-I (Drilling and Blasting) **Subject Code: BTCMNPEC501A** **Subject Credit: 3**

Course Objectives:

- Discuss the various drilling machines used for exploratory drilling and production drilling.
- Explain different Explosives, Accessories and Tools and their use in blasting operation.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of drilling and blasting for understanding, formulating and solving fragmentation problem in mine.
- Identify, analyze and solve different blasting related problems.

Module 1: Exploratory Drilling

Drilling for exploration and other purposes; various types of drilling equipment – their merits, demerits and limitations; core recovery –single and double tube core barrels, wire line drilling; directional drilling, fishing tools; borehole surveying; borehole logging; novel and special drilling techniques. Drilling for oil and ground water.

Module 2: Production Drilling

Production drilling; Various methods of drilling - percussive, rotary, rotary percussive, Factors affecting drilling; mechanics of drilling; drillability and drilling index; micro-bit drilling; selection of drilling equipment; different types of bit, bit wear; drill hole economics; case studies.

Module 3: Explosives, Accessories and Tools

Explosives and Blasting Agents- ANFO, slurry, emulsion, LOX, permitted explosives, bulk explosives; Selection of explosives; Blasting accessories, Initiation systems, Testing of explosives; Storage, transportation and handling of explosives; Destruction of explosives and accessories. Theories of rock breakage; mechanics of rock fragmentation by explosive action, Instrumentation in blasting –V.O. D probe, vibration monitoring, high speed video camera, etc.

Module 4: Blasting in Underground Mines

Design of blast for coal and metal underground mines – gallery, Solid blasting techniques, periphery blasting, drilling pattern for tunneling and shaft sinking, controlled blasting techniques, dangers associated with underground blasting and preventive measures; misfires, blown out shots, incomplete detonation – their causes and remedial measures.

Module 5: Blasting in Surface Mines and Allied Engineering Field

Methods of blasting in surface mines, Blast design, Primary and secondary blasting, Rock fragmentation studies, Dangers associated with blasting in opencast mines and preventive measures, Environmental impacts due to blasting, Controlled blasting techniques, Blasting in opencast coal mines of developed galleries, Blasting economics, Computer aided design of blasts. Blasting for road constructions, trench cutting, demolition of buildings etc; Blasting for Dimensional stones; Underwater blasting. Alternatives to blasting.

Text/Reference Books:

1. Das, S. K., Explosives and Blasting Technique (Revised Enlarged Edition), Lovely Prakashan.
2. Pradhan, G. K., Explosive and Blasting Tech., Lovely Prakashan, 2018.

Subject Name: Elective-I (Mineral Exploration) **Subject Code: BTCMNPEC501B** **Subject Credit: 3**

Course Objectives:

- Discuss the various procedure used in mineral prospecting and exploration and their strategies.

Course Outcomes:

At the end of the course,the students are expected to prepare pre-feasibility and feasibility reports to start a mine.

Module 1: Mineral Resources and Prospecting

Introduction to important mineral resources in India and world wide, surface and aerial prospecting, reconnaissance, application of geochemical, geophysical and geostatistical methods

Module 2: Exploration

Preliminary and detailed exploration by boring, exploratory mining by shafts, drifts, cross-cuts, collection and compilation of data for computer processing.

Module 3: Exploration Strategies

Exploration investment decision, exploration techniques and strategies, exploration targets.

Module 4: Exploration Groups and their Role

Strategy and structure of the exploration group, government policies, aspects of exploration, role of exploration in the mining company.

Module 5: Preparation and Evaluation of Project Report

Evaluation of exploration and development projects, study of typical pre-feasibility andfeasibility reports.

Text/Reference Books:

1. Bhattacharjee, S., Frontiers in Exploration Geophysics, Oxford and IBH Publishing Company, 1992.
2. Ghosh, A. K., Strategies for Exploitation of Mineral Resources in developing countries, Oxford & IBH Publishing Company, 1992.

Subject Name: Elective-I (Nano Materials) **Subject Code:BTCMNPEC501C** **Subject Credit: 3**

Course Objectives:

- To recognize the differences between nanomaterials and conventional materials and to become familiar with a wide range of nanomaterials, their synthesis, characterization, properties and applications.

Course Outcomes:

At the end of the course,the students are expected to:

- Indicate the differences between nanomaterials and conventional materials.
- Indicate how specific synthesis techniques can result in nanomaterials.
- Give examples of specific nanomaterials and explain the scientific reasons for the properties displayed by them.
- Describe how specific characterization techniques can be used to analyze nanomaterials.

Module 1:

History of nanomaterials

Module 2:

Discussion of the Feynman talk "There is plenty of room at the bottom"

Module 3:

Synthesis routes for nano and ultra fine grained materials: bottom up and top down approaches.

Module 4:

Specific synthesis routes such as vapor deposition, sol-gel, rapid solidification processing, high energy ball milling, cryo rolling, and equal channel angular extrusion.

Module 5:

Thermodynamics of nanomaterials.

Module 6:

Mechanical property aspects of nanomaterials, inverse Hall-Petch relationship

Module 7:

Specific nano materials and their applications such as:

Carbon nanostructures (Nanotubes, nanohorns, graphene, buckyballsetc), Semiconducting nanomaterials – Quantum confinement, Quantum wells, quantum wires and quantum dots, Magnetic nanomaterials – super paramagnetism, Ferroelectric, nano ceramics, Superplasticity, Nanocomposites.

Module 8:

Characterization techniques from the perspective of nanomaterials

Text/Reference Books:

1. Poole, C. P. and Owens, F. J., Introduction to Nanotechnology, Wiley Interscience, 2003.

Subject Name: Mining Machinery-I Lab **Subject Code: BTCMNPCC502** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different machineries used in mines.

Laboratory Outcomes:

This lab curriculum gives understanding of working principle of different machineries used in mines.

1. Study of construction of different types of wire ropes and Types of rope chapels used for rope haulages & winding, safety hooks used in winding.
2. Construction and operation of compressed air operated drills.
3. Study of different types of haulage systems – tensioning arrangement in endless haulage and different types of haulage clips and other means of attachment of tubs to the rope.
4. Study of safety devices provided of haulage roads and locomotives - Exhaust conditioning and flame traps & underground Battery charging station layout.
5. Electrical power distribution in mines, electrical layout for rope haulages and pumps, Electrical and hydraulic layouts for longwall faces.
6. Study of aerial rope ways – driving/tensioning/loading/unloading and angle stations.
7. Study of various types of head gear-fleet angle, Study of shaft fittings-signal systems, guides, safety dogs and protective roofing, study of guides– methods of support and tensioning arrangements.

Subject Name: Mine Survey-II Lab **Subject Code: BTCMNPCC503** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different advanced instrument used in survey.

Laboratory Outcomes:

This lab curriculum gives understanding of working principle of different advanced survey instruments.

1. Handling Digital Theodolite and traverse surveying in field using Digital Theodolite.
2. Handling Total Station and detailed surveyingin field using Total Station.
3. Handling Hand Held GPS and detailed surveyingin field using Hand Held GPS.
4. Handling RTK DGPS Systems and detailed surveyingin field using RTK DGPS Systems.

Subject Name: Rock Mechanics Lab **Subject Code: BTCMNPCC504** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different procedure of rock testing.

Laboratory Outcomes:

This lab curriculum gives understanding of the weatherability and load bearing capacity of rocks.

1. Determination of slake durability strength index of rock sample by ISRM standard method.
2. Determination of point load strength index of rock sample by ISRM standard method.
3. Determination of Protodyakonov strength index of rock sample by ISRM standard method.
4. Determination of Uniaxial Compressive strength of rock sample by ISRM standard method.
5. Determination of Tensile strength of rock sample by Brazilian method.
6. Determination of Shear strength of rock sample by ISRM standard method.
7. Determination of Tri-axial strength of rock sample by ISRM standard method.

6th Semester

Subject Name: Mining Machinery-II **Subject Code: BTCMNPCC601** **Subject Credit: 3**

Course Objectives:

- To learn applicability conditions, workings and constructional features of various mine machinery used inunderground mine.
- To be able to select suitable winning machine for mineral deposit of different geo mining conditions.
- To be able to understand the compressor and its working.
- To calculate and analyze basic element of haulage system and winding system.
- To learn the construction and working of various haulage system and winding system.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of mine machinery for understanding, selecting and solving mine machinery problem inany underground mine.
- Acquire knowledge and hands-on competence in applying the concepts in the development of suitablemachinery.

Module 1: Winding Engines

Winding systems, drum winders, drives, mechanical braking of winders, safety devices in winding, over wind and over speed protection, Koepe and multi-rope friction winding, electrical layouts. Duty cycles of drum winders of different drum cross sections. Special problems of deep shaft winding.

Module 2: Winding Accessories

Head gear and their design, head sheave, cages and skips, suspension gear, shaft fittings and appliances – guides, keps, etc., signaling system, winding calculations relating to rope size & numbers, capacity & power requirement for cage, skip, drum and Koepe winding systems.

Module 3: Surface and Pit Bottom Layouts

Mine car circuits at the surface and pit bottom, creepers, skip winding – loading and discharge arrangements.

Module 4: Coal Face Machinery

Construction, salient mechanical and electrical features and operations of coal drills and their control panels, coal cutters, different types of mechanical loaders coal ploughs, cutter loaders and continuous miners; development road headers in face mechanization, long wall mining equipment, electrical and hydraulic layouts; condition monitoring of mining machinery for underground and opencast miens and ore handling plants, modern concepts in underground mine mechanization.

Module 5: Face Haulage and Conveyors

Scraper chain conveyors, AFCs, belt conveyors, shaking and vibrating conveyors, armored flexible conveyors, high angle conveying, electrical layouts.

Text/Reference Books:

1. Cummings, A.B. and Given, I.V., SME Mining Engg. Handbook,Vol .I and II, Society of Mining Engineers of American Institute of Mining, Metallurgical and Petroleum Engineers, INC, New York, 1992.
2. Mason, E., Coal Mining Series, Surveying, Vol I and II Virtue and Company Limited, London, 1985.
3. Cherkassky, B.M., Pumps, Fans, Compressors, MIR Publishers, 1980.
4. Deshmukh, D.J., Elements of Mining Technology, Vol. I, II & III, EMDEEE Publishers, Nagpur, 1979.
5. Alemgren, G., Kumar U. and Vagenas, N., Mine Mechanisation and Automation, A.A., Balkema Publication, 1993.
6. Walker, S.C., Mine Winding and Transport, Elsevier, 1988.

Subject Name: Mine Planning and Design **Subject Code: BTCMNPCC602** **Subject Credit: 3**

Course Objectives:

To learn different procedure of planning to start underground and surface mine.

Course Outcomes:

At the end of the course,the students are expected to apply knowledge of mine planning to start a mine from initial level.

Module 1: Introduction

Technical factors in mine planning, methodology of mine planning, short range & long range, mine modelling, mine simulation systems approach to mine planning based on mine subsystem and their elements, mine plan generation.

Module 2: Opencast Mine Planning

Selection of initial mine cuts, location of surface structures, division of mining area into blocks, mine design, bench drainage, geometry, haul roads, slope stability; open pit limits and optimization, calendar plan, production planning, production scheduling, economic productivity indices.

Module 3: Underground Mine Planning

Location of mine entries, mine and auxiliary, optimisation of mine parameters, design of shaft pillars and protective pillars, planning of production capacity, layout of development drives / raises / winzes etc, length of faces, size of panels, etc, planning of support systems, ventilation, lay out of drainage system, planning production schedule and monitoring, selection of depillaring / stoping method, manpower management economic/ productivity indices, technoeconomic analysis, mine reclamation design.

Module 4: Equipment Planning

Latest technological developments in increase in both types and capacities of equipment used in mining operations. Planning and selection of equipment for different mining conditions. Equipment design for optimum drilling and blasting operations. Equipment information – performance monitoring and expert systems, Innovative mining systems.

Module 5: Project Implementation and Monitoring

Pre-project activities – feasibility report, environment clearance, detailed project, report, sources of funds, import of technology, selection of contracts and contract administration, time management, cost control material management system, project quality assurance, social responsibility, government orders and guidelines. Environmental impact assessment and preparation of environmental management plan. Mine closure plan.

Text/Reference Books:

1. Bhattacharya, J., Principles of Mine Planning-Allied Publishers, Delhi 2003.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open pit Mine Planning and Design, Elsevier, 1995.
3. Ehrenburger, V. and Fajkos, A., Mining Modelling, Elsevier, 1995.
4. Bawden, W.F. and Archibald., J.F., Innovative Mine Design for the 21st Century Elsevier, 1993.
5. Passamehtoglu, A.G., Karpuz, C., Eskikaya, S. and Hizal, T., (Eds), Mine Planning and Equipment Selection, Elsevier, 1994.
6. Pazdziora, J., Design of Underground Hard Coal Mines, Elsevier, 1988.
7. Swilski and Richards, Underground Hard Coal Mines, Elsevier, 1986.
8. Singh, B. and Pal Roy, P., Blasting in Underground excavations and mines, CMRS Dhanbad, 1993.
9. Raj, K Singhal (Ed.), Mine Planning & Equipment Selection, A.A., Balkema, 1988.
10. Peng, S.S. and Chaing, H.S., Longwall Mining, John Wiley & Sons, New York, 1984.
11. Rzhevsky, V.V., Opencast Mining – Technology and Integrated Mechanisation, MIR Publishers, Moscow, 1987.
12. Rzhevsky, V.V., Opencast Mining – Unit Operations, MIR Publishers, Moscow, 1987.

Subject Name: Ground Control **Subject Code: BTCMNPCC603** **Subject Credit: 3**

Course Objectives:

- To understand characteristics of various materials used as supporting material.
- To be able to select and design suitable support for any underground mine.
- To measure the subsidence for any underground mines.
- To understand the ground movement and its controlling techniques.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of ground control for understanding, formulating and solving ground control problem in any underground mine.
- Identify, analyze and solve strata movement problems.
- Acquire knowledge and hands-on competence in applying the concepts in the development of ground control.

Module 1:Supports

Timber & steel supports; Examination of roof; Roof bolting; Roof stitching; Cable bolting; Shotcreting; Method of supporting roadways; Supporting under different conditions viz. Pit bottom, crossing, junctions, faulted area, longwall faces, depillaringareas and stoping areas; Support loads; SSR; Support withdrawal.

Module 2: Powered Supports

Frame support, Chock support, Shield support & Chock Shieldsupport: Classification; Constructional features; merits demerits and applications; Hydraulic fluids; PowerPack.

Module 3: Stowing

Principal methods of stowing: Hydraulic stowing, Pneumatic stowing,Mechanical stowing, Hand packing; Relative merits, demerits and applicability; Face arrangements; Pipe wear; Pipe jams; Hydraulic gradient.

Module4: Strata Control

Theories of ground movement; Stress distribution around narrow and wide openings; Front abutment and back abutment; Failure of roof and floor; Measurement of strata movement; Causes and preventive measures against Rock burst, Bumps and Gas outbursts.

Module5: Subsidence

Theories of subsidence; Types of subsidence; Damage and loss due to subsidence; Vertical and lateral movements and their estimation; Angle of fracture and angle of draw; Sub-critical, critical and super-critical widths of extraction; Factors affecting subsidence; Subsidence control; Protection of surface structures; Design of protective pillars including shaft pillars; Pot holes.

Module6: Slopes

Types of slope failure; Factors affecting slope stability; Drainage and reinforcement of slopes; Monitoring of slopes; Stability of waste dump.

Text/Reference Books:

1. Singh, T. N.,Underground Winning of Coal, Oxford and IBH New Delhi, 1992.
2. Deshmukh R. T. and Deshmukh, D. J.,Winning and Working Coal in India (Vol. I & II), IsMAG co-operative stores, Dhanbad, 1963.
3. Jeremic, M. L.,Strata Mechanics in Coal Mining, Taylor and Francis, 1985.
4. Bieniawski, T.,Strata Control in Mineral Engineering, New York: John Wiley & Sons, 1987.
5. Peng,S. S. and Chiang, H. S.,Longwall Mining, Wiley-Blackwell, New York, 1984.

Subject Name: Mineral Economics **Subject Code: BTCMNPCC604** **Subject Credit: 3**

Course Objectives:

- To choose proper method of sampling for different ore bodies and mineral heaps.
- To estimate grade and reserves.
- To choose proper method of mine valuation for valuation of any mine and also able to determine the NPV of any mine.
- To perform various financial management aspects related with the mine.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of mine economics for understanding, formulating and solving problems related with the mine economics.
- Identify, analyze and solve financial management problems.
- Acquire knowledge and hands-on competence in applying the concepts of management in the development of mine economics.

Module 1: Introduction

Mineral industry and its role in national economy; World and national mineral resources; Mining - A unique investment environment; special risk factors in mine investment and evaluation; National mineral policy.

Module 2: Ore Reserve Estimation

Methods of sampling; Sampling frequency; Analysis of sampling data; Estimation of reserves; Introduction to geo-statistical methods; Classification of reserves.

Module 3: Mine Valuation

Time value of money; annuity; redemption of capital; net present value; depletion allowance; depreciation; inflation; escalation; rates of return; Hoskold's Two rate method; capital and operating cost including wages, incentives, material, etc.; assets; liabilities; cash flows and discounted cash flow; profitability index – their implications in mine economic evaluation.

Module 4: Project Appraisal

Methods of project evaluation – pay back, annual value, benefit/cost ratio, ERR and IRR etc.; Evaluation of exploratory mining areas and operating mines; Mine project financing, its risks and constraints; Mine taxation; Critical impact of depreciation, depletion, type of funding, reserves, life etc. on mine profitability.

Module 5: Finance and Accounting

Sources of mine funds – shares, debentures, fixed deposit, sinking fund, capital gearing, P &L account, balance sheet; Typical case studies of mine feasibility; Cost estimation of individualmining operations and overall mining cost; Cost control methods.

Text/Reference Books:

1. Deshmukh, R. T.,Mineral and Mine Economics, Mira Publication., Nagpur, 1986
2. Sinha R. K. and Sharma, N. L.,Mineral Economics, Oxford & IBH Pub., 3rd ed, 1970
3. Ray S. C. andSinha, I. N., Mine and Mineral Economics, PHI Learning, 2016
4. Arogyaswamy, R. N. P.,Courses in Mining Geology, Oxford and IBH Pub., 2nd ed, 1973
5. Khanna, O. P.,Industrial Engineering and Management, Dhanpat Rai Delhi, 1993
6. Krishnaswamy, S.,India's Mineral Resources, Oxford & IBH pub., 2nd ed, 1972
7. Jain, P. K.,Financial Management, Tata McGraw Hill, 1981

Subject Name: Elective-II (Bulk Solid Handling) **Subject Code: BTCMNPEC601A** **Subject Credit: 3**

Course Objectives:

- To choose proper method of handling of bulk materials.
- To get knowledge about different types of belt conveyor system.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of Bulk Solid Handling for designing of transportation system in mine.

Module 1: Bulk Material Handling Systems

Basic principles in material handling exclusive to mining industry and its benefits. Classification of material handling equipments. Current state of art of bulk handling materials in mining in the world and Indian scenario; Selection of suitable types of systems for application. Stacking, blending, reclaiming and wagon loading, machinery and systems used at the stack yards; stock piles, silos, bunkers – their design, reclamation from them, various types of weigh bridges. Segregation - size wise and grade wise, Railway sidings.

Module 2: Short Conveyors and Haulage Systems

Roller conveyor, overhead conveyor, screw conveyor, auger conveyor, apron feeder, bucket elevators, scraper haulage, conveyors in steep gradient, Armoured face conveyor, Off-highway Trucks, haul roads, In-pit crushers and modular conveyors, electric trolley assisted haulage, shuttle cars, skip hoist, winders, LHD's, pneumatic conveying, hydraulic transport.

Module 3: Belt Conveyor System

Design, capacity, calculations with respect to the size, speed, troughing, power requirement, tension requirement, belt selection, factor of safety; developments in the design, of various components of belt conveyor systems such as; structures, rollers, gear boxes and motors, drums and pulleys, belting, ancillary components and safety gadgets.

Module 4: New Types of Belt Conveyor System

Curved conveyors, cable belts, pipe conveyors, rock belts – mine-run-rock conveyor, steel belt conveyors, steel slot conveyor, chain belt conveyors, etc., and other new developments, stackers and reclaimers, High Angle Conveyors (HAC); New inventions in HAC , Mobile or fixed installations; Woven wire belts, End Masse conveyor, Vibrating conveyor, gravity bucket conveyor.

Module 5: Material Handling in Mines, Plants and Workshops

Mobile cranes, derrick cranes, pillar cranes, tower cranes, radial cranes, bridge cranes, fork lifters, over head gantry material handling in workshops. Mineral handling in dimensional stone quarries, Mineral handling plants(coal, etc.) Locomotives, rail tracks, rail cars, railways wagons; Aerial ropeways, gravity ropeways; Containers and shipping; Rope haulage - different types.

Text/Reference Books:

1. Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors, Delhi, 1987.
2. Hustrulid, W. and Kuchta, M., Open Pit Mine Planning & Design, Vol. 1, Fundamentals, Balkema, Rotterdam, 1998.
3. Peng, S. S. and Chiang, H.S., Longwall Mining, John Wiley and Sons, New York, 1984.
4. Hartman, H.L., (Ed.), SME Mining Engg. Handbook Vol.I and II, Society for Mining, Metallurgy and Exploration, Inc., Colorado, 1992.
5. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990.
6. Deshmukh, D.J., Elements of Mining Technology, Vol.I, II and III, EMDEE Publishers, Nagpur, 1979.
7. Vorobjev, B.M. and Deshmukh, R.T., Advanced coal Mining, Vol.I and II, Mrs Kusum Deshmukh, P.O. Indian School of Mines, 1966.
8. Woodruff, S.D., Methods of Mining, Working, Coal and Metal Mines, Vol.II and III, Pergamon Press, 1968.
9. Sinclair, J., Winding and Transport in Mines, Sir Isaac Pitman and Sons, Ltd., London, 1959.

Subject Name: Elective-II (Material Management) **Subject Code: BTCMNPEC602B** **Subject Credit: 3**

Course Objectives:

- To get acquainted with different terminologies of material management.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of material management for understanding, formulating and solving problems related with management of materials.

Module 1: Introduction

Introduction to material management, importance of integrated materials management, need

for integrated materials management concept, definition, scope and advantage – an overview, A-B-C analysis, codification, variety reduction, standardisation.

Module 2: Purchasing Management

Material planning and purchase, purchase system, procedures, price forecasting, purchasing of capital equipment, vendor development, account procedure, purchasing decisions, procurement policies.

Module 3: Ware Housing and Store Management

Store keeping principles – past and latest techniques, stores-general layout, cost aspect and productivity, problems and development, store system procedures incoming material control, store accounting and stock incoming material control, store accounting and stock verification, value analysis

Module 4: Inventory Management

Introduction, basic models, definition of commonly used terms, replenishment model, choice of systems, etc. inventory work in progress, safety stock, computerisation in materials management control, information to materials management case study, spare parts

management.

Module 5: Material Procurement Procedure

Arbitration Act – Octroi, central and local sales tax, excise duties – customs tariff, import control policies, procurement from govt. agencies and international market – insurance, DGS and D tariff.

Text/Reference Books:

1. Gopalakrishnan, P. and Sundaresan, M., Material Management-An Integrated Approach, Prentice Hall of India Pvt. Ltd., New Delhi, 1982.
2. Datta, A.K., Materials Management Procedure, Test and Cases, Prentice Hall of India Pvt Ltd., New Delhi, 1984.
3. Peckam, H.H., Effective Materials Management, Prentice Hall of India Pvt Ltd., 1984.
4. Prichard, J. W. and Eagle, R. H., Modern Inventory Management, N.Y., Wiley and Breach Science Publishers, 1972.

Subject Name: Elective-III (Sensors and Transducer) **Subject Code: BTCMNPEC602A** **Subject Credit: 3**

Course Objectives:

- To get acquainted with the working principle of different sensors and transducers.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of Sensors and Transducer for understanding, formulating and solving problems related to them.

Module 1: Introduction

Definition, principle of sensing & transduction, classification

Module 2: Mechanical and Electromechanical sensor

Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity.

Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes.

Inductive sensor: common types- Reluctance change type, Mutual inductance change type, transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis.

LVDT: Construction, material, output input relationship, I/O curve, discussion.

Proximity sensor.

Capacitive sensors: variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity.

Stretched diaphragm type: microphone, response characteristics.

Piezoelectric element: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors.

Module 3: Thermal sensors

Material expansion type: solid, liquid, gas & vapor

Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification.

Thermoemf sensor: types, thermoelectric power, general consideration.

Junction semiconductor type IC and PTAT type.

Radiation sensors: types, characteristics and comparison.

Pyroelectric type 2 3 1 2 2 1

Module 4: Magnetic sensors

Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics.

Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive celltypes, materials, construction, response.

Geiger counters, Scintillation detectors.

Introduction to smart sensors

Text/Reference Books:

1. Patranabis, D.,Sensor &Transducers, 2nd edition, PHI
2. Neubert, H.K.P.,Instrument Transducers, Oxford University press.
3. Doebelin, E. A.,Measurement Systems: Application & Design, McGraw Hill.

Subject Name: Elective-III (Instrumentation Engineering) **Subject Code: BTCMNPEC602B** **Subject Credit: 3**

Course Objectives:

- To get acquainted with the working principle of different instruments.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of Instrumentation Engineering for understanding, formulating and solving problems related with different instruments.

Module 1: Electronic Instruments

CRO- Storage oscilloscope – Digital voltage meter (DVM) –Digital multi meter – XY Recorder, Strip chart recorder – Digital recording- Data logger – Introduction to virtual instrumentation.

Module 2: Pressure Measurement

Unit of Pressure – Manometers- Different types, - Elastic type pressure gauges – Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and strain gauge – Capacitive type pressure gauge – Measurement of vacuum – McLeod gauge – Thermal conductivity gauge – Ionisation gauge.

Module 3: Flow Measurement

Flow meters – Variable head type flow meter – Orifice plate – Venture tube – Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flow meter – Rota meter – Mass flow meters.

Module 4: Vibration, Viscosity, Humidity, Level Measurement

Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer – Vibrometers – Viscosity – Saybolt viscometer. Humidity – Hot wire electro type hygro meter – Dew cell – Electrolysis type hygrometer.

Module 5: Analyzer

Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyser – Sodium 56 analyser – Silica analyser – Turbidity meter – Gas analyser – NOx analyser – H2S analyser – CO and CO2 monitor, Dust & Smoke measurement.

Text/Reference Books:

1. Morrris,A. S.,Principles of Measurement and Instrumentation, Print ice-Hall of India Pvt., Ltd. New Delhi, 1999.
2. Doeblin,E. O.,Measurement Systems Application & Design, Tata McGraw Hill Publishing Co., New. Delhi, 1999
3. Murthy, D.V.S., Transducers and Instrument and Instrumentation, Prentice Hall of India Pvt. Ltd. New Delhi.
4. Patranabir, D. Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co., New Delhi 1999.
5. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishing, New Delhi, 1999.
6. Liptak B.G., Instrumentation Engineers Hand Book (Measurement), Chilton Book Co., 1994.

Subject Name: Mining Machinery-II Lab **Subject Code: BTCMNPCC601** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different machineries used in underground mines.

Laboratory Outcomes:

This lab curriculum gives understanding of the working principle of different machineries used in underground mines.

1. Study of fittings of winding engines- drums, brakes, and depth indicators.
2. Study of different types of conveyors like armoured face conveyors, belt conveyors, gate belt conveyors, shaker & vibrating conveyors, high angle conveyors
3. Study of coal drill and its electrical panel/gate end box
4. Study of coal ploughs and shearers
5. Study of continuous miners and road headers
6. Study of pit top & pit bottom layouts in shaft and incline under various conditions.
7. Study of different types of loading machines.

Subject Name: Mine Planning and Design Lab **Subject Code: BTCMNPCC602** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different mine planning software.

Laboratory Outcomes:

At the end of the course,the students are expected to apply knowledge of mine planning to design a mine.

Module 1: Geological Modelling of harder deposit using SURPAC

- Displaying the borehole trace using exploratory borehole data
- Digital Terrain Modelling
- Orebody Modelling
- Block Modelling
- Importing the block model into WHITTLE software for determination of ultimate pit

Module 2: Determination of Ultimate Pit using WHITTLE

- Determination of ultimate pit using the imported model from SURPAC
- Determination of nested pits using revenue factor
- Mine Scheduling

Module 3: Geological Modelling of softer deposit using MINEX

- Displaying the borehole trace using exploratory data
- Displaying the stratigraphy of softer deposit
- Displaying fault, fold and dyke in the deposit

Subject Name:Indian Constitution (Mandatory Course) **Subject Code:BTCMNMC601** **Subject Credit: Non-credit Course**

Constitution of India – Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India can notmake any law which violates the Fundamental Rights enumerated under the Part III ofthe Constitution. The Parliament of India has been empowered to amend theConstitution under Article 368, however, it cannot use this power to change the "basicstructure" of the constitution, which has been ruled and explained by the SupremeCourt of India in its historical judgments. The Constitution of India reflects the idea of"Constitutionalism" – a modern and progressive concept historically developed by thethinkers of "liberalism" – an ideology which has been recognized as one of the mostpopular political ideology and result of historical struggles against arbitrary use ofsovereign power by state. The historic revolutions in France, England, America andparticularly European Renaissance and Reformation movement have resulted intoprogressive legal reforms in the form of "constitutionalism" in many countries. TheConstitution of India was made by borrowing models and principles from manycountries including United Kingdom and America.The Constitution of India is not only a legal document but it also reflects social,political and economic perspectives of the Indian Society. It reflects India's legacy of"diversity". It has been said that Indian constitution reflects ideals of its freedommovement, however, few critics have argued that it does not truly incorporate our ownancient legal heritage and cultural values. No law can be "static" and therefore theConstitution of India has also been amended more than one hundred times. Theseamendments reflect political, social and economic developments since the year 1950.The Indian judiciary and particularly the Supreme Court of India has played ahistoric role as the guardian of people. It has been protecting not only basic ideals ofthe Constitution but also strengthened the same through progressive interpretationsof the text of the Constitution. The judicial activism of the Supreme Court of Indiaand its historic contributions has been recognized throughout the world and itgradually made it "as one of the strongest court in the world".

Course content:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights

5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

7th Semester

Subject Name: Mine Management, Safety and Legislation-I **Subject Code: BTCMNPCC701** **Subject Credit: 4**

Course Objectives:

- To know the various rules & regulations applicable in different conditions to the mine workers, managers and mine owner.
- To know the responsibility and duties of the various employee of the mine and owner of the mine

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of legislation in mines for the implementation of rules and regulations during their job.
- Work effectively with other engineering and science teams for suggesting any measures against any mineaccidents.

Module 1: Introduction to Mining Laws and Legislation

General principles of mining laws, development of mining legislation of India.

Module 2: Acts, Rules and Regulations-I

Mines Act, Mines Rules, Coal and metalliferous mines Regulations, Bye-laws, Circulars, and standing orders (Except the ones which are collected in course Drilling & Blasting, Surface Mining, Mining Machinery I & II, Mine Environmental Engineering I, II & III, Underground Mining methods (Coal & Metal))

Module 3:Acts, Rules and Regulations – II

Indian electricity rules, coalmines conservation and development act, Workman's compensation act., General provisions of Mines and Minerals Regulation and Development Act, Mineral Concession Rules, Vocational Training, Rules, Crèche rules, Maternity benefit act, Payment of Wages Act, Gratuity and P.F. Rules, Explosives act, Rescue Rules, Factory Act, Environmental Protection Act.

Module 4: Accidents and Diseases

Classification of accidents, causes and prevention of accidents, accident enquiry reports, cost of accidents, occupational diseases and their social effects.

Module 5: Mine Safety

Role of management, labour and government, Safety audit, instrumentation, organisationfordisaster management in mines, safety conferences.

Text/Reference Books:

1. Mines Act 1952, Lovely Prakashan, Dhanbad, 1995.
2. Coal Mines Regulations, 1957, Lovely Prakashan, Dhanbad, 1995.
3. Coal Mines Regulations, 2017, Lovely Prakashan, Dhanbad, 2018
4. Metal Mines Regulations, 1961, Lovely Prakashan, Dhanbad, 1995.
5. DGMS Circulars, By National Council of Safety in Mines, Dhanbad, 1995.
6. Mines rules, 1955, Lovely Prakashan, Dhanbad, 1995.
7. The Mines Rescue Rules, 1986, Lovely Prakashan, Dhanbad, 1995.
8. The Indian Electricity Rules, 1995, Lovely Prakashan, Dhanbad, 1995.
9. The Payment of Wages Act, 1936, Ram Narain Lal Beni Prasad, 1995.
10. Vocational Training Rules, Lovely Prakashan, Dhanbad, 1995.
11. The Workmen's compensation Act, 1923, Ram Narainlal Beni Prasad, Allahabad, 1995.
12. Kejriwal, B.K., Safety in Mines, Gyan Khan Prakashan, Dhanbad, 1994.

Subject Name: Environmental Aspects of Mining **Subject Code: BTCMNPCC702** **Subject Credit: 3**

Course Objectives:

- To get knowledge about different environmental pollution associated with mining activities

Course Outcomes:

At the end of the course,the students are expected to apply knowledge of this subject to counter different environmental pollution in mines.

Module 1: Soil degradation due to mining activities

Safety aspects in opencast mines regarding height, width and slope of benches, drilling and blasting, fly rock, nearby dwellings, mine illumination, gradient and other aspects of haul roads, formation of spoil dumps, tailings management etc.

Module 2: Water Pollution in mining area

Water pollution, ground water disturbance, water pollution due to blasting activities, pollution due to mine tailings.

Module 3: Air pollution in mining area

Air quality monitoring in mining area, pollution due to exhaust of HEMM and other machineries, monitoring air quality in a mine after blasting operations.

Module 4: Noise pollution in mining area

Pollution due to noise, vibrations due to machinery and blasting.

Module 5: Land reclamation and rehabilitation in mining area

Land reclamation and afforestation, environmental audit.

Text/Reference Books:

1. Sengupta,M.,Environmental Impacts of Mining, Lewis Publishers
2. Ripley, E. A., Redman R. E. and CrowderA.A, Environmental Effects of Mining, St. Luciy Press.

Subject Name: Mine Environment **Subject Code: BTCMNPCC703** **Subject Credit: 3**

Course Objectives:

- To choose proper fire fighting method for different types of fire.
- To be able to perform reopening a sealed off area.
- To investigate accidents caused by various types of explosions, fires, roof fall and inundation in an underground mine.
- To perform rescue and recovery works during any accident in the mine.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of mine environment for understanding and solving problems related with mine accidents.

Module 1: Mine Fire

Causes and classification of mine fires; Spontaneous combustion - mechanism, stages ofspontaneous combustion, susceptibility indices; factors affecting spontaneous combustion; Detection andprevention of spontaneous heating and accidental fires; Dealing with mine fires - direct and indirectmethods; fire stoppings; Re-opening of sealed-off areas; Fires in quarries, coal stacks and waste dumps; Different types of fire extinguishers

Module 2: Mine Explosions

Firedamp and coal dust explosions - causes and prevention; explosive limits; Stonedust and water barriers; Explosion in quarries over developed pillars; Investigation after an explosion.

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.

Module 4: Rescue and Recovery

Rescue equipment; Self-contained portable breathing apparatus; Gas musk; Smoke helmets; Self rescuer; Reviving apparatus; Resuscitation; Rescue stations and rescue rooms; Organisation of rescue work.

Module 5: Airborne Respirable Dust

Generation, dispersion, measurement and control; Physiological effects of dust; dust-related diseases; Sampling procedure; Apparatus used and organisation.

Module 6: Illumination: Cap lamps; Layout and organisation of lamp rooms; Standards of illumination; Photometry and illumination survey.

Module 7: Sound Pollution

Text/Reference Books:

1. Ramlu, M. A.,Mine Disaster and Mine Rescue, Oxford & IBH, New Delhi, 1991
2. Banerjee, S. C.,Prevention and Combating Mine Fires, Oxford & IBH, New Delhi, 2000.
3. Kejriwal, B. K.,Safety in Mines, Lovely Prakashan, Dhanbad.
4. Donalad, A. T.,The lighting of Underground Mines, Trans Tech Switzerland, 1982
5. Mcadam,R. and Davidson, D.,Mine Rescue Work, Oliver and Boyd, London, 2000
6. McPherson, M. J.,Subsurface Ventilation and Environmental Engineering, Chapman & Hall Publication, London, 1993.
7. Mishra, G. B.,Mine Environment and Ventilation, Oxford University Press, 1993.
8. The Mine Rescue Rules, 1986, Lovely Prakashan, Dhanbad, 1992.

Subject Name: Open Elective-I (Advance Materials and Semiconductor Materials) Subject Code: BTCMNOEC701A Subject Credit: 3

Course Objectives:

- To get acquainted with different type of semiconductor materials.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of Advance Materials and Semiconductor Materials for understanding, formulating and solving problems related to semiconductor materials.

Module 1: Physical basis of Semiconductors

Review of energy bands, Effective mass, Fermi level in intrinsic and extrinsic semiconductors, Effect of temperature, Carrier concentration and mobility on Fermi level and electrical conductivity. Hall effect, Drift and diffusion currents, Einstein relation, Element and compound semiconductor materials: Classification of semiconductors into element, Binary, Ternary and quaternary compounds, Conduction mechanisms, Amorphous semiconductors, Oxide and magnetic semiconductors.

Module 2: Processing of Semiconductor Materials

Purification, Zone refining and zone floating methods, Czochralski and Bridgemann techniques, Epitaxial growth methods, Liquid phase, Vapour phase and molecular beam epitaxy, Thin film techniques.

Module 3: Optical Processes in Semiconductors

Radiative and non-radiative recombination, Absorption in semiconductors. Luminescence from quantum well, Photo luminescence and phosphorescence, Phototransistors electro luminescence process, LED's; their structures and choice of materials, Polymer LEDS.

Module 4: Materials for Optical Communication

Optical fibers, Single and multimode electro-optic effect, Kerr and pockels effect liquid crystal displays and display materials, TN and STN effect.

Module 5: Materials Classification

Engineering materials and their classification: metals/ ceramics /polymers, Structure-property-processing co-relationship as a theme of materials science, Different levels of structures. Material Properties: Mechanical, electrical, thermal, dielectric, semi-conducting properties of materials.

Module 6: Bonding in Solids

Primary and secondary bonds, Mixed bonding, Potential energy vs bond length criteria, Concept of bond length and nature of bonding Madelung energy, Variation in materials properties with bonding character.

Text/Reference Books:

1. Sze, S.M., Physics of Semiconductor Devices, Wiley (2007).
2. Bhattacharya, P., Semiconductor Opto-electronic Devices, PHI (2006).
3. Wilson, J. and Hawkes, J.F.B., Optoelectronics- PHI (1988)
4. Smallman, R.E. and Bishop, R.J., Metals and Materials, Butterworth-Heinemann, Oxford University Press (1995).

Subject Name: Open Elective-I (Industrial Management) **Subject Code: BTCMNOEC701B** **Subject Credit: 3**

Course Objectives:

- To deliver the principles of management, functions of management, organizational structureand dynamics, modern concepts of Industrial Management.

Course Outcomes:

At the end of the course,the students are expected to get a clear understanding of basic management principles that leads to corporate building.

Module 1: Introduction

Technology Management – Definition – Functions – Evolution of Modern Management – Scientific Management – Development of Management thought. Approaches to the study of Management, Forms of Organization – Individual Ownership – Partnership – Joint Stock companies – Co-operative Enterprises – Public sector Undertakings, Corporate Frame Work – Share Holders - Board of Directors – Committees – Chief Executive – Constraints – Environmental – Financial – Legal – Trade Union.

Module 2: Functions of Management

Planning – Nature and Purpose – Objectives – Strategies – Policies and Planning Premises – Decision Making – Organizing – Nature and Process – Premises – Departmentalization – Line and Staff – Decentralization – Organizational culture – Selection and training – Placement – Performance appraisal – Controlling – Process of Controlling – Controlling techniques – Preventive control, industrial safety.

Module 3: Organizational Behavior

Definition – Organization – Managerial Role and functions – Organizational approaches, individual behavior – Causes – Environmental effect – Behaviour and Performance, Perception – Organizational implications. Personality – Contributing factors – Theories of motivation – Job satisfaction – Learning Curves, Work Design and approaches.

Module 4: Group Dynamics

Group behavior – Groups – Contributing factors – Group norms – Communication – Process – Barriers to communication – Effective communication leadership – Managerial Grid – Leadership Role in Group Decision, Group Conflicts – Types – Causes – Conflict Resolution – Inter group relations and conflict organization – Centralization and decentralization – Formal and informal – Change Process – Resistance to change – Culture and Ethics.

Module 5: Modern Concepts

Management by objectives (MBO) – Management by Exception (MBE) – Developing strategies, information technology in management – Decision support system – Business Process Reengineering (BPR) – Enterprises Resource Planning (ERP) – Supply Chain Management (SCM) – Activity based management (ABM) – Globalization.

Text/Reference Books:

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India Pvt. Ltd., Ninth edition, 2008.
2. Herald, K. and Heinz, W., Essentials of Management, McGraw Hill Publishing Company, Singapore International Edition, 1980.
3. Chandran, S. Organizational Behaviour, Vikas Publishing House Pvt. Ltd., 1994.
4. Ties, A.F. Stoner and R. Edward Freeman, Management, Prenticie Hall of India Pvt. Ltd. New Delhi 110 011, 1992.
5. Joseph J. M, Essentials of Management, Prentice Hall of India Pvt. Ltd., 1985.

Subject Name: Elective-V (Mine System Engineering) **Subject Code: BTCMNPEC701A** **Subject Credit: 3**

Course Objectives:

- To prepare feasibility report and detailed project report for any mine.
- To work out planning and scheduling for any mine.

Course Outcomes:

At the end of the course,the students are expected to apply knowledge of mine planning for understanding, formulating and solving mine planning &scheduling problems.

Module 1: Introduction to System Engineering

Concept of system, sub-system and system environment; Classification of systems; Systems analysis.

Module 2: Linear Programming

Linear Programming models; Assumption of linear programming; Graphical and Simple method ofsolving Linear Programming Problems; Basic and Basic feasible solution; optimal solution; interpretationof SIMPLEX table; Primal and Dual Problem; Application of Linear Programming for solution of miningrelated problems of production planning, scheduling and blending.

Module 3: Transportation and Assignment ProblemTransportation model; Variations on Classical Transportation model; Solution; Algorithm forTransportation problem; Assignment model; Variations on Classical Assignment model; Solution; Algorithm for Assignment problem; Application to mining problems.

Module 4: Project Management with PERT & CPM

Assumption of PERT and CPM; Methods of drawing network; Redundancy and identification ofredundant jobs; Critical path calculation, Criticality index; Statistics related to PERT; Probability ofcompleting a project by a due date; Lowest cost schedule: Case studies.

Module 5: Network Models

Introduction and concept; Shortest route and minimal spanning tree problems, Application to miningproblems.

Module 6: Simulation

Introduction and concept; Scope and limitation; System type versus simulation technique; Generatinginput data; Monte-Carlo simulation; Simulation of equipment maintenance and inventory systems inmines.

Text/Reference Books:

1. Taha, H. A.,Operations Research an Introduction, Prentice Hall of India, 8th Ed, 2007.
2. Hillier, F. S. andLieberman, G. J.,Introduction to Operation Research, 8th Ed, McGraw-Hill, 2008.
3. Rao, S. S.,Optimisation Theory and applications, Wiley Eastern Ltd. India, 1978, reprint 2005.

Subject Name: Elective-V (Numerical Methods in Mining Engineering) **Subject Code: BTCMNPEC701B** **Subject Credit: 3**

Course Objectives:

- To get idea about different numerical methods used to solve problems in rock mechanics.

Course Outcomes:

At the end of the course,the students are expected to apply knowledge of numerical methods for solving Rock Mechanics problems.

Module 1: Introduction to Elastic and Plastic models

Fundamentals, elastic, plastic, homogeneous and isotropic, non-linear elastic and elastoplastic models.

Module 2: Finite Difference Methods

Concept, formation of mesh element, finite difference patterns, solutions, application to mining.

Module 3: Finite Element Methods

Concept, discretisation, element configuration, element stiffness, assemblage and solutions, two and three dimensional solutions, linear and non-linear analysis, applications in geomechanics; simulation of joints in strata.

Module 4: Boundary Element Method

Concept, discretisation, different methods of solution for isotropic and infinite media.

Module 5: Practical Applications in Mining and Rock Mechanics

Practical Applications in stress analysis, slope stability, subsidence prediction, pillar design,rock burst, etc.

Text/Reference Books:

1. Deb, D., Finite Element Methods: Concepts and Applications in Geomechanics,2nd Edition, PHI Learning Pvt. Ltd., 2012.
2. Desai, C.S. and Abel, J.F., Introduction to the finite Element Method, Van Nostrand Riehokl Co., New York, 1983.

3. Zienkiewicz, O.C., The Finite Element Method in Engineering Science, Tata McGraw Hill 1972.

4. Segerlind, L.J., Applied Finite Element Analysis, John Wiley and Sons, New York, 1987.

5. Mukhopadyay, M., Matrix Finite Element – Computer and Structural Analysis, Oxfordand IBH Publishing co., 1984

6. Brown, E.T., (Ed) Analytical and Computational Methods in Engineering Rock Mechanics, Allen and Unwin, London, 1987.

Subject Name: Elective-V (Remote Sensing & GIS) **Subject Code:BTCMNPEC701C** **Subject Credit: 3**

Course Objectives:

- To learn various application of computers in the mining field.
- To. be able to understand the use of Remote sensing in the surveying of opencast mine
- To be able to understand the use of GIS in transportation system of opencast mine.
- To understand the pit slope stability and its impact on mining activity.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of this subject for understanding, formulating and solving transportation problem in any opencast mine.
- Identify, analyze and solve opencast mining problems.
- Acquire knowledge and hands-on competence in applying the application of GIS, Remote Sensing and application of computer in the development of opencast mine planning.

Module 1: Introduction to Remote Sensing

Terminology in Remote Sensing, Types of Remote Sensing,Advantages anddisadvantages of Remote Sensing Data, Electromagnetic Radiation, AtmosphericWindows, Remote Sensing Platformsand Sensors Systems, Path-Row Referencing System, RemoteSensing Data Product, Procedure for Obtaining SatelliteData. Hardware and Software related toRemote Sensing.

Module 2: Image Interpretation and Analysis

Elements of Visual Image Interpretation, Digital Image Pre-Processing, RadiometricCorrection, Geometric Correction, Resolution of Remote Sensing Data, ImageEnhancement, Contract Enhancement, SpatialFiltering, Band Ratioing Image Classification, Supervisedand Unsupervised Classification. Remote Sensing Applications inForestry, Geology, Hydrogeology, Landuse and Land Cover Mapping.

Module 3: Fundamentals of GIS

Basic Concepts including Definition and History of GIS, Essential Elements of GIS,Uses andUsers of GIS, General GIS Applications, Advantages of GIS, Geodesy, Grids, Datum's andProjection Systems, GISData Formats, GIS Layers and Digitization, Overview of GPS and its Applications,Hardwares and Softwares related to GIS.

Module 4: Raster and Vector Based GIS

Raster based GIS, Definition and Concept of Raster Based GIS, SpatialReferencing,Definition and Representation of Raster Data, Vector based GIS, Definition and Concept ofVector Based GIS, DataStructures, Data Capture and Basic Operations of Spatial Analysis, Advantagesand Disadvantages in Raster and VectorBased GIS, Introduction to Networks in GIS, GIS-ProjectPlanning, Management and Implementation.

Module 5: Application of computers in mining

Text/Reference Books:

1. Gonzalez, R. C. and Woods R. E., Digital Image Processing, 3rd Edition, Pearson Education Asia, 2008.
2. Burrough, P. A. and McDonnell, R. A., Principles of Geographical Information Systems, Oxford University Press, 1998.
3. Agarwal, C. S. and Garg, P. K., Textbook on Remote Sensing: In Natural Resources Monitoring and Management, A. H. Wheeler Publishing Co. Ltd., 2002.
4. Jensen, J. R., Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Edition, Pearson Education India, 2013.
5. Rashid, S. M. and Khan, M. M. A., Dictionary of Remote Sensing, Manak Publisher, 1993.
6. Heywood, I., Cornelius S. and Carver, S., An Introduction to Geographical Information Systems, 4th Edition,Pearson Education Asia, 2012.
7. Demers, M. N., Fundamentals of Geographic Information Systems, 4th Edition, John Wiley & Sons, 2008.

Subject Name: Mine Environment Lab **Subject Code: BTCMNPCC703** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different instruments used for measuring different parameters of mine environment.

Laboratory Outcomes:

This lab curriculum gives understanding of the working principle of different instruments used for measuring different parameters of mine environment.

1. Study of different types of fire extinguisher.
2. Study of different types of self-rescuers.
3. Study of different types of self-contained breathing apparatus.
4. Study of DGMS approved Resuscitator.
5. Measurement of illumination using Digital Lux Meter.
6. Measurement of noise using Digital Sound Level Meter.

8th Semester

Subject Name: Mine Management, Safety and Legislation-II **Subject Code: BTCMNPCC801** **Subject Credit: 4**

Course Objectives:

- To know the various rules & regulations applicable in different conditions to the mine workers, managers and mineowner.
- To know the responsibility and duties of the various employee of the mine and owner of the mine.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply knowledge of legislation in mines for the implementation of rules and regulations during their job.
- Work effectively with other engineering and science teams for suggesting any measures against any mine accidents.

Module 1: Introduction to Mining Laws and Legislation

General principles of mining laws, development of mining legislation of India.

Module 2: Acts, Rules and Regulations-I

Mines Act, Mines Rules, Coal and metalliferous mines Regulations, Bye-laws, Circulars, and standing orders (Except the ones which are collected in course Drilling & Blasting, Surface Mining, Mining Machinery I & II, Mine Environmental Engineering I, II & III, Underground Mining methods (Coal & Metal))

Module 3:Acts, Rules and Regulations–II

Indian electricity rules, coalmines conservation and development act, Workman's compensation act., General provisions of Mines and Minerals Regulation and Development Act, Mineral Concession Rules, Vocational Training, Rules, Crèche rules, Maternity benefit act, Payment of Wages Act, Gratuity and P.F. Rules, Explosives act, Rescue Rules, Factory Act, Environmental Protection Act.

Module 4: Accidents and Diseases

Classification of accidents, causes and prevention of accidents, accident enquiry reports, cost of accidents, occupational diseases and their social effects.

Module 5: Mine Safety

Role of management, labour and government, Safety audit, instrumentation, organisation for disaster management in mines, safety conferences.

Text/Reference Books:

1. Mines Act, 1952, Lovely Prakashan, Dhanbad, 1995.
2. Coal Mines Regulations, 1957, Lovely Prakashan, Dhanbad, 1995.
3. Coal Mines Regulations, 2017, Lovely Prakashan, Dhanbad, 2018.
4. Metal Mines Regulations, 1961, Lovely Prakashan, Dhanbad, 1995.
5. DGMS Circulars, By Directorate General of Mines Safety, Dhanbad, Ministry of Labour & Employment, Government of India,1995.
6. Mines Rules, 1955, Lovely Prakashan, Dhanbad, 1995.
7. The Mines Rescue Rules, 1986, Lovely Prakashan, Dhanbad, 1995.
8. The Indian Electricity Rules, 1995, Lovely Prakashan, Dhanbad, 1995.
9. The Payment of Wages Act, 1936, Ram Narain Lal Beni Prasad, 1995.
10. Vocational Training Rules, Lovely Prakashan, Dhanbad, 1995.
11. The Workmen's compensation Act, 1923, Ram Narainlal Beni Prasad, Allahabad, 1995.
12. Kejriwal, B.K., Safety in Mines, Gyan Khan Prakashan, Dhanbad, 1994.

Subject Name: Mineral Processing **Subject Code:BTCMNPCC802** **Subject Credit: 3**

Course Objectives:

- To discuss the subject andvarious mineral processing methods to make the mining engineering students familiar with the various processes.

Course Outcomes:

At the end of the course,the students are expected to:

- understand the subject and practice in the regularmining industries without the aid of Mineral engineers.

Module 1: Introduction

Scope, objectives, minerals/ores for mineral processing, methods of treatment, choice of methods, sequence of operations, product, flow sheets, ore sorting – hand mechanical, electronic, removal of harmful materials, ore transportation.

Module 2: Comminution

Introduction to comminution, primary/secondary/tertiary crushing, purpose, duty, theory of crushing, crushing sequence, reduction ratio, types of crushers and comparison, general crushing flow sheet, wet/dry grinding, mechanism and various affecting parameters.

Module 3: Laboratory and Industrial Sizing and Sampling and Control

Purpose, factors governing particle behavior, laboratory and industrial screens, trommels, vibrating screens, etc. wet and dry screening, classification, classifiers. Purpose, sampling - solid ore, pulp, head feed, grinding circuit samples, flotation products etc., X-ray fluorescence, automatic sampling. Metallurgical accounting.

Module 4: Separation/Concentration

Newton's and Stoke's Laws of particle settlement, different concentration techniques – gravity, chemical froth flotation, wet & dry magnetic separation, electromagnetic, amalgamation, heavy media, jigging, shaking tables, sluicing, spirals, thickeners, filtration, etc., coal washing.

Module 5: Special Methods

Chemical extraction, cyanide process, leaching, use of ion exchange, solvent extraction, pilot plant studies on ores, tailing dams; generalized plant practice/flow sheets for coal and other important ores – copper, aluminium, lead, zinc, silver, gold, uranium, iron, limestone, magnesite.

Text/Reference Books:

1. Jain, S.K., Ore Processing, Oxford – IBH Publishing, 1984.
2. Gaudin, A.M., Principles of Mineral Dressing – McGraw Hill Book Company, 1971.
3. Taggart, A.F., Handbook of Mineral Dressing, John Wiley and Sons, New York, 1990.
4. Wills, B.A. Mineral Processing Technology, Pergamon Press, 1985.

Subject Name: Elective-VI (Special Underground Methods) **Subject Code:BTCMNPEC801A** **Subject Credit: 3**

Course Objectives:

- To study about different special methods of mining.

Course Outcomes:

At the end of the course,the students are expected to:

- Apply detailed knowledge about special mining methods to solve the challenging problems.

Module 1: Mining of Thick Seams

Concept of a thick seam; Problems of mining thick seams; Past experience of working thick seams by Bord & Pillar method in multi-sections; Longwal based multi-slice methods: Inclined slicing, horizontal slicing and cross-slicing in ascending and descending sequence; Under winning methods: sub-level caving, integral caving, blasting gallery method, descending shield method.

Module 2: Hydraulic Mining of Coal

Conditions suitable for hydraulic Mining of Coal; Hydraulic Mining Operation; Hydraulic breaking of coal; Hydraulic transport and hydro hoisting; Layout of workings for hydraulic mining of moderately thick seams.

Module 3: Mining of Thin Seams

Problems in Mining thin seams; Equipment and methods for thin seam extraction.

Module 4: Underground Coal Gasification

Conditions suitable for Underground Coal Gasification; Basic principle and technology of underground coal gasification; Advantage and disadvantage of UCG; Scope of application of UCG in Indian conditions.

Module 5: Highwall Mining

Introduction; Applicability and Method

Module 6: Deep Mining

Problems of deep mining: rock pressure, heat, humidity, rock burst, noise and dust pollution, deep winding and transport, etc; remedial measures.

Module 7: Special Methods

Coal Bed Methane; Shale Gas; Scope of application for mining of deep seated low grade mineral deposits; Underwater/sea-bed mining; current status.

Text/Reference Books:

1. Das, S. K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994
2. Singh T. N. and. Dhar, B. B., Thick Seam Mining, Problems and Issues, Oxford & IBH Publishers, 1992
3. Mathur, S. P., Mining Planning for Coal, M G Consultants, Bilaspur, 1993
4. Peng, S. S.and Chiang, H. S., Longwall Mining, John Willey and Sons, New York, 1992
5. Singh, T. N., Underground Winning of Coal, Oxford IBH Publishers, 1999
6. Singh, R. D., Principles and Practices of Modern Coal Mining, New Age International, 1997
7. Peng, S. S., Ground Control, Wiley Interscience, New York, 1985

Subject Name: Elective-VI (Chemical Processing) **Subject Code: BTCMNPEC801B** **Subject Credit: 3**

Course Objectives:

- To discuss the subject andvarious chemical processing methods to make the mining engineering students familiar with the various processes.

Course Outcomes:

At the end of the course,the students are expected to:

- understand the subject and practice in the regularmining industries without the aid of chemical engineers.

Module 1: Unit Processes

Unit processes of chemical processing

Module 2: Leaching Practices

Leaching with various solvents for solid-liquid interaction with reference to U, Al, Th, Zr etc.

Module 3: Leaching Parameters

Effect of various parameters on rate of leaching

Module 4: Rate Controlling Steps

Determination of rate controlling step in process design

Module 5: Separation Practices

Solid-Liquid separation practices

Module 6: Recovery Practices

Recovery of valuable fraction for solution

Module 7: Enrichment Treatment and Metal Recovery

Enrichment treatment of solvent like – solvent extraction, ion exchange, precipitation technique. Metal recovery from solvent and solid fraction

Text/Reference Books:

1. Ray, H. S., Sridhar, R., Abraham, K.P., Extraction Of Nonferrous Metals, Affiliated East-west Press Pvt Ltd., 2008.
2. Hayes, P., Metallurgical Process Design
3. Phelke, R. D., Unit Processes

Subject Name: Mineral Processing Lab **Subject Code: BTCMNPCC802** **Subject Credit: 1**

Laboratory Objectives:

Training students to make them conversant with different instruments and techniques used in mineral processing.

Laboratory Outcomes:

This lab curriculum gives understanding of the working principle of different instruments used in mineral processing.

1. Study of grab sampling and different sample division techniques like coning and quartering, riffle sampling techniques, etc.
2. Determination of crushing characteristics of a given mineral sample using jaw crusher
3. Determination of the grinding characteristics of a given mineral sample using ball mill
4. Sieve analysis of a given sample and to calculate (a) percentage sample retained on screens (b) average size of sample material and (c) to plot sizing curves
5. Concentration of a given mineral sample using mineral jig
6. Concentration of a given mineral using Wilfley table
7. Concentration of a given mineral using froth flotation cell
8. Concentration of a given mineral using magnetic separator
9. Study of washability characteristic of a coal sample using float and sink test.
10. Study of sedimentation characteristics of a given sample.